# DESIGN CONCEPTS FOR CO-PRODUCTION

# OF

# POWER, FUELS & CHEMICALS VIA COAL/BIOMASS MIXTURES

## FINAL REPORT


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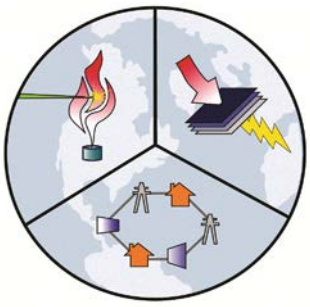

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## ABSTRACT

The overall goal of the program is to develop design concepts, incorporating advanced technologies in areas such as oxygen production, feed systems, gas cleanup, component separations and gas turbines, for integrated and economically viable coal and biomass fed gasification facilities equipped with carbon capture and storage for the following scenarios: (i) coproduction of power along with hydrogen, (ii) coproduction of power along with fuels, (iii) coproduction of power along with petrochemicals, and (iv) coproduction of power along with agricultural chemicals. To achieve this goal, specifically the following objectives are met in this proposed project: (i) identify advanced technology options and innovative preliminary design concepts that synergistically integrate plant subsections, (ii) develop steady state system simulations to predict plant efficiency and environmental signature, (iii) develop plant cost estimates by capacity factoring major subsystems or by major equipment items where required, and then capital, operating and maintenance cost estimates, and (iv) perform techno- economic analyses for the above described coproduction facilities.

Thermal efficiencies for the electricity only cases with 90% carbon capture are 38.26% and 36.76% (HHV basis) with the bituminous and the lignite feedstocks respectively. For the coproduction cases (where 50% of the energy exported is in the form of electricity), the electrical efficiency, as expected, is highest for the hydrogen coproduction cases while lowest for the higher alcohols (ethanol) coproduction cases. The electrical efficiencies for Fischer-Tropsch coproduction cases are slightly higher than those for the methanol coproduction cases but it should be noted that the methanol (as well as the higher alcohol) coproduction cases produce the finished coproduct while the Fischer-Tropsch coproduction cases produce a coproduct that requires further processing in a refinery. The cross comparison of the thermal performance between the various coproduct cases is further complicated by the fact that the carbon footprint is not the same when carbon leaving with the coproduct are accounted for. The economic analysis and demand for a particular coproduct in the market place is a more meaningful comparison of the various coproduction scenarios.

The first year cost of electricity calculated for the bituminous coal is $102.9/MWh while that for the lignite is $108.1/MWh. The calculated cost of hydrogen ranged from $1.42/kg to $2.77/kg depending on the feedstock, which is lower than the DOE announced hydrogen cost goal of $3.00/kg in July 14, 2005. Methanol cost ranged from $345/MT to $617/MT, while the market price is around $450/MT. For Fischer-Tropsch liquids, the calculated cost ranged from $65/bbl to $112/bbl, which is comparable to the current market price of crude oil at around $100/bbl. It should be noted, however, that F-T liquids contain no sulfur and nitrogen compounds. The calculated cost of alcohol ranged from $4.37/gal to $5.43/gal, while it ranged from $2.20/gal to $3.70/gal in a DOE funded study conducted by Louisiana State University. The Louisiana State University study consisted of a significantly larger plant than our study and benefited from economies of scale. When the plant size in our study is scaled up to similar size as in the Louisiana State University study, cost of alcohol is then reduced to a range of $3.24/gal to $4.28/gal, which is comparable. Urea cost ranged from $307/MT to $428/MT, while the market price is around $480/MT.

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## LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AGRU | Acid Gas Removal Unit |
| ASU | Air Separation Unit |
| Atm | Atmosphere (Pressure) |
| BarA | Bar Absolute (Pressure) |
| DoE | U.S. Department of Energy |
| EP | Elevated Pressure |
| GJ | Giga Joules |
| GJ/hr | Giga Joules per hour |
| GT | Gas Turbine |
| HHV | Higher Heating Value |
| HP | High Pressure |
| HRSG | Heat Recovery Steam Generator |
| IGCC | Integrated Gasification Combined Cycle |
| IP | Intermediate Pressure |
| ITM | Ion Transport Membrane |
| kg/s | Kilograms per Second |
| kJ | Kilo Joules |
| kPa | Kilo Pascal (Pressure) |
| kW | Kilowatt |
| LHV | Lower Heating Value |
| LP | Low Pressure |
| MJ | Mega Joules |
| MP | Medium Pressure |
| MW | Megawatt |
| MT | Metric ton (1000 kg) |
| MT/D | MT per Day |
| MMBtu | Million British Thermal Units |
| MF | Moisture Free |
| NETL | National Energy Technology Laboratory |
| NOx | Oxides of Nitrogen |
| ppmVd | Parts per Million by Volume on a Dry Basis |
| PSA | Pressure Swing Adsorption |
| psi | Pounds per Square Inch (Pressure) |
| psia | Pounds per Square Inch Absolute (Pressure) |
| RTI | Research Triangle Institute |
| SCR | Selective Catalytic Reduction |
| SOx | Oxides of Sulfur |
| SRU | Sulfur Recovery Unit |
| ST | Short Ton |
| ST/D | ST per Day |
| TDA | Technology Development Associates |
| Vol % | Percentage by Volume |
| WGS | Water Gas Shift |
| $ | United States Dollar |

## EXECUTIVE SUMMARY

The overall goal of the program is to develop design concepts, incorporating advanced technologies in areas such as oxygen production, feed systems, gas cleanup, component separations and gas turbines, for integrated and economically viable coal and biomass fed gasification facilities equipped with carbon capture and storage for the following scenarios: (i) coproduction of power along with hydrogen, (ii) coproduction of power along with fuels, (iii) coproduction of power along with petrochemicals, and (iv) coproduction of power along with agricultural chemicals. To achieve this goal, specifically the following objectives are met in this proposed project: (i) identify advanced technology options and innovative preliminary design concepts that synergistically integrate plant subsections, (ii) develop steady state system simulations to predict plant efficiency and environmental signature, (iii) develop plant cost estimates by capacity factoring major subsystems or by major equipment items where required, and then capital, operating and maintenance cost estimates, and (iv) perform techno- economic analyses for the above described coproduction facilities with the following specifications:

- Primary Feedstock: Since plant performance and economics are highly dependent on coal type, develop two different plant types for two different coals (i.e., feedstock specific designs) consisting of a bituminous (Illinois No.6) coal and a lignite (North Dakota).
- Primary Coproduct: In addition to electricity, five different coproducts consisting of hydrogen, methanol, Fischer-Tropsch liquids, higher alcohols and urea.
- Power Output: Greater than or equal to 50% of the total energy output of the co-production plant and equipped with carbon capture and storage.
- Biomass Cofeed: Woody mass for each coal type and coproduct, while performing sensitivity analyses with grasses.

For comparison purposes, design concepts also incorporate coal-only feeds in both an electricity only mode as well as co-production mode. The type of gasifier is based on a currently available dry-feed entrained-bed commercial-scale gasifier with commercially offered operating pressure of ~41 bar (600 psi).

The dry scrubbing option showed little performance gain over the proven wet scrubbing option to justify the use of dry scrubbing when the developmental nature of the advanced technologies required for the dry scrubbing is taken into account. Four ITM configurations were examined for air separation, all of which showed significant decreases in net plant heat rate, as high as 3.4% over cryogenic air separation option.

Sensitivity analyses indicated that from a plant thermal efficiency standpoint, the purge from the synloop of the methanol as well as the Fischer Tropsch coproduction cases should be minimized, implying that once-through synthesis is not beneficial from a plant efficiency standpoint. When the purge rate becomes higher than a threshold amount, decarbonization of the purge gas is also required to limit the overall plant carbon emissions to the design value. This requires shifting and reforming in the case of F-T liquids coproduction. Since ITM technology is utilized for air separation, the inerts buildup due to reduction in purge rate is less significant than for a plant utilizing cryogenic air separation.

Thermal efficiencies for the electricity only cases with 90% carbon capture are 38.26% and 36.76 (HHV basis) with the bituminous and the lignite feedstocks respectively. For the coproduction cases (where 50% of the energy exported is in the form of electricity), the electrical

efficiency, as expected, is highest for the hydrogen coproduction cases while lowest for the higher alcohols (ethanol) coproduction cases. The electrical efficiencies for Fischer-Tropsch coproduction cases are slightly higher than those for the methanol coproduction cases but it should be noted that the methanol (as well as the higher alcohol) coproduction cases produce the finished coproduct while the Fischer-Tropsch coproduction cases produce a coproduct that requires further processing in a refinery. The cross comparison of the thermal performance between the various coproduct cases is further complicated by the fact that the carbon footprint is not the same when carbon leaving with the coproduct are accounted for. The economic analysis and demand for a particular coproduct in the market place is a more meaningful comparison of the various coproduction scenarios.

The first year cost of electricity calculated for the bituminous coal is $102.9/MWh while that for the lignite is $108.1/MWh. The calculated cost of hydrogen ranged from $1.42/kg to $2.77/kg depending on the feedstock, which is lower than the DOE announced hydrogen cost goal of $3.00/kg in July 14, 2005. Methanol cost ranged from $345/MT to $617/MT, while the market price is around $450/MT. For Fischer-Tropsch liquids, the calculated cost ranged from $65/bbl to $112/bbl, which is comparable to the current market price of crude oil at around $100/bbl. It should be noted, however, that F-T liquids contain no sulfur and nitrogen compounds. The calculated cost of alcohol ranged from $4.37/gal to $5.43/gal, while it ranged from $2.20/gal to $3.70/gal in a DOE funded study conducted by Louisiana State University. The Louisiana State University study consisted of a significantly larger plant than our study and benefited from economies of scale. When the plant size in our study is scaled up to similar size as in the Louisiana State University study, cost of alcohol is then reduced to a range of $3.24/gal to $4.28/gal, which is comparable. Urea cost ranged from $307/MT to $428/MT, while the market price is around $480/MT.

## APPROACH

To accomplish the objectives of this project, four major tasks are carried out. Task 1.0 which is an ongoing task throughout the life of the project includes project management, planning and reporting. Task 2.0 is associated with establishing the basis for process design as well as for the economic analysis; Task 3.0 **i**dentifies advanced technology options and integration concepts while Task 4.0 performs a screening analysis where required to select the advanced integration concepts; and Task 5.0 performs detailed analyses of selected configurations of the advanced technology options and integration concepts identified in the previous task as well as the sensitivity analyses.

## TASKS TO BE PERFORMED

### Task 1.0— Project Management, Planning and Reporting

The project is managed by an experienced PI assisted by a senior staff, who guides a team of graduate students and staff in the execution of the plan. This task is an ongoing activity with the technical progress evaluated at weekly group meetings which identify any schedule slips. The technical milestone dates are reviewed at these weekly meetings and progress made towards the milestones established. Administratively, a program manager provides monthly spending reports and compares the proposed spending plan with the actual spending plan. These reports support submission of regular reports to the U.S. DoE. Technical reports are prepared on a continuous basis such that the findings and results are documented while they are still fresh in the minds of the investigators rather than waiting till the end of the reporting period to prepare these documents. The appropriate reports include in addition to the results, an explanation and the rationale of how and why the choices were made with respect to the technology / concept selections. The appropriate reports thoroughly document the process design and economic assumptions made. In addition, the PI and a senior staff member attend and report out at meetings as required by the DoE. The PMP developed for the proposed work is used to guide the effort and minimize risk.

### Task 2.0 – Study Basis

A project kick-off meeting is held first and the frame-work for the design basis is presented including its consistency with DoE's "Quality Guidelines for Energy System Studies." An initial task in performing this study consists of developing a "Design Basis" document that specify the various pieces of technical information to be utilized in this study and is issued to the DoE/NETL Project Officer or designated representative. Documented in this design basis are items such as: feedstock data, coproduct specifications, level of $CO_2$ capture and its specifications consistent with the chosen sequestration method, criteria for establishing plant size, site ambient conditions (average, minimum and maximum), method of plant heat rejection (i.e., mechanical draft cooling towers, or once-through river or brakish water cooling or air-cooled exchangers), plant raw makeup water composition, plant emissions and waste discharge criteria, as well as economic criteria (methodology for estimating capital requirements, operating and maintenance costs, and for performing economic analysis).

## Task 3.0 - Identify Advanced Technology Options and Integration Concepts

In this task, a variety of concepts for the electricity only and for the coproduction plants are developed and evaluated. Concepts for use in the gasification island as well as the power block are not be limited by currently available components and technology; however, any advanced technology incorporated is be well-grounded in current research and/or sound engineering principles, consistent with the approved design basis established in the previous task. The concept or concepts with the greatest potential to achieve the program goals are selected for further analysis in the subsequent tasks. The following lists the main activities proposed under this task:

- Based on a literature search and in-house data, identify subsystem technologies that have a potential for integration in the coproduction facilities to improve plant performance and economics.
- Conduct brainstorming sessions in order to identify those subsystem or system configurations that have a potential to meet the objectives of this program. Any synergy that may be possible when combining subsystems in an overall plant configuration are identified in these brainstorming sessions.

## Task 4.0 - Screening Analyses of Advanced Integration Concepts

In this task, integration concepts for the electricity only and for the coproduction plants identified in the previous task are developed and evaluated at a screening level. Advanced technology options are not limited by currently available components and technology but are well-grounded in current research and/or sound engineering principles. The integration concept with the greatest potential to achieve the program goals are selected for each type of plant for further analysis in the subsequent Analyses task (Task 5.0).

## Task 5.0 – Analyses

### Detailed Analyses

This task configures the entire plant starting at a subsystem level for the configuration evolved by the previous task to develop the preliminary conceptual design and quantify the overall plant performance and cost estimates.

Material and Energy Balances: The material and energy balances are developed utilizing a predictive computer simulation technique. Tools that are utilized are: (i) Aspen Plus® and (ii) GateCycle™. The primary material and energy balance code is the Aspen Plus® simulator for the gasification island. GateCycle™ is utilized primarily in developing the performance for the power block on an as required basis. These steady state simulations are developed using thermodynamic models (with approaches to equilibrium specified) to a maximum extent. Vendors or technology licensors are provided functional specifications where necessary to obtain performance estimates for plant sections or subsystems (such as the air separation unit, gasifier, warm gas cleanup etc). For example, Research Triangle Institute (RTI) / Siemens and Technology Development Associates (TDA) are contacted for sections of the warm gas cleanup

process. Data available in the public domain are utilized to generate the performance estimates where the vendors or licensors are unwilling to provide the requested information. The following specific modeling guidelines are applied to the overall plant system:

- The "plant" includes all necessary facilities for a stand-alone operation and includes the feed processing, ASU, coproduct conditioning / stabilization, losses associated with raw water and boilerfeed water treating, condensate handling, and general facilities such as waste water treating and cooling water system.
- Overall performance summaries are developed taking into account the power generation by each equipment and the power consumed by the plant.
- Heat loss, blowdown amount, pressure drop, mechanical efficiency, auxiliary and miscellaneous power and cooling water requirements are taken into account for each equipment or plant section. All major streams appearing in the overall block flow diagram are labeled with an accompanying table that provides stream compositions, flow rates and conditions of pressure and temperature.

Cost Estimates: Plant cost estimates are developed utilizing "in-house" techniques as well as utilizing vendor provided data. The in-house cost estimates for a major subsystem involved in the estimate are developed from known cost for a similar system or a factored analysis based on sizing of major equipment. These two types of methodologies are employed depending upon the type of unit and availability of data in APEP's in-house data base as well as that available in the public domain.

- Capacity Factored Estimates: These types of estimates are based on multiplying the cost of a unit for which the direct construction costs are known by the ratio of the new unit's capacity to the capacity of the known unit. Capacity ratios are adjusted by an exponent chosen on the basis of the unit type. The costs are adjusted for design differences, location and time frame.
- Equipment Modeled Estimates: These types of estimates for each mechanical equipment item are developed utilizing ICARUS which is an Aspen Suite product. The bare equipment cost as well as the various other costs such as piping, instrumentation, foundations etc. are also estimated by these software.
- Vendor Supplied Estimates: Vendors or technology licensors are also provided functional specifications where necessary to obtain individual equipment costs or plant section or subsystem turnkey cost estimates (e.g., ASU, warm gas cleanup etc).
- Capital requirements, operating and maintenance costs are developed in accordance with the criteria established in the Design Basis document.

Techno-economic analyses of these preliminary conceptual designs take into account the projected plant efficiency and cost of produced products, and environmental signature with the ultimate goal of assessing the potential impacts of integrating emerging technologies in the co-production of power, fuels, and chemicals from coal or coal-biomass mixtures. An economic assessment is made to identify the potential savings in cost of electricity relative to operating in a co-production mode compared to operation in an electricity only mode.

**Sensitivity Analyses**

Next, the plant performance and cost estimates of the cases resulting from the above detailed analyses are adjusted by substituting grasses for the woody mass used in the detailed analyses.

This adjustment of the performance may require rerunning the Aspen Plus® files with the different composition of the biomass as well as accounting for other difference such as those in the drying load and power demand of the milling process.

The various cases to be evaluated in this study are presented in Tables 1 and 2 which shows that the detailed analyses are performed on the Coal Only and the Coal + Woody Mass cases (total of 22 cases) while a sensitivity analyses are performed on the remaining cases, i.e., the Coal + Grass cases (total of 10 cases).

## DELIVERABLES

Periodic, topical, and final reports are submitted in accordance with the "Federal Assistance Reporting Checklist" provided in the contract and the instructions accompanying the checklist. Deliverables other than those identified on the "Federal Assistance Reporting Checklist" that are submitted documenting the findings / results generated by: (i) Task 2.0 - Study Basis Document.

In addition, the Final Report that is issued at the completion of the study includes: (1) process descriptions, (2) block flow diagrams and major stream data, (3) plant performance estimates (4) operating and maintenance costs estimates, (5) installed plant costs and capital requirement estimates, (6) economic analysis, and (7) analyses of results.

**Table 1: Coal Case Matrix**

| Case Designation+ | Coal | Biomass Type | Major Co-product |
|---|---|---|---|
| BOE | Illinois No. 6 | None* | None (Electricity Only) |
| BOH<br>BWH<br>BGH | Illinois No. 6 | None*<br>Woody Mass*<br>Grasses** | Hydrogen |
| BOM<br>BWM<br>BGM | Illinois No. 6 | None*<br>Woody Mass*<br>Grasses** | Methanol |
| BOF<br>BWF<br>BGF | Illinois No. 6 | None*<br>Woody Mass*<br>Grasses** | Fischer-Tropsch Liquids |
| BOA<br>BWA<br>BGA | Illinois No. 6 | None*<br>Woody Mass*<br>Grasses** | Higher Alcohols |
| BOU<br>BWU<br>BGU | Illinois No. 6 | None*<br>Woody Mass*<br>Grasses** | Urea |

**Table 2: Lignite Case Matrix**

| Case Designation+ | Lignite | Biomass Type | Major Co-product |
|---|---|---|---|
| LOE | N. Dakota | None* | None (Electricity Only) |
| LOH<br>LWH<br>LGH | N. Dakota | None*<br>Woody Mass*<br>Grasses** | Hydrogen |
| LOM<br>LWM<br>LGM | N. Dakota | None*<br>Woody Mass*<br>Grasses** | Methanol |
| LOF<br>LWF<br>LGF | N. Dakota | None*<br>Woody Mass*<br>Grasses** | Fischer-Tropsch Liquids |
| LOA<br>LWA<br>LGA | N. Dakota | None*<br>Woody Mass*<br>Grasses** | Higher Alcohols |
| LOU<br>LWU<br>LGU | N. Dakota | None*<br>Woody Mass*<br>Grasses** | Urea |

*as Detailed Analyses Cases
**as Sensitivity Cases only

+B: Bituminous
L: Lignite
O: No Biomass (Coal Only)
W: Woody Mass
G: Grasses
E: Electricity Only
H: Hydrogen Coproduct
M: Methanol Coproduct
F: Fischer-Tropsch Liquids Coproduct
A: Higher Alcohols Coproduct
U: Urea Coproduct

## RESULTS AND DISCUSSION

## TASK 2.0 – STUDY BASIS

The design basis established for this study is summarized in the following.

### Power Output

Net power output for each of the plant design is greater than or equal to 50% of total energy output of co-production plant, i.e.,

$$\frac{\text{Net MW} \times 3.413 \text{ MM Btu/hr/MW}}{\text{Net MW} \times 3.413 \text{ MM Btu/hr/MW} + \text{MM Btu HHV Coproduct}} \geq 50\%$$

### Feedstock and Coproduct Data

Illinois No. 6 is utilized as the representative bituminous coal while the lignite is from N. Dakota. All data presented for these feedstocks except that for the Hg content of Illinois No. 6 coal and Cl content of N. Dakota lignite are taken from DoE Funding Opportunity Number: DE-FOA0000496, 3/15/2011, "Advanced Gasification: Novel $CO_2$ Utilization Systems, Low Rank Coal IGCC Optimization, and Improvements in Gasification Systems Availability & Costs." The Hg content of the Illinois No. 6 coal is taken from DoE/NETL Report 2010/1397, November 2010, "Cost and Performance Baseline for Fossil Energy Plants Volume 1: Bituminous Coal and Natural Gas to Electricity." The Cl content of the N. Dakota lignite is taken from paper titled, "Comparison of Sorbents and Furnace Additives for Mercury Control in Low Rank Fuel Combustion Systems," by C. R. Crocker, S. A. Benson, M.l J. Holmes,Y. Zhuang, J. H. Pavlish, K. C. Galbreath [Prepr. Pap.-Am. Chem. Soc., Div. Fuel Chem. 2004, 49 (1), 289].

Data for the woody mass is obtained from DoE/NETL Report 2012/1547, February 2012, "Greenhouse Gas Reductions in the Power Industry Using Domestic Coal and Biomass Volume 2: Pulverized Coal Plants." Data for the switch grass is obtained from DoE/NETL Report 2012/1546, February 2012, "Greenhouse Gas Reductions in the Power Industry Using Domestic Coal and Biomass Volume 1: IGCC." The moisture content for the switch grass corresponds to covered field drying. The chloride content of the woody biomass is obtained from Umeki et al., "High temperature steam-only gasification of woody biomass," Applied Energy 2009; 87:791–8 while that for switch grass is obtained from Lemus et al., "Biomass yield and quality of 20 switchgrass populations in southern Iowa, USA," Biomass and Bioenergy 2002, 23, 433-442.

The relative amount of biomass in the cofeed cases is proposed at 30% of the total feed on a dry weight basis.

Coproduct specifications were primarily established in the project kick-off meeting.

**Table 3: Coal Properties**

| | **Bituminous** | | **Lignite** | |
|---|---|---|---|---|
| | Illinois No. 6 (Herrin) | | North Dakota Beulah-Zap Lignite | |
| | Old Ben Mine | | Freedom, ND Mine | |
| Proximate Analysis[1] | Dry Basis, % | As Received, % | Dry Basis, % | As Received, % |
| Moisture | 0 | 11.12 | 0 | 36.08 |
| Ash | 10.91 | 9.7 | 15.43 | 9.86 |
| Volatile Matter | 39.37 | 34.99 | 41.49 | 26.52 |
| Fixed Carbon | 49.72 | 44.19 | 43.09 | 27.54 |
| Total | 100 | 100 | 100 | 100 |
| Ultimate Analysis | Dry Basis, % | As Received, % | Dry Basis, % | As Received, % |
| Carbon | 71.72 | 63.75 | 61.88 | 39.55 |
| Hydrogen | 5.06 | 4.5 | 4.29 | 2.74 |
| Nitrogen | 1.41 | 1.25 | 0.98 | 0.63 |
| Sulfur | 2.82 | 2.51 | 0.98 | 0.63 |
| Chlorine | 0.33 | 0.29 | 18 ppmW | 12 ppmW |
| Ash | 10.91 | 9.7 | 15.43 | 9.86 |
| Moisture | 0 | 11.12 | 0 | 36.08 |
| Oxygen | 7.75 | 6.88 | 16.44 | 10.51 |
| Total | 100 | 100 | 100 | 100 |
| Heating Value | Dry Basis | As Received | Dry Basis | As Received |
| HHV, kJ/kg | 30,531 | 27,135 | 24,253 | 15,391 |
| HHV, Btu/lb | 13,126 | 11,666 | 10,427 | 6,617 |
| LHV, kJ/kg | 29,568 | 26,172 | 23,334 | 14,803 |
| LHV, Btu/lb | 12,712 | 11,252 | 10,032 | 6,364 |
| Trace Components | | | | |
| Mercury, ppm | | 0.18 | | 0.116 |

**Table 4: Biomass Properties**

| | Woody Mass | | Switchgrass | |
|---|---|---|---|---|
| **Ultimate Analysis** | **Dry Basis, %** | **As Received, %** | **Dry Basis, %** | **As Received, %** |
| Carbon | 52.36 | 26.18 | 42.60 | 36.21 |
| Hydrogen | 5.60 | 2.80 | 6.55 | 5.57 |
| Nitrogen | 0.37 | 0.19 | 1.31 | 1.11 |
| Sulfur | 0.03 | 0.02 | 0.01 | 0.01 |
| Chlorine | 0.10 | 0.05 | 0.04 | 0.03 |
| Ash | 1.38 | 0.69 | 7.41 | 6.30 |
| Moisture | 0.00 | 50.00 | 0.00 | 15.00 |
| Oxygen | 40.16 | 20.08 | 42.08 | 35.77 |
| Total | 100.00 | 100.00 | 100.00 | 100.00 |
| **Heating Value** | **Dry Basis** | **As Received** | **Dry Basis** | **As Received** |
| HHV, kJ/kg | 19,627 | 9,813 | 18,113 | 15,396 |
| HHV, Btu/lb | 8,438 | 4,219 | 7,787 | 6,619 |
| LHV, kJ/kg | 18,464 | 9,232 | 16,659 | 14,161 |
| LHV, Btu/lb | 7,938 | 3,969 | 7,162 | 6,088 |

**Table 5: Coproduct Specifications**

| Coproduct | Specifications |
|---|---|
| $H_2$ | Industrial grade or gas turbine fuel but not Fuel Cell Hybrid Vehicle quality. APEP/UCI will recommend purity as numbers are generated from simulations. |
| Methanol | Chemical grade (AAA) methanol using distillation of crude methanol. |
| Fischer-Tropsch Liquids | Stabilized but not refined. The coproduct will be shipped to a refinery for further processing. |
| Higher Alcohols | Fuel grade mixed alcohols |
| Urea | Farm grade urea |

## Site Data

The conditions shown in Table 3 are consistent with DoE/NETL Report 2010/1397, November 2010 and DOE/NETL Report 2010/1399, May 2011. The dry bulb temperature, humidity and elevation correspond to ISO conditions for Illinois No. 6 bituminous coal but those for the lignite are more specific to N. Dakota.

**Table 6: Site Conditions**

| | |
|---|---|
| Dry Bulb Temperature | 15°C for bituminous / 4.4°C for lignite |
| Relative Humidity | 60% for bituminous / 40% for lignite |
| Elevation | Sea level for bituminous<br>579 m (1900 ft) above sea level for lignite |
| Plant Heat Rejection | Mechanical draft cooling towers for bituminous / Mechanical draft cooling towers + Air Cooled (for half of surface condenser duty) for lignite |
| Plant Make-up Water | Fresh water |
| Plant Site | Level greenfield without any piling requirement |
| Access | Land locked, having access by train and highway |
| Ash | Off-site disposal |
| Waste Water | Treated for disposal (not zero-discharge) |

## Environmental Data

Targets presented for the criteria pollutants are obtained from DoE Funding Opportunity Number: DE-FOA0000496, 3/15/2011, "Advanced Gasification: Novel $CO_2$ Utilization Systems, Low Rank Coal IGCC Optimization, and Improvements in Gasification Systems Availability & Costs."

The coal only based cases capture 90% of the carbon present in the particulate free syngas while for the biomass cofed cases, 80% of the carbon is captured consistent with DoE Funding Opportunity Number: DE-FOA0000496, 3/15/2011, "Advanced Gasification: Novel $CO_2$ Utilization Systems, Low Rank Coal IGCC Optimization, and Improvements in Gasification Systems Availability & Costs." Actually, 80% capture for biomass cofed cases (with 30% by weight of the total feed as biomass on a dry basis) results in substantially lower $CO_2$ emissions on a net MW basis.

The net waste water produced by the plant is treated to U.S. Environmental Performance Standards before discharge consistent with DoE/NETL Report 2010/1397, November 2010, "Cost and Performance Baseline for Fossil Energy Plants Volume 1: Bituminous Coal and Natural Gas to Electricity" and will not be design for zero effluent discharge.

**Table 7: Criteria Pollutants**

| Pollutant | Environmental Limits | Environmental Targets |
|---|---|---|
| $SO_2$ | 1.4 lb/MWh | 0.0128 lb/MMBtu |
| NOx | 1.0 lb/MWh | 15 ppmv (dry) @ 15% $O_2$ |
| PM (Filterable) | 0.015 lb/MMBtu | 0.0071 lb/MMBtu |
| Hg | $20 \times 10^{-6}$ lb/MWh | >90% capture |

**Table 8: $CO_2$ Capture / Specifications**

| Parameter | Units | Parameter Value |
|---|---|---|
| $CO_2$ Capture[1] | % of C in syngas | 90 (for coal only)<br>80 for coal + biomass |
| Inlet Pressure | MPa (psia) | 15.3 (2,215) |
| Outlet Pressure | MPa (psia) | 10.4 (1,515) |
| Inlet Temperature | °C (°F) | 35 (95) |
| $N_2$ Concentration | ppmv | < 300 |
| $O_2$ Concentration | ppmv | < 40 |
| Ar Concentration | ppmv | < 10 |
| $H_2O$ Concentration | ppmv | < 150 |

## TASK 3.0 – IDENTIFY ADVANCED TECHNOLOGY OPTIONS AND INTEGRATION CONCEPTS

Table 9 summarizes the technologies selected for major plant sections for the electricity only and for the coproduction plants. The advanced technology options are not limited by currently available components and technology but are well-grounded in current research and/or sound engineering principles. The overall integration schemes for the electricity only as well as for each type of coproduct are depicted in block flow diagrams, Figures 1 through 6. These flow schemes incorporate results of the screening analysis conducted in Task 4 as described in the section following the process descriptions.

### Process Description – Electricity Only Cases

Air Separation. Ion Transport Membrane (ITM) technology is selected for the ASU to supply high pressure, high purity $O_2$ (at a nominal 100 mole %) to the gasification unit. Highly selective ceramic membranes are used for the ITM process to separate $O_2$ from hot compressed air. At the operating temperature of 800 to 900°C, $O_2$ in the feed side (air) is ionized on the surface of the membrane and diffuses through the membrane as oxygen ions, forms oxygen molecules on the permeate side. The pressure at the feed side is in excess of 14 barg (200 psig) and low to sub-atmospheric pressure on the permeate side. The chemical potential or $O_2$ partial pressure gradient is the driving force for transporting $O_2$ from one side to the other.

[1] % $CO_2$ capture = 100 - % of syngas carbon emitted through stack.

Feed to the ITM is extracted from the gas turbine compressor, further compressed to 25.7 bar in a booster compressor, and then heated up in an interchanger against the depleted air stream followed by further heating to 850°C by directly firing decarbonized syngas into the air stream in a combustor. It then enters the membrane separation unit which is modeled using methodology developed by Air Products and Chemicals, Inc. [Armstrong]. Permeate oxygen stream is cooled in a Heat Recovery Steam Generator (HRSG) while generating high pressure (HP), intermediate pressure (IP) and low pressure (LP) steam. Finally it is cooled against cooling water and then compressed by a multistage intercooled compressor before it is provided to the gasifier and the $H_2SO_4$ unit, while non-permeate oxygen-depleted air is recycled back to the gas turbine.

Coal Receiving and Handling. Coal is received at the plant site by unit train. The coal is unloaded from bottom dump cars into an unloading hopper. Vibrating feeders withdraw the coal from these hoppers and place it on receiving conveyors. A belt scale measures the actual conveyor transport rate. After passing through a magnetic separator, the coal is transported to storage pile. Coal is reclaimed from the coal pile and supplied to the day bins which supply coal on a continuous basis to the drying and milling operations. Coal dust recovered by dust collection systems in the coal storage areas is also sent to the grinding mills.

Gasification and Syngas Cleanup. The dry feed, entrained flow, slagging, single stage, down-flow gasifier operates at a pressure of 40 bar. The dry feedstock is transported by $CO_2$ and is fed to the gasifier along with $O_2$ and steam via a top-mounted feed injector. Almost complete conversion of feedstock occurs at temperature 1300°C to 1400°C. Hot raw syngas and liquid slag are discharged from the gasifier reaction chamber, the raw gas is cooled to 677°C in a radiant syngas cooler while generating HP steam. Coarser particulates are removed from raw syngas by barrier filter, followed by scrubbing with recycled water to remove water soluble components including alkalis and chlorides. The slag discharges into a water bath at the bottom of the radiant syngas cooler and is cooled to temperatures of around 220°C and the molten slag solidifies. The vitrified slag granulates accumulating in the water bath are discharged via a lock hopper. The gas is then fed through a fixed bed of nacholite sorbent for the removal of halides. The syngas is then preheated in a feed/effluent interchanger and desulfurized by the RTI regenerable ZnO process operating at 260°C by the overall reactions: $H_2S + ZnO = ZnS + H_2O$ and $COS + ZnO = ZnS + CO_2$. The regenerator off-gas containing $SO_2$ obtained by the reaction: $ZnS + O_2 = ZnO + SO_2$, is fed to a sulfuric acid unit to produce a saleable byproduct. The desulfurized syngas after cooling in the feed/effluent interchanger enters TDA's fixed-bed sorption process for Hg removal. Some of the $NH_3$ and HCN are also captured by this adsorbent.

Syngas Shifting and Decarbonization. The purpose of this unit is to convert most of the CO in the syngas to $H_2$ by means of the water gas shift reaction: $CO + H_2O = H_2 + CO_2$. This conversion step is crucial to the overall carbon capture of the IGCC plant. $NH_3$ in the feed passes through the shift reactor unchanged and will not affect the catalyst performance. On the other hand, HCN will be hydrogenated to $CH_4$ and $N_2$. Sufficient steam is injected into the syngas and then fed to a fixed bed shift reactor and the heat evolved by the exothermic shift reaction is used to generate IP and medium pressure (MP) steam. The syngas is then fed to a second shift reactor for further conversion and the effluent from this second reactor is cooled to 232°C while generating MP steam. The syngas is then combined with recycle gas exiting the $CO_2$ purification unit and then fed to the TDA fixed-bed sorption unit for decarbonizing the syngas. Regeneration

is accomplished utilizing steam. The mixture consisting of desorbed $CO_2$, steam and residual syngas is cooled in a series of heat exchangers consisting of generating LP steam, vacuum condensate / makeup boiler feed water (BFW) heating and finally trim cooling against cooling water. The gas is then compressed, cooled while recovering bulk of the heat for vacuum condensate / makeup BFW heating, dehydrated and fed to the cryogenic $CO_2$ purification unit. The primary function of the distillation column is to produce a $CO_2$ product that meets specifications as defined in the design basis. The purified $CO_2$ bottoms stream is then split into various fractions as required for in-plant usage (such as gasifier feed transport), and pressurized in pumps to the required pressures. The feed to the column is cooled in a series of heat exchangers to a final temperature of -37°C against cold process streams as well as refrigerated liquid propane. The decarbonized syngas leaving the adsorption unit at a temperature of 252°C with its accompanying steam is supplied to the gas turbine along with the depleted air from the ASU.

Power Block. The process scheme for the combined-cycle power block consists of a gas turbine supporting a reheat steam turbine. The interface between the HRSG and the steam turbine also includes a reheat steam loop. The power block consists of the following major subsystems:

- Gas Turbine
- HRSG
- Steam Turbine and the associated Vacuum Condensate System
- Integral Deaerator
- Blowdown System
- Miscellaneous Supporting Facilities:
    - Boiler chemical injection
    - Demineralized water package.

The performance on decarbonized syngas of the gas turbine selected for this study, a steam cooled H class machine, was developed in a previous study utilizing Thermoflex. A model was set up in Thermoflex utilizing published performance by General Electric (GE) for their 7H gas turbine on natural gas and then this model was "operated" in off-design mode to obtain an estimate of its performance on syngas while limiting the blade surface temperatures at the same values as those for the natural gas case. This resulted in a decrease in the firing temperature of the gas turbine from1428°C on natural gas to 1392°C on the syngas. The decarbonized syngas and the depleted air from the ASU are injected into the gas turbine combustor through separate nozzles. The hot gas turbine exhaust flows through the HRSG equipped with its own stack and a continuous emissions monitoring system (CEMS). The steam enters the HP section of the steam turbine at 166.5 bara/538°C. Exhaust from the HP section is reheated to 538°C before admitting it to the IP section. The surface condenser uses circulating cooling water from the cooling towers as the cooling medium while the makeup water for the steam system is sprayed directly into the condenser. Demineralized water system consists of mixed-bed exchangers, one in operation and one in stand-by, filled with cation/anion resins, with internal-type regeneration. The package includes facilities for resin bed regeneration, chemical storage and neutralization basin.

General Facilities. The following is a listing of the various necessary support and general facilities that are required for a stand-alone plant. Any utility requirements by these facilities are accounted for in developing the plant performances.

- Natural gas supply – for start-up
- Cooling water system – includes mechanical draft cooling towers and the cooling water supply pumps
- Potable water system
- General makeup water supply system
- Oily water separator - oily water from all process units is collected in the oily water sump, which separates the oil from the water by a corrugated plate interceptor (oil/water separator). Contaminated storm water is also sent to the oily water sump for treatment.
- Drains and blowdowns
- Fire protection and monitoring systems – consist of general firewater system and specialized system for chemical fire protection
- Plant and instrument air system
- Wastewater treatment system – process wastewater is collected for treatment and the treated water is discharged from the plant. A sanitary wastewater treating unit is included in this system
- Flare – the flare system consists of collection headers for the process unit relief gases and a system of knockout drums prior to safe disposal in an elevated flare.
- Miscellaneous materials (e.g. slag, fine slag, byproduct) handling (unloading and loading facilities)
- In-plant electric power distribution
- Uninterruptible power supply
- Generator step-up transformers
- Distributed control system
- Continuous emissions monitoring
- Process analyzers
- Hazardous gas detection system
- Communications
- Laboratory for inspection, certification and process control
- Maintenance, warehouse and administration facility
- Other supporting facilities (e.g. interconnecting piping; rail spur for construction materials access; roads, paving, parking, fencing and lighting; heating, ventilation and air conditioning systems).

## Process Description – Hydrogen Coproduction Cases

The plant configuration is similar to that for the previously described Electricity Only case. Major differences in the configuration are described in the following.

Air Separation. Since a significant portion of the syngas is utilized for producing the coproduct

stream, the relative size of the gasification island in relation to the power island is much larger than that in the Electricity Only case. This results in the amount of air that may be extracted from the gas turbine not being sufficient for the ASU, since the maximum amount of extraction air is limited to 50% of the total gas turbine inlet air. A compressor is included in the plant to supply the additional air required by the ASU.

Biomass Receiving and Handling. In cases where woody biomass is a cofeed, hybrid poplar logs are received at the plant by truck and are unloaded using dedicated forklifts. The first step in size reduction consists of chipping the wood which is then sent to storage. In cases where switchgrass is a cofeed, the field dried switchgrass is received at the plant by truck as bundled bales. The trucks are again unloaded using dedicated forklifts and switchgrass storage consists of covered bales with allowances for water drainage. Each bale is wrapped in plastic net to prevent them from breaking during handling. The biomass is transferred from long term storage to short term storage, equivalent to 72 hours of uninterrupted production. In the case of switchgrass, from short term storage, the bales are conveyed to an unwrapping station and then to the biomass preparation and feed system. For this study it is assumed that there are no logistical barriers to transporting the required tonnages of either of the biomass feedstocks.

Coproduction. The $H_2$ rich decarbonized syngas is fed to a PSA unit to produce the high purity coproduct meeting the specifications as defined in the design basis. The tail gas from the PSA is compressed and combined with the fuel gas to the gas turbine.

## Process Description – Methanol Coproduction Cases

The plant configuration is similar to that for the previously described Electricity Only case. Major differences in the configuration are described in the following.

Air Separation. Since a significant portion of the syngas is utilized for producing the coproduct stream, the relative size of the gasification island in relation to the power island is much larger than that in the Electricity Only case. This results in the amount of air that may be extracted from the gas turbine not being sufficient for the ITM ASU, since the maximum of extraction portion is limited to 50% of the total gas turbine inlet air. A compressor is included in the plant to supply the additional air required by the ITM ASU.

Biomass Receiving and Handling. In cases where woody biomass is a cofeed, hybrid poplar logs are received at the plant by truck and are unloaded using dedicated forklifts. The first step in size reduction consists of chipping the wood which is then sent to storage. In cases where switchgrass is a cofeed, the field dried switchgrass is received at the plant by truck as bundled bales. The trucks are again unloaded using dedicated forklifts and switchgrass storage consists of covered bales with allowances for water drainage. Each bale is wrapped in plastic net to prevent them from breaking during handling. The biomass is transferred from long term storage to short term storage, equivalent to 72 hours of uninterrupted production. In the case of switchgrass, from short term storage, the bales are conveyed to an unwrapping station and then

to the biomass preparation and feed system. For this study it is assumed that there are no logistical barriers to transporting the required tonnages of either of the biomass feedstocks.

Coproduction. A fraction of the unshifted clean syngas is combined with a fraction of the decarbonized syngas in order to obtain the specified Ribblett ratio[2] of 2.05 in the feed to the synthesis unit and is passed through a bed of ZnO sandwiching a COS hydrolysis catalyst to remove the trace amounts of sulfur compounds present. The desulfurized syngas is then cooled while most of the heat is recovered for steam generation before it is compressed to near the synloop pressure (which operates at about 56 barA) and combining with the synloop recycle syngas. The combined stream is then preheated in a feed/effluent interchanger before being fed to a slurry reactor containing fine catalyst particles suspended in an inert hydrocarbon liquid (a mineral oil) [Air Products Final Report, Contract No. DE-FC22-92PC90543]. The mineral oil acts as a temperature moderator and a heat removal medium, transferring the heat of reaction from the catalyst surface via the liquid slurry to boiling water in an internal tubular heat exchanger. IP steam is generated from the heat. The overall reactions occurring are: $2\ H_2 + CO = CH_3OH$, $CO_2 + 3\ H_2 = CH_3OH + H_2O$ and $CO + H_2O = CO_2 + H_2$. The reactor effluent at 260°C is cooled in a series of heat exchangers including the feed/effluent interchanger. The condensate collected is fed to the methanol purification unit which consists of a light ends column to remove the dissolved light ends, and a set of energy saving heat integrated distillation columns (HP and LP columns with the condenser of the HP column providing heat for the reboiler of the LP column) to produce the methanol meeting the specifications as defined in the design basis.

## Process Description – Fischer Tropsch Liquids Coproduction Cases

The plant configuration is similar to that for the previously described Electricity Only case. Major differences in the configuration are described in the following.

Air Separation. Since a significant portion of the syngas is utilized for producing the coproduct stream, the relative size of the gasification island in relation to the power island is much larger than that in the Electricity Only case. This results in the amount of air that may be extracted from the gas turbine not being sufficient for the ITM ASU, since the maximum amount of extraction air is limited to 50% of the total gas turbine inlet air. A compressor is included in the plant to supply the additional air required by the ITM ASU. The ASU provides $O_2$ to an autothermal reformer which is located in the Fischer Tropsch synthesis unit, in addition to the gasifier and the $H_2SO_4$ unit.

Biomass Receiving and Handling. In cases where woody biomass is a cofeed, hybrid poplar logs are received at the plant by truck and are unloaded using dedicated forklifts. The first step in size reduction consists of chipping the wood which is then sent to storage. In cases where switchgrass is a cofeed, the field dried switchgrass is received at the plant by truck as bundled

[2] Ribblett ratio = (Moles H2 - Moles CO2)/(Moles CO + Moles CO2)

bales. The trucks are again unloaded using dedicated forklifts and switchgrass storage consists of covered bales with allowances for water drainage. Each bale is wrapped in plastic net to prevent them from breaking during handling. The biomass is transferred from long term storage to short term storage, equivalent to 72 hours of uninterrupted production. In the case of switchgrass, from short term storage, the bales are conveyed to an unwrapping station and then to the biomass preparation and feed system. For this study it is assumed that there are no logistical barriers to transporting the required tonnages of either of the biomass feedstocks.

Coproduction. A fraction of the clean syngas before it enters the 2nd shift reactor is combined with a fraction of the unshifted syngas in order to obtain the specified $H_2$/CO ratio of about 1 for the synthesis reactor feed gas, and passes through a bed of ZnO sandwiching a COS hydrolysis catalyst to remove the trace amounts of sulfur compounds present. The desulfurized syngas is then expanded through a power recovery turbine to near synloop pressure (which operates at about 24 barA) and combined with the synloop recycle syngas. The combined stream is then cooled in a series of heat exchangers and then fed to an amine wash unit to remove most of the $CO_2$. The combined stream is then preheated by two heat exchangers including a feed/effluent interchanger before being fed to a slurry reactor with Fe based catalyst particles suspending in an inert hydrocarbon liquid (a mineral oil). The mineral oil acts as a temperature moderator and a heat removal medium, transferring the heat of reaction from the catalyst surface via the liquid slurry to boiling water in an internal tubular heat exchanger. IP steam is generated from the heat. The major overall reactions occurring are: $(2n+1)\ H_2 + n\ CO = H\text{-}(CH_2\text{-})_n\text{-}H + n\ H_2O$ and $CO + H_2O = CO_2 + H_2$. The reactor effluent at 260°C is cooled in a series of heat exchangers including the feed/effluent interchanger. The condensate collected is fed to the product stabilization unit which consists of a column to remove the dissolved light ends. The recycle gas which contains $CH_4$ and other undesirable hydrocarbons is compressed and fed to an autothermal reformer to convert the hydrocarbons back to $H_2$ and CO.

## Process Description – Higher Alcohols Coproduction Cases

The plant configuration is similar to that for the previously described Electricity Only case. Major differences in the configuration are described in the following.

Air Separation. Since a significant portion of the syngas is utilized for producing the coproduct stream, the relative size of the gasification island in relation to the power island is much larger than that in the Electricity Only case. This results in the amount of air that may be extracted from the gas turbine not being sufficient for the ITM ASU, since the maximum amount of extraction air is limited to 50% of the total gas turbine inlet air. A compressor is included in the plant to supply the additional air required by the ITM ASU. The ASU provides $O_2$ to an autothermal reformer which is located in the alcohols synthesis unit, in addition to the gasifier and the $H_2SO_4$ unit.

Biomass Receiving and Handling. In cases where woody biomass is a cofeed, hybrid poplar logs are received at the plant by truck and are unloaded using dedicated forklifts. The first step in size

reduction consists of chipping the wood which is then sent to storage. In cases where switchgrass is a cofeed, the field dried switchgrass is received at the plant by truck as bundled bales. The trucks are again unloaded using dedicated forklifts and switchgrass storage consists of covered bales with allowances for water drainage. Each bale is wrapped in plastic net to prevent them from breaking during handling. The biomass is transferred from long term storage to short term storage, equivalent to 72 hours of uninterrupted production. In the case of switchgrass, from short term storage, the bales are conveyed to an unwrapping station and then to the biomass preparation and feed system. For this study it is assumed that there are no logistical barriers to transporting the required tonnages of either of the biomass feedstocks.

Coproduction. A fraction of the clean syngas before it enters the 2nd shift reactor is combined with a fraction of the unshifted syngas in order to obtain the specified $H_2$/CO ratio of about 2 at the synthesis reactor inlet and is passed through a bed of ZnO sandwiching a COS hydrolysis catalyst to remove the trace amounts of sulfur compounds present. The desulfurized syngas is then expanded through a power recovery turbine to near synloop pressure (with synthesis reactor outlet at about 14 barA) and combined with the synloop recycle syngas. The combined stream is then cooled in a series of heat exchangers and then fed to an amine wash unit to remove most of the $CO_2$. The combined stream is then preheated in two heat exchangers including a feed/effluent interchanger before being fed to a fixed bed reactor containing Rh based catalyst. The exothermic reaction heat is transferred to boiling water in an internal tubular heat exchanger to generate IP steam. The major overall reactions occurring are: $2n\ H_2 + n\ CO = C_n\ H_{2n+1}\ OH + (n-1)\ H_2O$ (with n predominantly = 2), $3\ H_2 + CO = CH_4 + H_2O$ and $CO + H_2O = CO_2 + H_2$. The reactor effluent at 285°C is cooled in a series of heat exchangers including the feed/effluent interchanger. The condensate collected is fed to the purification unit which consists of a set of energy saving heat integrated distillation columns (HP and LP columns with the condenser of the HP column providing heat for the reboiler of the LP column) to produce the azeotropic mixture of $C_2H_5OH$ and $H_2O$ which is then dehydrated using molecular sieves to meet the specifications as defined in the design basis.

## Process Description – Urea Coproduction Cases

The plant configuration is similar to that for the previously described Electricity Only case. Major differences in the configuration are described in the following.

Air Separation. Since a significant portion of the syngas is utilized for producing the coproduct stream, the relative size of the gasification island in relation to the power island is much larger than that in the Electricity Only case. This results in the amount of air that may be extracted from the gas turbine not being sufficient for the ITM ASU, since the maximum amount of extraction air is limited to 50% of the total gas turbine inlet air. All Urea Coproduction Cases except for the Bituminous Cases require a separate compressor to supply the additional air required by the ITM ASU. In addition to the ITM ASU, a cryogenic ASU is also provided in order to produce the $N_2$ required for $NH_3$ synthesis.

Biomass Receiving and Handling. In cases where woody biomass is a cofeed, hybrid poplar logs are received at the plant by truck and are unloaded using dedicated forklifts. The first step in size reduction consists of chipping the wood which is then sent to storage. In cases where switchgrass is a cofeed, the field dried switchgrass is received at the plant by truck as bundled bales. The trucks are again unloaded using dedicated forklifts and switchgrass storage consists of covered bales with allowances for water drainage. Each bale is wrapped in plastic net to prevent them from breaking during handling. The biomass is transferred from long term storage to short term storage, equivalent to 72 hours of uninterrupted production. In the case of switchgrass, from short term storage, the bales are conveyed to an unwrapping station and then to the biomass preparation and feed system. For this study it is assumed that there are no logistical barriers to transporting the required tonnages of either of the biomass feedstocks.

Coproduction. The $H_2$ rich decarbonized syngas is fed to a PSA unit to produce the high purity $H_2$ for the $NH_3$ synthesis which is subsequently converted to urea. The tail gas from the PSA is compressed and combined with the fuel gas to the gas turbine. The PSA derived $H_2$ stream is combined with the $N_2$ from the cryogenic ASU and fed into a noble metal catalyst containing deoxidation reactor since the $N_2$ from the cryogenic ASU contains a small amount of $O_2$. The deoxidized gas with a $H_2$ to $N_2$ molar ratio of 3 to 1 is cooled, compressed to near the synloop pressure (which operates at about 120 barA) and combined with the synloop recycle gas. The combined stream is then preheated in a feed/effluent interchanger before being fed to the $NH_3$ synthesis reactor containing a Fe based catalyst. The overall reaction occurring is: $N_2 + 3H_2 = 2NH_3$. The reactor effluent at about 400°C is cooled in a series of heat exchangers including the feed/effluent interchanger and finally refrigerated exchanger. The $NH_3$ condensate collected is pumped to a pressure of 158 barA and then vaporized before feeding it to the urea synthesis unit consisting of the Stamicarbon process. A portion of the $CO_2$ from the syngas decarbonization step is also supplied at this pressure. The exothermic condensation to ammonium carbamate as well as the endothermic dehydration of the carbamate to urea and water takes place in the synthesis section. The reaction mixture is subjected to a stripping process, using $CO_2$ to strip off the unreacted $NH_3$. The stripper off-gases are introduced into a HP pool condenser together with the carbamate solution from the HP scrubber and fresh $NH_3$. The gas/liquid mixture flows into the urea reactor in which the main urea formation takes place. The liquid reaction mixture leaving the reactor is introduced into the stripper. Exhaust gases (inert gases, $NH_3$, $CO_2$ and $H_2O$), which are separated from the liquid are scrubbed in the HP scrubber with carbamate solution from the LP recirculation section. $NH_3$ and $CO_2$ still contained in the urea solution discharged by the stripper are recovered in an LP stage. The urea solution leaving the synthesis section is concentrated in an evaporation section to meet the requirements of the granulation process.

## TASK 4.0 – SCREENING ANALYSES OF ADVANCED INTEGRATION CONCEPTS

### Wet versus Dry Scrubbing

A screening analysis is conducted for making a selection between dry and wet scrubbing of the

raw syngas by developing plant simulations in Aspen Plus®. Both cases consist of producing power only while utilizing coal and biomass mixtures[3]. Compared to wet scrubbing, the dry scrubbing IGCC system shows only a half a percent decrease in plant net heat rate. Due to the low efficiency gain while the required technologies for high temperature halogen, alkali and particulate removal are still under development, it is recommended that the wet scrubbing option be selected for all cases to be developed in the next detailed task (Task 5 – Analyses).

The wet scrubbing option consists of the following commercially proven units in the high-temperature gas cleanup section of the IGCC upstream of the syngas shift unit:

- Cooling of the syngas exiting the gasifier at 1371°C to 677°C while generating high pressure steam
- Barrier filter for removal of coarser particulates
- Wet water scrubbing to remove remaining particulates and water soluble components including alkalis and chlorides
- Preheating of the scrubbed gas from 189°C to 260°C followed by desulfurization using the RTI regenerable ZnO process
- Cooling the desulfurized syngas to 250°C followed by mercury removal using TDA's "Throw Away" process.

The dry scrubbing option consists of the following units in the high-temperature gas cleanup section of the IGCC upstream of the syngas shift unit:

- Injection of aluminosilicates [Sharma et. al., 2010] into the raw syngas above 1000°C to react with alkalies by the following reaction: $NaCl + 0.5Al_2O_3 + 3SiO_2 + 0.5H_2 + 0.5CO \rightarrow NaAlSi_3O_8 + HCl + 0.5C$.
- Cooling of the syngas to 800°C while generating high pressure steam
- Passing the syngas through a halide filter-reactor containing nacholite, $NaHCO_3$ to remove the halogens from the syngas by the reaction: $NaHCO_3 + HCl \rightarrow NaCl + H_2O + CO_2$
- Further cooling of the syngas from to 399°C while generating high pressure steam
- Removal of particulates using monolithic ceramic filter [Martin, et. al., 2002] at 399°C which has a separation efficiency of 99.999%.
- Spray water cooling of the syngas to 238°C
- Preheating of the gas from 238°C to 260°C followed by desulfurization using the RTI regenerable ZnO process
- Cooling the desulfurized syngas to 302°C followed by mercury removal using TDA's "Throw Away" process

[3] The selected case will be modified to develop the remainder of the cases of this study under the next detailed task (Task 4 – Analyses).

## ITM and Gas Turbine Integration Options

A screening analysis is next conducted to select the integration configuration of the ITM technologies for the ASU with the gas turbine. Figures 7 through 10 depict the four integration concepts investigated for the ITM while Table 10 summarizes the impact on the relative heat rate of the IGCC for these various integration concepts as compared to the cryogenic ASU based IGCC. Case 1 preheats the depleted air against the extracted air, prior to returning it to the gas turbine. Cases 2 and 3 return the depleted air to the gas turbine at the same temperature as the air extracted from the gas turbine compressor discharge in order to minimize the impact on the gas turbine. This is accomplished by the generation of HP steam. Cases 3 and 4 return the depleted air to the gas turbine at the same pressure as the air extracted from the gas turbine compressor discharge without reducing the gas turbine pressure ratio. This booster compressor, however, requires inlet temperatures that are quite high. An axial compressor with design conditions similar to the HP stages of the gas turbine compressor would be suitable for this high temperature operation. Generation of HP steam to reduce the temperature of the depleted air returned to the gas turbine, however, negatively impact the overall plant performance, as much as a 1% heat rate penalty. Inclusion of a booster compressor does improve the plant performance. Thus, the performance for the Case 4 configuration which returns the depleted air at the higher temperature and utilizes the high temperature booster compressor shows for the highest plant performance, about 4.0% decrease in overall plant heat rate over the cryogenic ASU based IGCC. It is recommended that this configuration be selected for all cases to be developed in the next detailed task (Task 5 – Analyses).

## Coproduct Hydrogen Purity

A screening analysis is next conducted to select the purity of coproduct hydrogen, i.e., industrial grade consisting of 99.95% $H_2$ versus decarbonized fuel for off-site gas turbine. The industrial grade hydrogen is produced using a PSA unit to purify the decarbonized syngas while the tail gas from the PSA is compressed and combined with the decarbonized syngas fed to the on-site gas turbine. In the alternate case, where decarbonized syngas is exported, a portion of the decarbonized syngas leaving the warm gas $CO_2$ removal unit is simply cooled while separating out the moisture. The loss in electrical power output when producing industrial grade hydrogen is about 2.3% while gasifiying the same amount of feedstock and exporting the same amount of energy (LHV basis) contained in the hydrogen coproduct. The increase in plant cost for producing the industrial grade hydrogen by the use of the PSA unit is expected to be also low. It is recommended that industrial grade hydrogen be produced in the hydrogen coproduction cases (to be developed in the next detailed Task 5 – Analyses) since a significantly higher revenue stream associated with the industrial grade hydrogen is expected to provide the offset.

## Sensitivity to Purge Rate

A screening analysis is conducted to quantify the effect of purge rate from the synthesis loop on the overall system efficiency. This sensitivity analysis is conducted on the methanol coproduction and the F-T coproduction cases. It is found that the overall electrical efficiency is actually decreased as the purge rate is increased over the base values of 2.5% for the methanol case and 2% for the F-T case. For the methanol case, the electrical heat rate is increased by 0.6% when the purge rate is increased to 10%, while that for the F-T case is increased by as much as 1.46% when the purge rate is increased to 10%. These results may be generalized to include the higher alcohols coproduction case.

In summary, from a plant thermal efficiency standpoint, the purge from the synloop should be minimized, implying that once-through synthesis is not beneficial from a plant efficiency standpoint. When the purge rate becomes higher than a threshold amount, decarbonization of the purge gas is also required to limit the overall plant carbon emissions to the design value. This requires shifting and reforming in the case of F-T liquids coproduction. Since ITM technology is utilized for air separation, the inerts buildup due to reduction in purge rate is less significant than for a plant utilizing cryogenic air separation.

**Table 9: Plant Subsection Technology**

| Plant Unit | Technology | Comments |
|---|---|---|
| Air Separation | ITM for non urea cases (unless ITM does not show a significant advantage over cryogenic, based on screening analysis) | All cases are expected to use the ITM technology except where high pressure $N_2$ is required as in the urea coproduct case where an elevated pressure cryogenic air separation unit will be utilized. |
| Biomass Pretreatment | Drying using Vapor Recompression and Size Reduction by Milling | Co-feeding biomass with coal into a pressurized dry feed (Shell) gasifier at proposed levels demonstrated at Nuon IGCC (particle size < 1 mm). Experimental data for hammer mill power for switch grass with 6 - 12% moisture available. Milling power not significant impact on plant thermal performance. Milling of woody mass more challenging but was successfully fed to the Nuon IGCC entrained bed gasifier. |
| Gasifier feeding | Solids Pump | Using recycle $CO_2$ as inerting and injection gas. Maximum discharge pressure limited to 8.3 MPa (1200 psi) based on PW gasifier demonstration program. |
| Gasifier | Siemens type dry-feed entrained-bed operating at commercially offered operation pressure of ~41 bar (600 psi) and not at higher unproven pressure | Siemens gasifier is simpler in design than Shell gasifier and multiple feed nozzle available.<br>The operating pressure of the Siemens gasifier for current projects is 4 MPa while their patents site a maximum pressure of 10 MPa. |
| Raw Syngas Scrubbing[4] | Both dry and wet scrubbing are evaluated | Dry scrubbing consists of spraying water into the raw syngas after high temperature heat recovery while staying above the dew point temperature. |
| Syngas Alkali Removal for Dry Scrubbing Option | Injection of aluminosilicates into raw syngas. | Alkali is removed by aluminosilicates. |
| Syngas Halide Removal for Dry Scrubbing Option | Halide filter-reactor | Halide sorbent consisting of a “throw away” nacholite process used (a “throw away” process used since halide content of the feedstocks is low). |
| Syngas Particulate Removal for Dry Scrubbing Option | Monolithic ceramic filter | Power Systems Development Facility (PSDF) [Martin, et. al, 2002] has achieved a maximum operating period of 2,700 hours and particle separation efficiency of 99.999% with filter media type of monolithic ceramic. |

[4] Wet scrubbing option was selected as discussed in the Screening Analyses.

**Table 9 (cont'd): Plant Subsection Technology**

| Plant Unit | Technology | Comments |
|---|---|---|
| Syngas Desulfurization | Humid Gas Cleanup using RTI's ZnO Process | Regenerable process while producing $H_2SO_4$ from the regenerator off-gas. |
| Syngas Mercury Removal | Humid Gas Cleanup using TDA's Process | A "Throw Away" process, Hg content of feedstock being low. |
| Syngas Shifting | Sulfur Tolerant Catalyst | All cases are expected to use adiabatic beds with intercooling in series depending on the degree of shifting required. |
| Syngas $CO_2$ Separation | Humid Gas Cleanup using Absorption Beds such as the TDA process | |
| Power Island | H Class Gas Turbine based Combined Cycle (it is assumed that this type of gas turbine will be offered for syngas applications in the time frame of these advanced gasification plants) | Lower rotor inlet temperature than the 1700°C Class (advanced) gas turbine as indentified in a study conducted for the DoE titled, "Systems Analyses of Advanced Brayton Cycles for High Efficiency Zero Emission Plants" (Award No. DE-FC26-05NT42652). |
| $H_2$ Purification | Decarbonized syngas purified with a PSA | |
| Methanol Synthesis | Slurry Bed Reactor with copper and zinc oxide Catalyst | Design basis derived from DOE/NETL-2004/1199 Report, 2003 |
| Fischer-Tropsch Liquids Synthesis | Slurry Bed Reactor with Fe based Catalyst | Design basis for synthesis derived from Kreutz, et. al. 2008, and that for autothermal reforming from Rao, et. al., 2000. |
| Alcohol Synthesis | Transport Reactor with Rh-based Catalyst | Design basis for synthesis derived from Spivey et. al, 2009, and Subramanian et. al., 2010. |
| $NH_3$ Synthesis Gas Preparation | Decarbonized syngas purified with a PSA | $N_2$ required for $NH_3$ synthesis supplied by small cryogenic ASU (bulk of $O_2$ produced by ITM). |

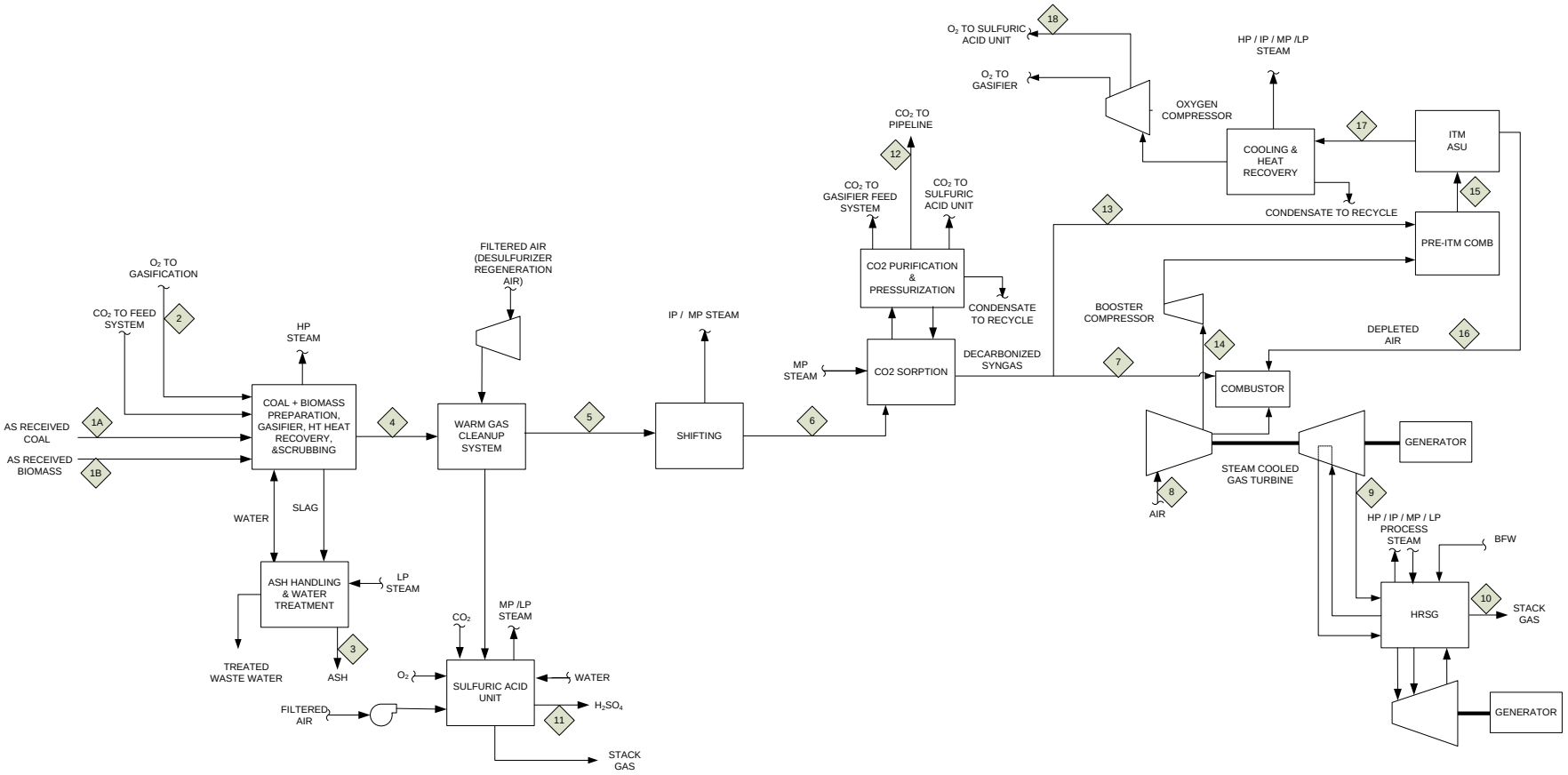


**Figure 1: Block Flow Diagram – IGCC with Power Only and CCS**

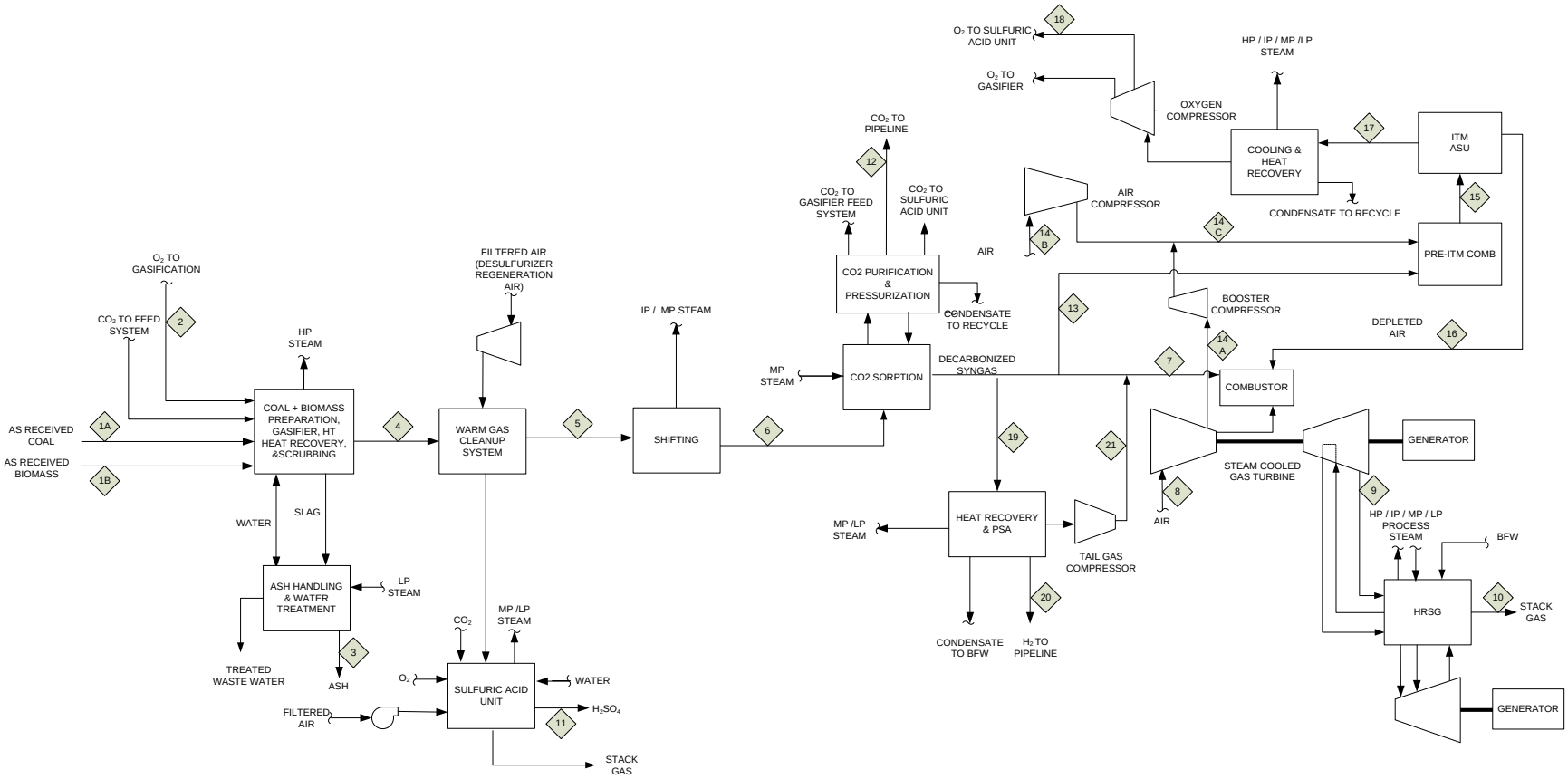


**Figure 2: Block Flow Diagram – IGCC with $H_2$ Coproduction and CCS**

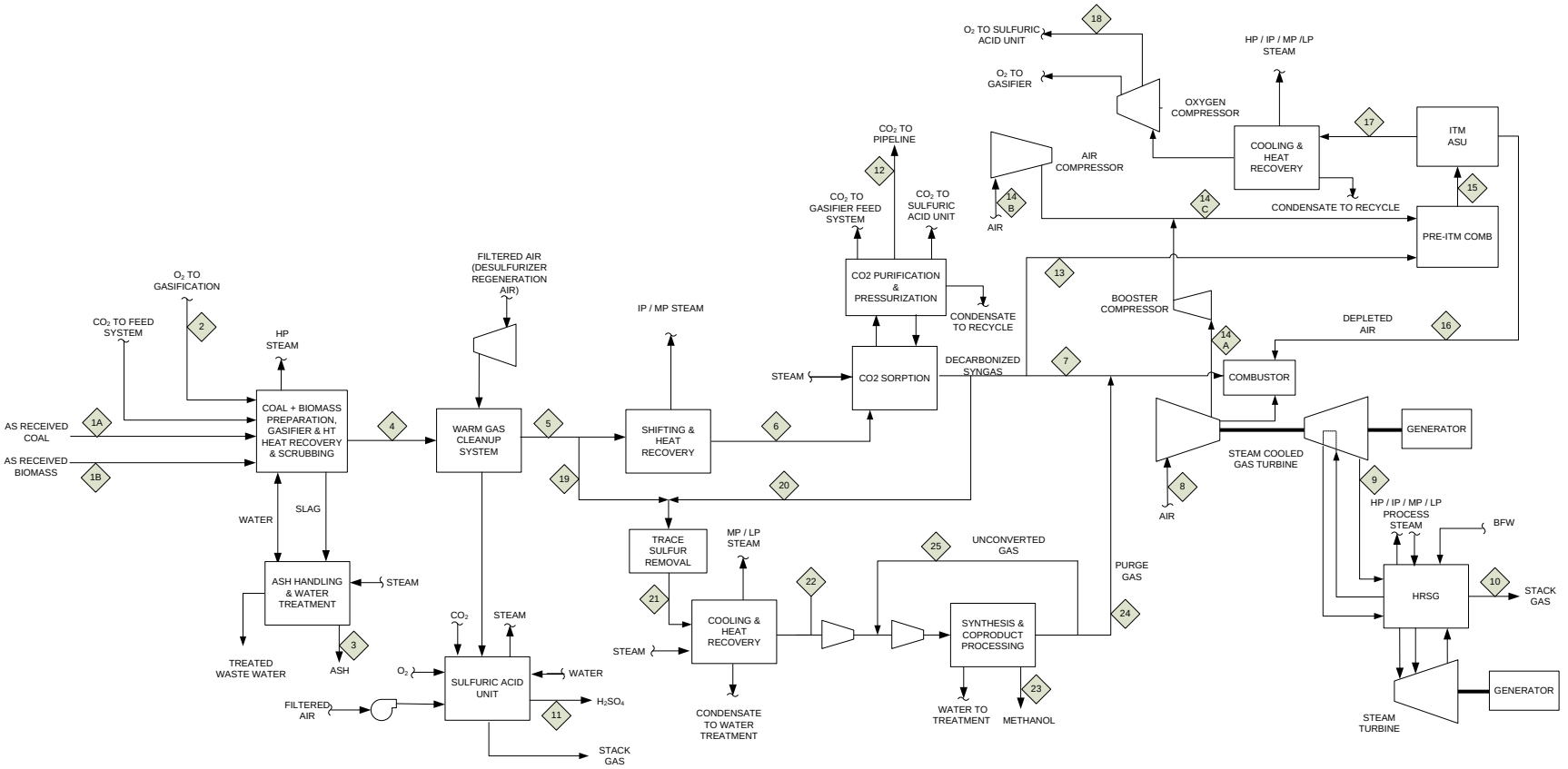


**Figure 3: Block Flow Diagram – IGCC with Methanol Coproduction and CCS**

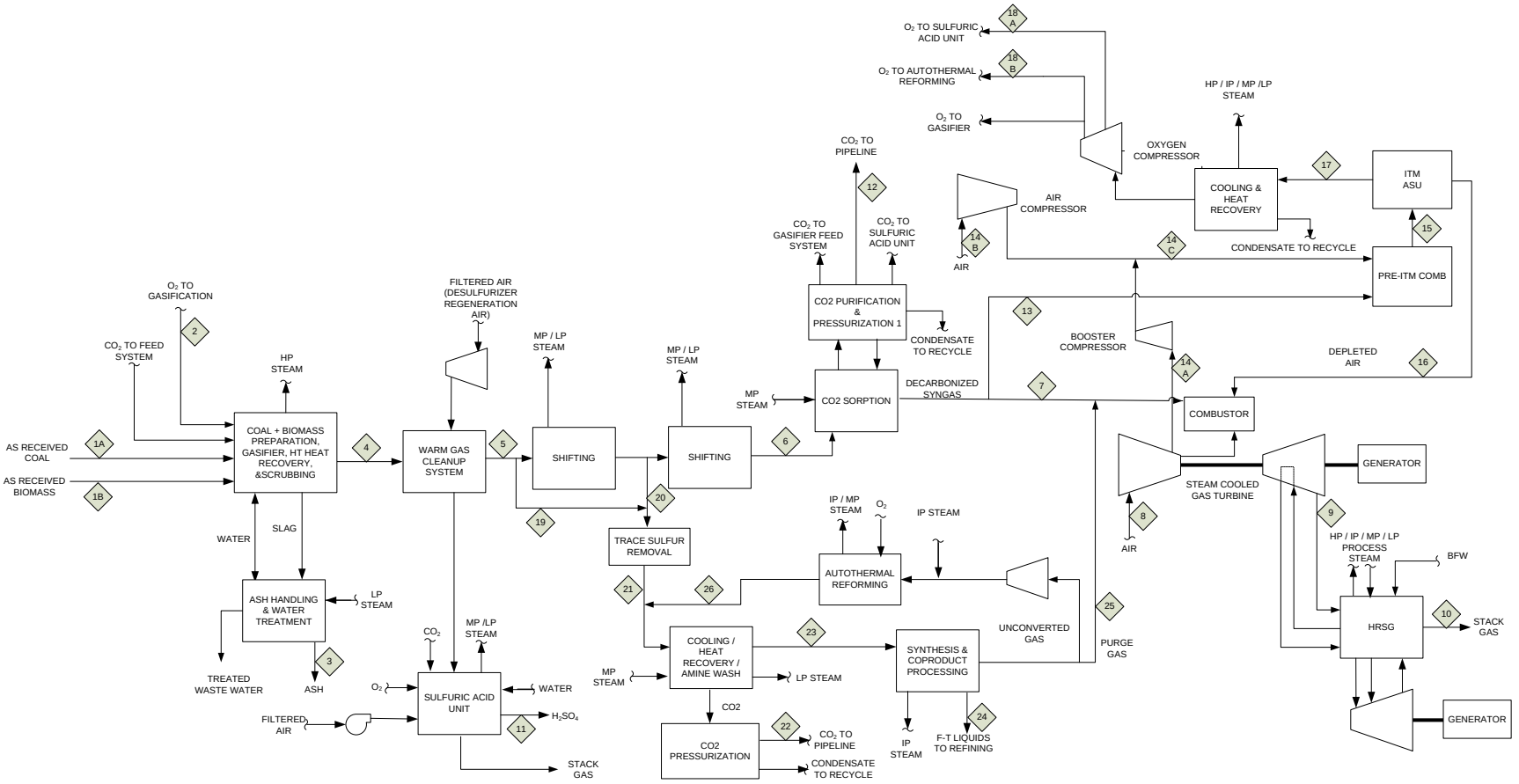


**Figure 4: Block Flow Diagram – IGCC with Fischer Tropsch Liquids Coproduction and CCS**

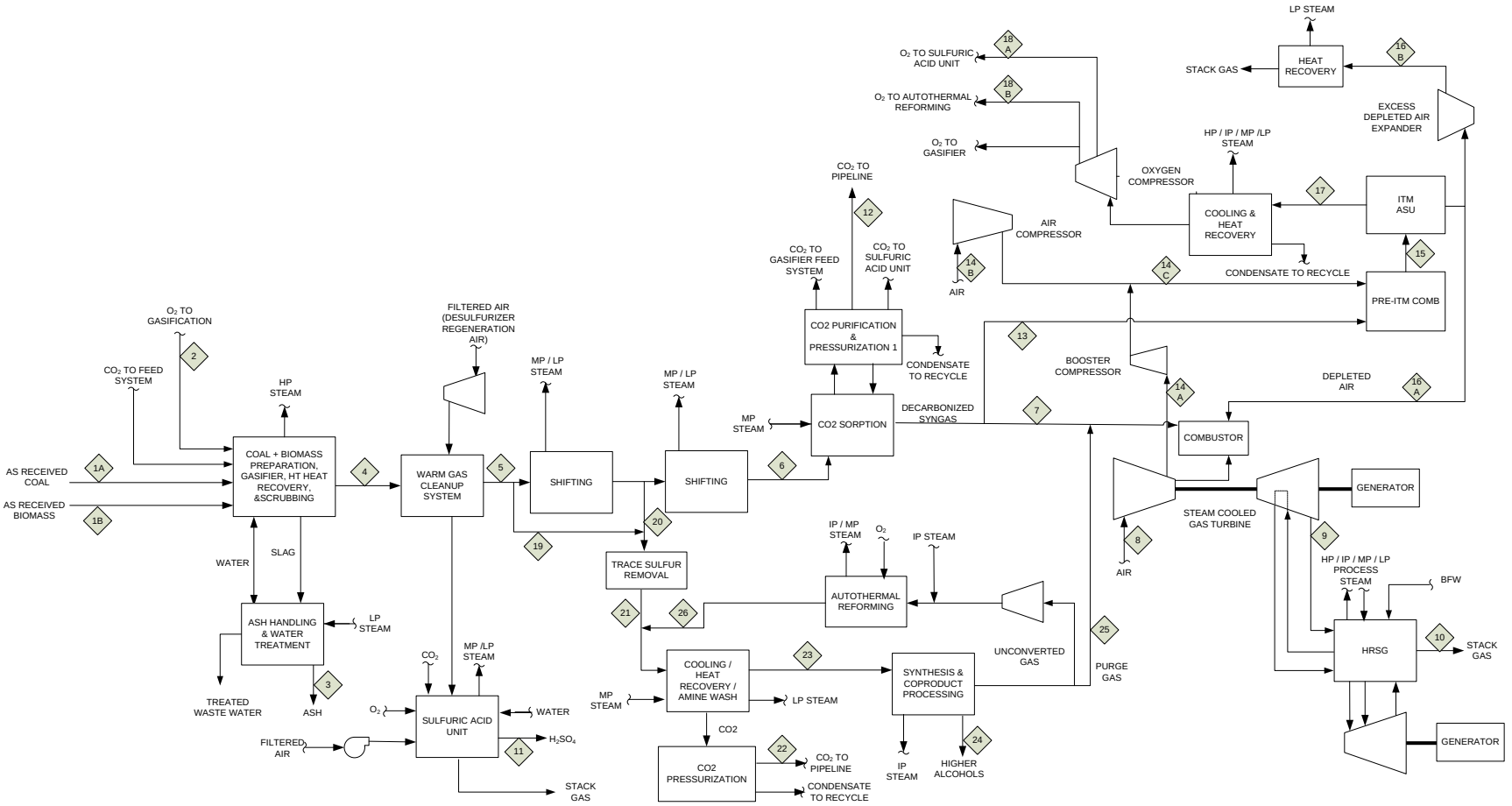


**Figure 5: Block Flow Diagram – IGCC with Higher Alcohols Coproduction and CCS**

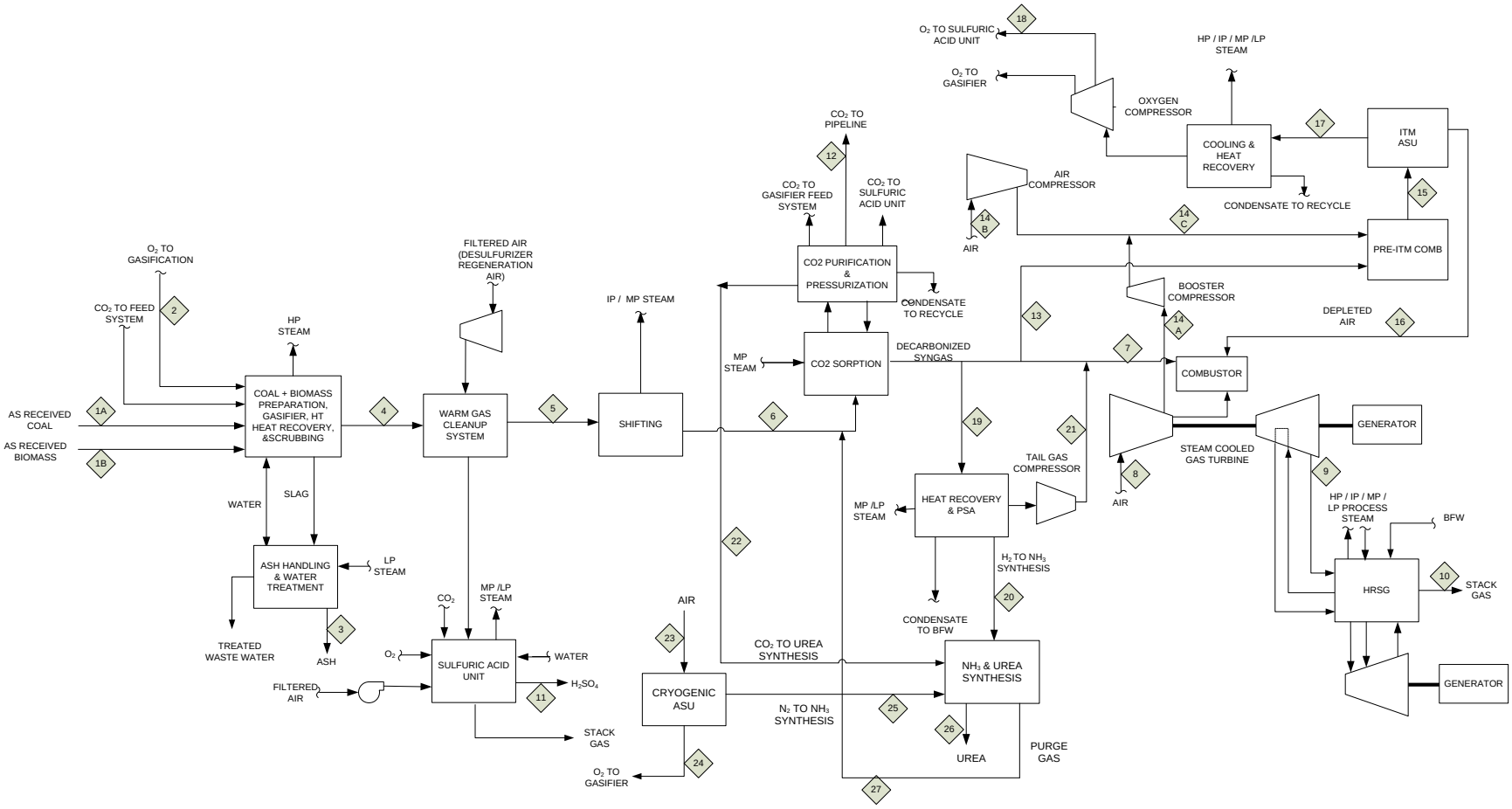


**Figure 6: Block Flow Diagram – IGCC with Urea Coproduction and CCS**

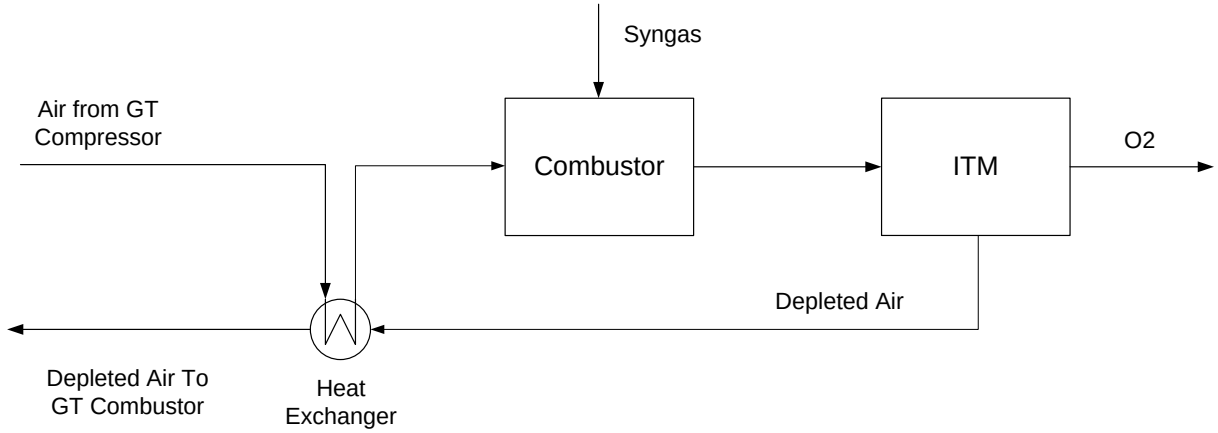


**Figure 7: Block Flow Diagram – ITM Integration for Case 1**

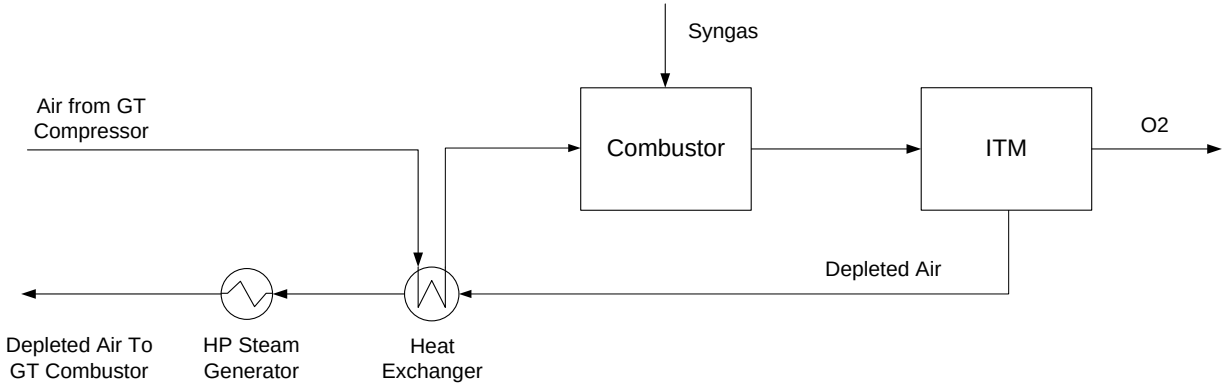


**Figure 8: Block Flow Diagram – ITM Integration for Case 2**

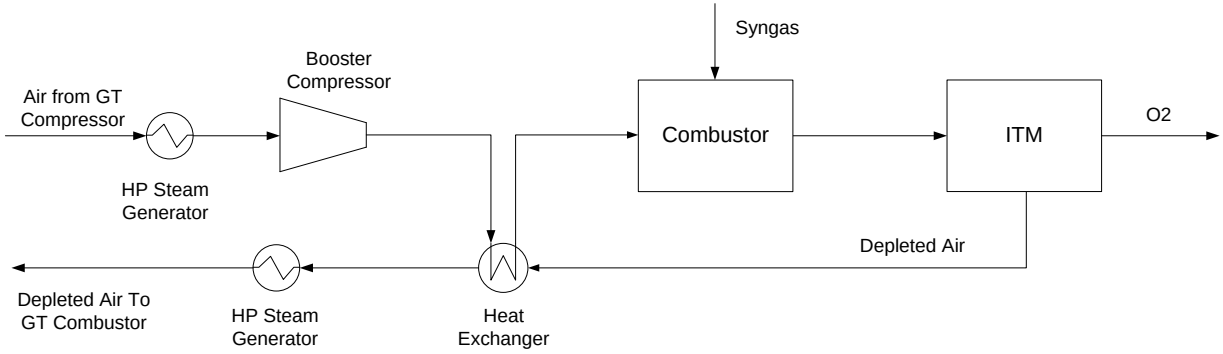


**Figure 9: Block Flow Diagram – ITM Integration for Case 3**

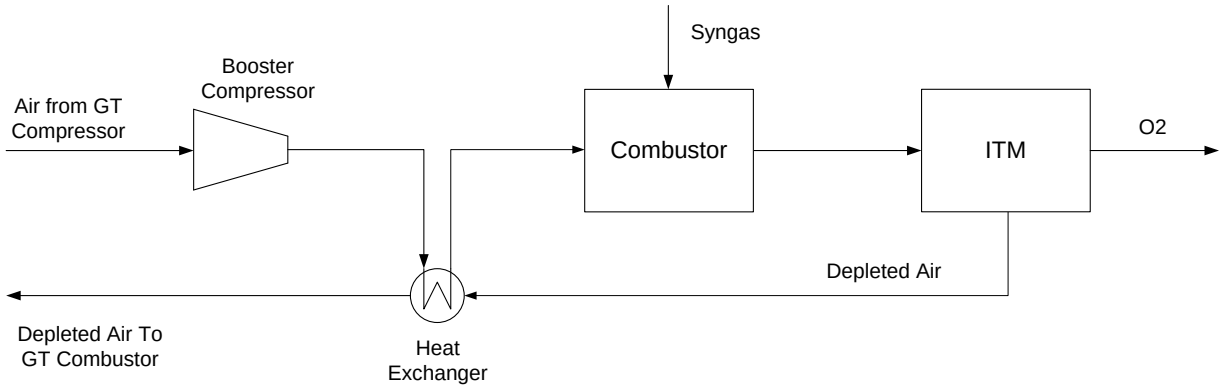


**Figure 10: Block Flow Diagram – ITM Integration for Case 4**

**Table 10: Impact of ITM and Gas Turbine Integration Concepts on Plant Heat Rate**

| | Case 0 (Cryogenic) | Case 1 (ITM) | Case 2 (ITM) | Case 3 (ITM) | Case 4 (ITM) |
|---|---|---|---|---|---|
| ITM Configuration | - | w/o HPS Producer | with HPS Producer | with HPS Producer | w/o HPS Producer |
| | - | w/o Booster Compressor | w/o Booster Compressor | with Booster Compressor | with Booster Compressor |
| Air Temperature to Booster Compressor, °C | - | - | - | 362 | 485.5 |
| Air and Depleted Air Mixture Temperature, °C | 485.5 | 548.8 | 485.6 | 485.5 | 550.0 |
| Decrease in Net Plant Heat Rate over Case 0, % | - | 3.374 | 2.588 | 2.944 | 4.013 |

## TASK 5.0 – DETAILED ANALYSES

Sensitivity analyses indicated that from a plant thermal efficiency standpoint, the purge from the synloop of the methanol as well as the Fischer Tropsch coproduction cases should be minimized, implying that once-through synthesis is not beneficial from a plant efficiency standpoint. When the purge rate becomes higher than a threshold amount, decarbonization of the purge gas is also required to limit the overall plant carbon emissions to the design value. This requires shifting and reforming in the case of F-T liquids coproduction. Since ITM technology is utilized for air separation, the inerts buildup due to reduction in purge rate is less significant than for a plant utilizing cryogenic air separation. The synthesis of the higher alcohols (ethanol) is similar to the Fischer Tropsch synthesis and thus the same configuration was utilized, i.e., with recycle and not a once through process.

Tables 11 and 12 summarize the plant performances for the bituminous and the lignite cases. The plant feed rates for each of the cases are determined to fully load the H class gas turbine (the General Electric Frame 7H machine was used as the basis for this study with its projected output on syngas determined in a previous study conducted by APEP/UCI for NETL/DoE) under the site specific ambient conditions. Thus the plant feed rates vary from case to case. In each of the coproduction cases, the ratio of electricity exported to the total energy exported (electrical + HHV of coproduct) is held at 50%. Tables 13 through 44 present the major stream data for each of the cases.

Thermal efficiencies for the electricity only cases with 90% carbon capture are 38.26% and 36.76% (HHV basis) with the bituminous and the lignite feedstocks respectively. For the coproduction cases (where 50% of the energy exported is in the form of electricity), the electrical efficiency, as expected, is highest for the hydrogen coproduction cases while lowest for the higher alcohols coproduction cases. The electrical efficiencies for Fischer-Tropsch coproduction cases are slightly higher than those for the methanol coproduction cases but it should be noted that the methanol (as well as the higher alcohol) coproduction cases produce the finished coproduct while the Fischer-Tropsch coproduction cases produce a coproduct that requires further processing in a refinery. The cross comparison of the thermal performance between the various coproduct cases is further complicated by the fact that the carbon footprint is not the same when carbon leaving with the coproduct are accounted for. The higher alcohols cases show a significantly lower efficiency than the methanol cases primarily due to the significantly lower per pass conversion to the alcohol, a large recycle rate, and the undesirable $CH_4$ and methanol formation side-reaction which requires autothermal reforming (and its $O_2$ demand) to get back $H_2$ and CO. The thermal efficiency and consequently the overall plant economics could be enhanced if the methanol is not recycled but purified and sold as an additional coproduct. The $CH_4$ could also be separated to meet substitute natural gas specifications to potentially enhance the plant economics, depending on the impact shale gas is having on natural gas prices.

The economic analysis and demand for a particular coproduct in the market place is a more meaningful comparison of the various coproduction scenarios. Tables 45 through 50 present the plant cost estimates and results of the economic analysis for all the cases. The 1$^{st}$ year levelized cost of electricity for the two Electricity Only (bituminous and lignite) cases were first developed using methodology described in the DoE/NETL Report 2010/1397, November 2010, “Cost and

Performance Baseline for Fossil Energy Plants Volume 1: Bituminous Coal and Natural Gas to Electricity." Next, the coproduct cost was selected for each of the coproduction cases such that the same 1st year levelized cost of electricity as the corresponding Electricity Only case (i.e., with the same coal) resulted.

The cost of the bituminous coal was obtained from DoE/NETL Report 2010/1397, November 2010 while the cost of the lignite was obtained from DOE/NETL Report 2010/1399, May 2011.

The cost of woody biomass was obtained from DOE/NETL Report 2012/1547, February 2012 by applying the cost correlation below with X = (1 – biomass moisture fraction) * (as received biomass feed) [ST per day]:

$$Hybrid\ Poplar\ Cost\ (\$/dry\ ST) = 1.136*10^{-11}*X^3 - 2.675*10^{-7}*X^2 + 3.153*10^{-3}*X + 116.2$$

The cost of switchgrass was obtained from DOE/NETL Report 2012/1546, February 2012 by applying the cost correlation below with X = switchgrass production rate, dry ST/day:

$$Switchgrass\ Cost\ (\$/dry\ ST) = 1.286*10^{-11}*X^3 - 3.028*10^{-7}*X^2 + 3.569*10^{-3}*X + 85.32$$

The costs of woody biomass and switchgrass were calculated by applying the above correlations to the production rate (biomass feed rate) of each case. The cost of woody biomass ranged from $120.08/dry ST to $120.97/dry ST, and the cost of switchgrass ranged from $89.89/dry ST to $91.02/dry ST. Due to the small variation in the cost for a given biomass, the respective costs were held constant as listed below.

The following summarizes the cost of the various feedstocks thus obtained:

- Bituminous coal = $38.18
- Lignite = $10.92
- Woody biomass = $120
- Switchgrass = $90

The first year cost of electricity calculated for the bituminous coal is $102.9/MWh while that for the lignite is $108.1/MWh. The calculated cost of hydrogen ranged from $1.42/kg to $2.77/kg depending on the feedstock, which is lower than the DOE announced hydrogen cost goal of $3.00/kg in July 14, 2005. Methanol cost ranged from $345/MT to $617/MT, while the market price is around $450/MT [ICISPring of Methanol, Jan 27, 2012]. For Fischer-Tropsch liquids, the calculated cost ranged from $65/bbl to $112/bbl, which is comparable to the current market price of crude oil at around $100/bbl [Crude Oil and Commodity Prices, July 30, 2012]. It should be noted, however, that F-T liquids contain no sulfur and nitrogen compounds. The calculated cost of alcohol ranged from $4.37/gal to $5.43/gal, while it ranged from $2.20/gal to $3.70/gal in a DOE funded study conducted by Louisiana State University [DOE Award: DE-FC26-06NT43024]. The Louisiana State University study consisted of a significantly larger plant than our study and benefited from economies of scale. When the plant size in our study is scaled up to similar size as in the Louisiana State University study, cost of alcohol is then reduced to a range of $3.24/gal to $4.28/gal, which is comparable. Urea cost ranged from $307/MT to $428/MT, while the market price is around $480/MT [Urea Monthly Price – US Dollars per MT.

Jun 2011 – Jun 2012]. In all cases, the coproduct cost was lowest for bituminous coal (only) fed plants and highest for plants cofed with lignite and the woody biomass.

# Table 11: Performance Summary of Bituminous Cases

| CASE DESIGNATION | | BOE | BOH | BWH | BGH | BOM | BWM | BGM | BOF | BWF | BGF | BOA | BWA | BGA | BOU | BWU | BGU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COFEED | | NONE | NONE | Woody Mass | Grass | NONE | Woody Mass | Grass | NONE | Woody Mass | Grass | NONE | Woody Mass | Grass | NONE | Woody Mass | Grass |
| COPRODUCT | UNITS | NONE | | Hydrogen | | | Methanol | | | F-T Liquids | | | Alcohol | | | Urea | |
| COAL FEED RATE | LB/HR (DRY | 271,000 | 391,532 | 291,176 | 306,302 | 377,922 | 286,274 | 300,434 | 358,238 | 268,911 | 281,284 | 387,760 | 290,738 | 301,820 | 424,386 | 319,122 | 337,806 |
| | KG/HR (DRY | 122,902 | 177,565 | 132,053 | 138,913 | 171,393 | 129,829 | 136,251 | 162,466 | 121,955 | 127,566 | 175,855 | 131,854 | 136,880 | 192,466 | 144,727 | 153,200 |
| | ST/D (DRY) | 3,252 | 4,698 | 3,494 | 3,676 | 4,535 | 3,435 | 3,605 | 4,299 | 3,227 | 3,375 | 4,653 | 3,489 | 3,622 | 5,093 | 3,829 | 4,054 |
| | MT/D (DRY) | 2,950 | 4,262 | 3,170 | 3,334 | 4,114 | 3,116 | 3,271 | 3,900 | 2,927 | 3,062 | 4,221 | 3,165 | 3,286 | 4,620 | 3,474 | 3,677 |
| GRASS FEED RATE | LB/HR (DRY | - | - | - | 131,272 | - | - | 128,757 | - | - | 120,550 | - | - | 129,352 | - | - | 144,774 |
| | KG/HR (DRY | - | - | - | 59,534 | - | - | 58,393 | - | - | 54,671 | - | - | 58,663 | - | - | 65,657 |
| | ST/D (DRY) | - | - | - | 1,575 | - | - | 1,545 | - | - | 1,447 | - | - | 1,552 | - | - | 1,737 |
| | MT/D (DRY) | - | - | - | 1,429 | - | - | 1,402 | - | - | 1,312 | - | - | 1,408 | - | - | 1,576 |
| WOOD FEED RATE | LB/HR (DRY | - | - | 124,790 | - | - | 122,689 | - | - | 115,247 | - | - | 124,602 | - | - | 136,767 | - |
| | KG/HR (DRY | - | - | 56,594 | - | - | 55,641 | - | - | 52,266 | - | - | 56,509 | - | - | 62,026 | - |
| | ST/D (DRY) | - | - | 1,497 | - | - | 1,472 | - | - | 1,383 | - | - | 1,495 | - | - | 1,641 | - |
| | MT/D (DRY) | - | - | 1,358 | - | - | 1,336 | - | - | 1,255 | - | - | 1,356 | - | - | 1,489 | - |
| TOTAL HHV INPUT | MMBTU/HR | 3,557 | 5,139 | 4,875 | 5,043 | 4,961 | 4,793 | 4,946 | 4,702 | 4,502 | 4,631 | 5,090 | 4,868 | 4,969 | 5,570 | 5,343 | 5,561 |
| | GJ/HR | 3,753 | 5,422 | 5,143 | 5,320 | 5,234 | 5,057 | 5,218 | 4,961 | 4,750 | 4,886 | 5,370 | 5,136 | 5,243 | 5,877 | 5,637 | 5,868 |
| GAS TURBINE POWER OUTPUT | KW | 318,000 | 318,000 | 318,000 | 318,000 | 318,000 | 318,000 | 318,000 | 318,000 | 318,000 | 318,000 | 318,000 | 318,000 | 318,000 | 318,000 | 318,000 | 318,000 |
| STEAM TURBINE POWER OUTPU | KW | 147,382 | 162,653 | 159,346 | 165,137 | 126,441 | 127,187 | 130,773 | 163,785 | 162,150 | 166,963 | 122,087 | 126,163 | 126,491 | 160,810 | 160,498 | 167,627 |
| TOTAL GROSS POWER OUTPUT | KW | 465,382 | 480,653 | 477,346 | 483,137 | 444,441 | 445,187 | 448,773 | 481,785 | 480,150 | 484,963 | 440,087 | 444,163 | 444,491 | 478,810 | 478,498 | 485,627 |
| TOTAL AUXILIARY CONSUMPTIO | KW | 66,550 | 103,344 | 129,342 | 110,652 | 109,420 | 131,743 | 111,522 | 155,865 | 175,525 | 159,926 | 216,684 | 231,364 | 221,944 | 135,472 | 156,967 | 138,544 |
| TOTAL NET POWER OUTPUT | KW | 398,833 | 377,310 | 348,004 | 372,484 | 335,021 | 313,444 | 337,250 | 325,920 | 304,625 | 325,037 | 223,402 | 212,800 | 222,547 | 343,339 | 321,530 | 347,083 |
| NET POWER EFFICIENCY, HHV | % | 38.26 | 25.05 | 24.36 | 25.20 | 23.04 | 22.31 | 23.27 | 23.65 | 23.09 | 23.95 | 14.98 | 14.92 | 15.28 | 21.03 | 20.53 | 21.29 |
| NET POWER HEAT RATE | BTU/KWH | 8,919 | 13,621 | 14,008 | 13,538 | 14,807 | 15,291 | 14,666 | 14,428 | 14,779 | 14,247 | 22,783 | 22,874 | 22,328 | 16,224 | 16,617 | 16,023 |
| | KJ/KWH | 9,410 | 14,371 | 14,780 | 14,283 | 15,622 | 16,133 | 15,474 | 15,222 | 15,593 | 15,032 | 24,037 | 24,134 | 23,557 | 17,118 | 17,532 | 16,905 |
| COPRODUCT PRODUCED | ST/D | - | 253 | 233 | 250 | 1,318 | 1,242 | 1,336 | 663 | 617 | 654 | 695 | 654 | 685 | 3,103 | 2,887 | 3,096 |
| | MT/D | - | 229 | 211 | 226 | 1,196 | 1,126 | 1,212 | 601 | 560 | 593 | 630 | 593 | 621 | 2,815 | 2,619 | 2,808 |
| COPRODUCT HHV | MMBTU/HR | - | 1,286 | 1,187 | 1,271 | 1,127 | 1,061 | 1,142 | 1,112 | 1,035 | 1,097 | 762 | 718 | 751 | 1,170 | 1,089 | 1,167 |
| | 10^6 KJ/H | - | 1,357 | 1,252 | 1,341 | 1,189 | 1,120 | 1,205 | 1,173 | 1,092 | 1,157 | 804 | 757 | 792 | 1,235 | 1,149 | 1,232 |
| ELECTRICITY / TOTAL ENERGY C | % | 100 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| CARBON CAPTURED | % | 90.0 | 90.0 | 80.0 | 80.0 | 90.0 | 80.0 | 80.0 | 90.0 | 80.0 | 80.0 | 90.0 | 80.0 | 80.0 | 90.0 | 80.0 | 80.0 |
| CONDENSER COOLING DUTY | MMBTU/HR | 650.23 | 730.96 | 718.64 | 755.16 | 316.27 | 334.71 | 350.50 | 849.41 | 836.49 | 873.44 | 391.80 | 430.42 | 432.92 | 713.76 | 757.28 | 805.25 |
| | 10^6 KJ/H | 686.03 | 771.21 | 758.21 | 796.74 | 333.69 | 353.13 | 369.80 | 896.18 | 882.55 | 921.52 | 413.37 | 454.11 | 456.76 | 753.06 | 717.77 | 763.23 |
| RAW WATER USE | GPM | 3,483 | 4,508 | 4,114 | 4,205 | 4,123 | 3,833 | 3,869 | 4,955 | 4,575 | 4,644 | 5,298 | 4,901 | 4,940 | 6,408 | 5,945 | 6,191 |
| | M^3/MIN | 13.18 | 17.06 | 15.57 | 15.92 | 15.60 | 14.51 | 14.64 | 18.75 | 17.32 | 17.58 | 20.05 | 18.55 | 18.70 | 24.25 | 22.50 | 23.43 |

## Table 12: Performance Summary of Lignite Cases

| CASE DESIGNATION | | LOE | LOH | LWH | LGH | LOM | LWM | LGM | LOF | LWF | LGF | LOA | LWA | LGA | LOU | LWU | LGU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COFEED | | NONE | NONE | Woody Mass | Grass | NONE | Woody Mass | Grass | NONE | Woody Mass | Grass | NONE | Woody Mass | Grass | NONE | Woody Mass | Grass |
| COPRODUCT | UNITS | NONE | Hydrogen | | | Methanol | | | F-T Liquids | | | Alcohol | | | Urea | | |
| COAL FEED RATE | LB/HR (DRY | 332,584 | 437,223 | 313,862 | 331,954 | 423,890 | 308,822 | 326,270 | 407,449 | 293,908 | 309,719 | 447,790 | 321,318 | 335,454 | 477,369 | 341,042 | 363,928 |
| | KG/HR (DRY | 150,832 | 198,287 | 142,341 | 150,546 | 192,241 | 140,055 | 147,968 | 184,784 | 133,292 | 140,462 | 203,080 | 145,722 | 152,134 | 216,494 | 154,668 | 165,047 |
| | ST/D (DRY) | 3,991 | 5,247 | 3,766 | 3,983 | 5,087 | 3,706 | 3,915 | 4,889 | 3,527 | 3,717 | 5,373 | 3,856 | 4,025 | 5,728 | 4,093 | 4,367 |
| | MT/D (DRY) | 3,621 | 4,760 | 3,417 | 3,614 | 4,615 | 3,362 | 3,552 | 4,436 | 3,200 | 3,372 | 4,875 | 3,498 | 3,652 | 5,197 | 3,713 | 3,962 |
| GRASS FEED RATE | LB/HR (DRY | - | - | - | 142,266 | - | - | 139,830 | - | - | 132,737 | - | - | 143,766 | - | - | 155,969 |
| | KG/HR (DRY | - | - | - | 64,520 | - | - | 63,415 | - | - | 60,198 | - | - | 65,200 | - | - | 70,734 |
| | ST/D (DRY) | - | - | - | 1,707 | - | - | 1,678 | - | - | 1,593 | - | - | 1,725 | - | - | 1,872 |
| | MT/D (DRY) | - | - | - | 1,549 | - | - | 1,522 | - | - | 1,445 | - | - | 1,565 | - | - | 1,698 |
| WOOD FEED RATE | LB/HR (DRY | - | - | 134,512 | - | - | 132,352 | - | - | 125,961 | - | - | 137,708 | - | - | 146,161 | - |
| | KG/HR (DRY | - | - | 61,003 | - | - | 60,024 | - | - | 57,125 | - | - | 62,452 | - | - | 66,286 | - |
| | ST/D (DRY) | - | - | 1,614 | - | - | 1,588 | - | - | 1,512 | - | - | 1,652 | - | - | 1,754 | - |
| | MT/D (DRY) | - | - | 1,464 | - | - | 1,441 | - | - | 1,371 | - | - | 1,499 | - | - | 1,591 | - |
| TOTAL HHV INPUT | MMBTU/HR | 3,468 | 4,559 | 4,408 | 4,569 | 4,420 | 4,337 | 4,491 | 4,248 | 4,127 | 4,263 | 4,669 | 4,512 | 4,617 | 4,978 | 4,789 | 5,009 |
| | GJ/HR | 3,659 | 4,810 | 4,650 | 4,821 | 4,663 | 4,576 | 4,738 | 4,482 | 4,355 | 4,498 | 4,926 | 4,761 | 4,871 | 5,252 | 5,053 | 5,285 |
| GAS TURBINE POWER OUTPUT | KW | 312,928 | 312,928 | 312,928 | 312,928 | 312,928 | 312,928 | 312,928 | 312,928 | 312,928 | 312,928 | 312,928 | 312,928 | 312,928 | 312,928 | 312,928 | 312,928 |
| STEAM TURBINE POWER OUTPU | KW | 140,679 | 143,166 | 143,595 | 149,308 | 107,468 | 110,846 | 115,170 | 147,326 | 148,836 | 154,071 | 117,896 | 121,321 | 120,758 | 140,496 | 142,275 | 147,743 |
| TOTAL GROSS POWER OUTPUT | KW | 453,607 | 456,094 | 456,523 | 462,236 | 420,396 | 423,774 | 428,098 | 460,254 | 461,764 | 466,999 | 430,824 | 434,249 | 433,686 | 453,424 | 455,203 | 460,671 |
| TOTAL AUXILIARY CONSUMPTIO | KW | 80,057 | 137,330 | 154,607 | 136,110 | 140,394 | 155,940 | 137,560 | 180,516 | 195,164 | 179,200 | 224,241 | 237,106 | 225,758 | 158,611 | 175,733 | 158,440 |
| TOTAL NET POWER OUTPUT | KW | 373,550 | 318,764 | 301,916 | 326,126 | 280,001 | 267,834 | 290,538 | 279,738 | 266,600 | 287,798 | 206,583 | 197,143 | 207,928 | 294,814 | 279,470 | 302,231 |
| NET POWER EFFICIENCY, HHV | % | 36.76 | 23.86 | 23.37 | 24.36 | 21.62 | 21.07 | 22.08 | 22.47 | 22.04 | 23.04 | 15.10 | 14.91 | 15.37 | 20.21 | 19.91 | 20.59 |
| NET POWER HEAT RATE | BTU/KWH | 9,284 | 14,302 | 14,599 | 14,010 | 15,785 | 16,192 | 15,457 | 15,187 | 15,482 | 14,813 | 22,602 | 22,889 | 22,206 | 16,884 | 17,137 | 16,574 |
| | KJ/KWH | 9,795 | 15,089 | 15,403 | 14,782 | 16,654 | 17,084 | 16,308 | 16,023 | 16,334 | 15,628 | 23,846 | 24,149 | 23,429 | 17,813 | 18,081 | 17,487 |
| COPRODUCT PRODUCED | ST/D | - | 214 | 202 | 219 | 1,102 | 1,060 | 1,143 | 569 | 542 | 583 | 643 | 613 | 646 | 2,668 | 2,501 | 2,730 |
| | MT/D | - | 194 | 183 | 198 | 1,000 | 961 | 1,037 | 516 | 491 | 529 | 583 | 556 | 586 | 2,420 | 2,268 | 2,476 |
| COPRODUCT HHV | MMBTU/HR | - | 1,088 | 1,029 | 1,113 | 942 | 906 | 977 | 955 | 909 | 979 | 705 | 673 | 709 | 1,006 | 943 | 1,029 |
| | 10^6 KJ/H | - | 1,148 | 1,086 | 1,174 | 994 | 956 | 1,031 | 1,007 | 959 | 1,032 | 744 | 710 | 748 | 1,061 | 995 | 1,086 |
| ELECTRICITY / TOTAL ENERGY C | % | 100 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| CARBON CAPTURED | % | 90.0 | 90.0 | 80.0 | 80.0 | 90.0 | 80.0 | 80.0 | 90.0 | 80.0 | 80.0 | 90.0 | 80.0 | 80.0 | 90.0 | 80.0 | 80.0 |
| CONDENSER COOLING DUTY | MMBTU/HR | 594.06 | 609.82 | 617.11 | 653.94 | 220.91 | 251.58 | 271.29 | 715.65 | 726.63 | 765.44 | 369.66 | 399.86 | 393.80 | 576.38 | 630.51 | 667.52 |
| | 10^6 KJ/H | 626.77 | 643.40 | 651.08 | 689.94 | 233.07 | 265.43 | 286.22 | 755.05 | 766.63 | 807.58 | 390.02 | 421.88 | 415.49 | 608.11 | 597.61 | 632.68 |
| RAW WATER USE | GPM | 3,409 | 4,071 | 3,740 | 3,817 | 3,764 | 3,520 | 3,586 | 4,451 | 4,160 | 4,219 | 4,837 | 4,495 | 4,500 | 5,624 | 5,214 | 5,443 |
| | M^3/MIN | 12.90 | 15.41 | 14.16 | 14.45 | 14.25 | 13.32 | 13.57 | 16.85 | 15.74 | 15.97 | 18.31 | 17.01 | 17.03 | 21.29 | 19.74 | 20.60 |

## Table 13: Stream data for BOE Case

(Refer to Figure 1 for stream numbers)

| | As Received Coal | As Received Biomass | Oxygen to Gasifier | Ash | Raw Syngas | Sulfur Removal Outlet | WGS Outlet | Syngas to GT Combustor | GT Air Inlet | GT Outlet | HRSG Outlet | H2SO4 Product | CO2 Product | Syngas to Pre-ITM Combustor | Extracted GT Air | Air to ITM Unit | Depleted Air | Oxygen from ITM Unit | Oxygen to H2SO4 Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Number | 1A | 1B | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| Temperature, C | 15 | | 86 | 60 | 189.4 | 249.2 | 232.2 | 252.1 | 15 | 579.4 | 156 | 20 | 34.4 | 252.1 | 485.5 | 850 | 678 | 850 | 19.4 |
| Pressure, bar | 1.014 | | 51.021 | 1.014 | 40.679 | 38.128 | 35.715 | 34.819 | 1.014 | 1.04 | 0.983 | 1.014 | 152.698 | 34.819 | 24.4 | 25.145 | 24.4 | 1.279 | 8.584 |
| Solids, kg/hr | 122923 | | 0 | 10786 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vapor Frac (w/o Solids) | 0 | | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| kmol/hr (w/o Solids) | 854 | | 3053 | 0 | 17775 | 17774 | 25036 | 16390 | 68740 | 77682 | 77682 | 111 | 6419 | 1097 | 23106 | 23863 | 20747 | 3115 | 62 |
| kg/hr (w/o Solids) | 15379 | | 97696 | 0 | 342884 | 341120 | 471949 | 150181 | 1983122 | 2043682 | 2043682 | 10637 | 282516 | 10051 | 666609 | 676661 | 576982 | 99679 | 1980 |
| Mole Frac (w/o Solids) | | | | | | | | | | | | | | | | | | | |
| O2 | 0.00% | | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 7.40% | 7.40% | 0.00% | 0.00% | 0.00% | 20.80% | 18.70% | 6.50% | 100.00% | 100.00% |
| N2 | 0.00% | | 0.00% | 0.00% | 0.30% | 0.30% | 0.20% | 0.30% | 77.20% | 68.40% | 68.40% | 0.00% | 0.00% | 0.30% | 77.20% | 74.80% | 86.00% | 0.00% | 0.00% |
| AR | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% | 0.80% | 0.80% | 0.00% | 0.00% | 0.00% | 0.90% | 0.90% | 1.00% | 0.00% | 0.00% |
| H2 | 0.00% | | 0.00% | 0.00% | 23.70% | 23.70% | 42.40% | 60.70% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 60.70% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CO | 0.00% | | 0.00% | 0.00% | 37.40% | 37.40% | 0.90% | 1.30% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.30% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CO2 | 0.00% | | 0.00% | 0.00% | 4.60% | 4.60% | 28.90% | 2.70% | 0.00% | 0.90% | 0.90% | 0.00% | 100.00% | 2.70% | 0.00% | 0.20% | 0.20% | 0.00% | 0.00% |
| H2O | 100.00% | | 0.00% | 0.00% | 33.40% | 33.90% | 27.50% | 34.90% | 1.10% | 22.50% | 22.50% | 3.10% | 0.00% | 34.90% | 1.10% | 5.40% | 6.30% | 0.00% | 0.00% |
| CH4 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2S | 0.00% | | 0.00% | 0.00% | 0.60% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| NH3 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| COS | 0.00% | | 0.00% | 0.00% | 0.10% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CARBON | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SULFUR | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CL2 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCL | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCN | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SO2 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C2H6 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C3H8 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| S2 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2SO4 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 96.90% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

## Table 14: Stream data for LOE Case

(Refer to Figure 1 for stream numbers)

| | As Received Coal | As Received Biomass | Oxygen to Gasifier | Ash | Raw Syngas | Sulfur Removal Outlet | WGS Outlet | Syngas to GT Combustor | GT Air Inlet | GT Outlet | HRSG Outlet | H2SO4 Product | CO2 Product | Syngas to Pre-ITM Combustor | Extracted GT Air | Air to ITM Unit | Depleted Air | Oxygen from ITM Unit | Oxygen to H2SO4 Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Number | 1A | 1B | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| Temperature, C | 15 | | 74.6 | 60 | 191.1 | 216.1 | 232.2 | 253.5 | 4.4 | 569 | 153.2 | 20 | 34.4 | 253.5 | 473.7 | 849.9 | 678 | 849.9 | 10 |
| Pressure, bar | 1.014 | | 51.021 | 1.014 | 40.679 | 38.128 | 35.715 | 34.819 | 0.951 | 0.978 | 0.921 | 1.014 | 152.698 | 34.819 | 24.4 | 25.145 | 24.4 | 1.274 | 8.584 |
| Solids, kg/hr | 150858 | | 0 | 18485 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vapor Frac (w/o Solids) | 0 | | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| kmol/hr (w/o Solids) | 4727 | | 3292 | 0 | 17703 | 17701 | 25419 | 16068 | 65153 | 73935 | 73935 | 48 | 6907 | 1273 | 24648 | 25536 | 22219 | 3317 | 27 |
| kg/hr (w/o Solids) | 85152 | | 105330 | 0 | 358650 | 357887 | 496931 | 152568 | 1882737 | 1941252 | 1941252 | 4550 | 303995 | 12089 | 712252 | 724341 | 618188 | 106153 | 849 |
| Mole Frac (w/o Solids) | | | | | | | | | | | | | | | | | | | |
| O2 | 0.00% | | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 6.80% | 6.80% | 0.00% | 0.00% | 0.00% | 20.80% | 18.60% | 6.40% | 100.00% | 100.00% |
| N2 | 0.00% | | 0.00% | 0.00% | 0.30% | 0.30% | 0.20% | 0.30% | 77.60% | 68.50% | 68.50% | 0.00% | 0.00% | 0.30% | 77.60% | 74.90% | 86.10% | 0.00% | 0.00% |
| AR | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% | 0.80% | 0.80% | 0.00% | 0.00% | 0.00% | 0.90% | 0.90% | 1.00% | 0.00% | 0.00% |
| H2 | 0.00% | | 0.00% | 0.00% | 20.00% | 20.00% | 40.30% | 59.10% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 59.10% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CO | 0.00% | | 0.00% | 0.00% | 39.20% | 39.20% | 0.90% | 1.30% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.30% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CO2 | 0.00% | | 0.00% | 0.00% | 5.60% | 5.60% | 30.30% | 3.00% | 0.00% | 1.00% | 1.00% | 0.00% | 100.00% | 3.00% | 0.00% | 0.20% | 0.30% | 0.00% | 0.00% |
| H2O | 100.00% | | 0.00% | 0.00% | 34.60% | 34.90% | 28.20% | 36.30% | 0.60% | 22.90% | 22.90% | 4.60% | 0.00% | 36.30% | 0.60% | 5.40% | 6.20% | 0.00% | 0.00% |
| CH4 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2S | 0.00% | | 0.00% | 0.00% | 0.20% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| NH3 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| COS | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CARBON | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SULFUR | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CL2 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCL | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCN | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SO2 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C2H6 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C3H8 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| S2 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2SO4 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 95.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

## Table 15: Stream data for BOH Case

(Refer to Figure 2 for stream numbers)

| | As Received Coal | As Received Biomass | Oxygen to Gasifier | Ash | Raw Syngas | Sulfur Removal Outlet | WGS Outlet | Syngas to GT Combustor | GT Air Inlet | GT Outlet | HRSG Outlet | H2SO4 Product | CO2 Product | Syngas to Pre-ITM Combustor | Extracted GT Air | Extral Air Compressor Inlet | Air to Pre-ITM Combustor | Air to ITM Unit | Depleted Air | Oxygen from ITM Unit | Oxygen to H2SO4 Unit | Syngas to H2 Recovery | H2 Product | Tail Gas from H2 Recovery |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Number | 1A | 1B | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14A | 14B | 14C | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| Temperature, C | 15 | | 86 | 60 | 189.4 | 249.2 | 232.2 | 243.7 | 15 | 579.2 | 153.3 | 20 | 34.4 | 252.1 | 485.5 | 14.999998 | 498.73089 | 849.9 | 678 | 849.9 | 19.4 | 252.1 | 14.5 | 146.1 |
| Pressure, bar | 1.014 | | 51.021 | 1.014 | 40.679 | 38.128 | 35.715 | 34.819 | 1.014 | 1.04 | 0.983 | 1.014 | 152.698 | 34.819 | 24.4 | 1.01352932 | 25.696318 | 25.145 | 24.4 | 1.28 | 8.584 | 34.819 | 33.233 | 44.106 |
| Solids, kg/hr | 177596 | | 0 | 15583 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vapor Frac (w/o Solids) | 0 | | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| kmol/hr (w/o Solids) | 1233 | | 4411 | 0 | 25680 | 25677 | 36171 | 15827 | 69674 | 78188 | 78188 | 161 | 9265 | 1578 | 32273 | 1101 | 33375 | 34463 | 29962 | 4501 | 89 | 9081 | 4706 | 1212 |
| kg/hr (w/o Solids) | 22219 | | 141148 | 0 | 495362 | 492814 | 681856 | 150908 | 2010097 | 2063225 | 2063225 | 15367 | 407752 | 14477 | 931079 | 31768 | 962853 | 977330 | 833298 | 144032 | 2862 | 83332 | 9549 | 16788 |
| Mole Frac (w/o Solids) | | | | | | | | | | | | | | | | | | | | | | | | |
| O2 | 0.00% | | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 6.00% | 6.00% | 0.00% | 0.00% | 0.00% | 20.80% | 20.76% | 20.76% | 18.70% | 6.50% | 100.00% | 100.00% | 0.00% | 0.00% | 0.00% |
| N2 | 0.00% | | 0.00% | 0.00% | 0.30% | 0.30% | 0.20% | 0.50% | 77.20% | 70.00% | 70.00% | 0.00% | 0.00% | 0.30% | 77.20% | 77.19% | 77.19% | 74.80% | 86.00% | 0.00% | 0.00% | 0.30% | 0.10% | 2.30% |
| AR | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% | 0.90% | 0.90% | 0.00% | 0.00% | 0.00% | 0.90% | 0.94% | 0.94% | 0.90% | 1.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2 | 0.00% | | 0.00% | 0.00% | 23.70% | 23.70% | 42.40% | 61.20% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 60.70% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 60.70% | 99.90% | 66.90% |
| CO | 0.00% | | 0.00% | 0.00% | 37.40% | 37.40% | 0.90% | 2.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.30% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.30% | 0.00% | 10.10% |
| CO2 | 0.00% | | 0.00% | 0.00% | 4.60% | 4.60% | 28.90% | 4.10% | 0.00% | 1.30% | 1.30% | 0.00% | 100.00% | 2.70% | 0.00% | 0.03% | 0.03% | 0.20% | 0.20% | 0.00% | 0.00% | 2.70% | 0.00% | 20.40% |
| H2O | 100.00% | | 0.00% | 0.00% | 33.40% | 33.90% | 27.50% | 32.20% | 1.10% | 21.80% | 21.80% | 3.10% | 0.00% | 34.90% | 1.10% | 1.08% | 1.08% | 5.40% | 6.20% | 0.00% | 0.00% | 34.90% | 0.00% | 0.20% |
| CH4 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% |
| H2S | 0.00% | | 0.00% | 0.00% | 0.60% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| NH3 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| COS | 0.00% | | 0.00% | 0.00% | 0.10% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CARBON | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SULFUR | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CL2 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCL | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCN | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SO2 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C2H6 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C3H8 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| S2 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2SO4 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 96.90% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

## Table 16: Stream data for BWH Case

(Refer to Figure 2 for stream numbers)

| | As Received Coal | As Received Biomass | Oxygen to Gasifier | Ash | Raw Syngas | Sulfur Removal Outlet | WGS Outlet | Syngas to GT Combustor | GT Air Inlet | GT Outlet | HRSG Outlet | H2SO4 Product | CO2 Product | Syngas to Pre-ITM Combustor | Extracted GT Air | Extral Air Compressor Inlet | Air to Pre-ITM Combustor | Air to ITM Unit | Depleted Air | Oxygen from ITM Unit | Oxygen to H2SO4 Unit | Syngas to H2 Recovery | H2 Product | Tail Gas from H2 Recovery |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Number | 1A | 1B | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14A | 14B | 14C | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| Temperature, C | 15 | 15 | 86 | 60 | 189.1 | 236.3 | 232.2 | 239 | 15 | 588.8 | 152.1 | 20 | 34.4 | 248 | 485.5 | 14.999998 | 501.92307 | 850.1 | 678 | 850.1 | 19.4 | 248 | 14.5 | 134.2 |
| Pressure, bar | 1.014 | 1.014 | 51.021 | 1.014 | 40.679 | 38.128 | 35.715 | 34.819 | 1.014 | 1.04 | 0.983 | 1.014 | 152.698 | 34.819 | 24.4 | 1.01352932 | 25.696318 | 25.145 | 24.4 | 1.277 | 8.584 | 34.819 | 33.233 | 44.106 |
| Solids, kg/hr | 132075 | 56604 | 0 | 12313 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vapor Frac (w/o Solids) | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| kmol/hr (w/o Solids) | 917 | 3142 | 4257 | 0 | 24205 | 24203 | 34738 | 16409 | 59448 | 72425 | 72425 | 120 | 8074 | 1594 | 27536 | 4513 | 32049 | 33176 | 28852 | 4324 | 67 | 8304 | 4342 | 1121 |
| kg/hr (w/o Solids) | 16524 | 56604 | 136227 | 0 | 476581 | 474674 | 664476 | 193863 | 1715049 | 1917910 | 1917910 | 11485 | 355352 | 17156 | 794414 | 130191 | 924605 | 941761 | 803406 | 138355 | 2143 | 89352 | 8812 | 29361 |
| Mole Frac (w/o Solids) | | | | | | | | | | | | | | | | | | | | | | | | |
| O2 | 0.00% | 0.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 5.20% | 5.20% | 0.00% | 0.00% | 0.00% | 20.80% | 20.76% | 20.76% | 18.60% | 6.50% | 100.00% | 100.00% | 0.00% | 0.00% | 0.00% |
| N2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.30% | 0.30% | 0.20% | 0.40% | 77.20% | 68.30% | 68.30% | 0.00% | 0.00% | 0.30% | 77.20% | 77.19% | 77.19% | 74.60% | 85.80% | 0.00% | 0.00% | 0.30% | 0.10% | 1.90% |
| AR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% | 0.80% | 0.80% | 0.00% | 0.00% | 0.00% | 0.90% | 0.94% | 0.94% | 0.90% | 1.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2 | 0.00% | 0.00% | 0.00% | 0.00% | 22.50% | 22.50% | 41.60% | 56.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 57.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 57.40% | 99.90% | 37.80% |
| CO | 0.00% | 0.00% | 0.00% | 0.00% | 38.60% | 38.60% | 0.90% | 1.80% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.30% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.30% | 0.00% | 9.50% |
| CO2 | 0.00% | 0.00% | 0.00% | 0.00% | 5.00% | 5.00% | 29.40% | 9.80% | 0.00% | 2.80% | 2.80% | 0.00% | 100.00% | 6.80% | 0.00% | 0.03% | 0.03% | 0.40% | 0.50% | 0.00% | 0.00% | 6.80% | 0.00% | 50.30% |
| H2O | 100.00% | 100.00% | 0.00% | 0.00% | 33.20% | 33.60% | 27.80% | 32.00% | 1.10% | 22.90% | 22.90% | 3.30% | 0.00% | 34.30% | 1.10% | 1.08% | 1.08% | 5.40% | 6.30% | 0.00% | 0.00% | 34.30% | 0.00% | 0.50% |
| CH4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% |
| H2S | 0.00% | 0.00% | 0.00% | 0.00% | 0.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| NH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| COS | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CARBON | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SULFUR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CL2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCL | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCN | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SO2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C2H6 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C3H8 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| S2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2SO4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 96.70% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

## Table 17: Stream data for BGH Case

(Refer to Figure 2 for stream numbers)

| | As Received Coal | As Received Biomass | Oxygen to Gasifier | Ash | Raw Syngas | Sulfur Removal Outlet | WGS Outlet | Syngas to GT Combustor | GT Air Inlet | GT Outlet | HRSG Outlet | H2SO4 Product | CO2 Product | Syngas to Pre-ITM Combustor | Extracted GT Air | Extral Air Compressor Inlet | Air to Pre-ITM Combustor | Air to ITM Unit | Depleted Air | Oxygen from ITM Unit | Oxygen to H2SO4 Unit | Syngas to H2 Recovery | H2 Product | Tail Gas from H2 Recovery |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Number | 1A | 1B | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14A | 14B | 14C | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| Temperature, C | 15 | 15 | 86 | 60 | 189 | 237.2 | 232.2 | 238.4 | 15 | 587.6 | 153 | 20 | 34.4 | 247.7 | 485.5 | 14.999998 | 500.72653 | 850.1 | 678 | 850.1 | 19.4 | 247.7 | 14.5 | 134.7 |
| Pressure, bar | 1.014 | 1.014 | 51.021 | 1.014 | 40.679 | 38.128 | 35.715 | 34.819 | 1.014 | 1.04 | 0.983 | 1.014 | 152.698 | 34.819 | 24.4 | 1.01352932 | 25.696318 | 25.145 | 24.4 | 1.277 | 8.584 | 34.819 | 33.233 | 44.106 |
| Solids, kg/hr | 138936 | 59544 | 0 | 15725 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vapor Frac (w/o Solids) | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| kmol/hr (w/o Solids) | 965 | 583 | 4241 | 0 | 24904 | 24901 | 35416 | 16591 | 62085 | 73855 | 73855 | 127 | 8109 | 1586 | 28758 | 3209 | 31967 | 33084 | 28773 | 4311 | 70 | 8843 | 4650 | 1201 |
| kg/hr (w/o Solids) | 17383 | 10508 | 135710 | 0 | 483453 | 481446 | 670874 | 194874 | 1791139 | 1957534 | 1957534 | 12057 | 356862 | 16897 | 829657 | 92580 | 922237 | 939134 | 801184 | 137950 | 2248 | 94230 | 9436 | 30877 |
| Mole Frac (w/o Solids) | | | | | | | | | | | | | | | | | | | | | | | | |
| O2 | 0.00% | 0.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 5.30% | 5.30% | 0.00% | 0.00% | 0.00% | 20.80% | 20.76% | 20.76% | 18.60% | 6.50% | 100.00% | 100.00% | 0.00% | 0.00% | 0.00% |
| N2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.40% | 0.40% | 0.30% | 0.50% | 77.20% | 68.40% | 68.40% | 0.00% | 0.00% | 0.40% | 77.20% | 77.19% | 77.19% | 74.60% | 85.80% | 0.00% | 0.00% | 0.40% | 0.10% | 2.40% |
| AR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% | 0.80% | 0.80% | 0.00% | 0.00% | 0.00% | 0.90% | 0.94% | 0.94% | 0.90% | 1.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2 | 0.00% | 0.00% | 0.00% | 0.00% | 23.40% | 23.40% | 42.10% | 56.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 57.80% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 57.80% | 99.90% | 38.70% |
| CO | 0.00% | 0.00% | 0.00% | 0.00% | 37.90% | 37.90% | 0.90% | 1.90% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.30% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.30% | 0.00% | 9.50% |
| CO2 | 0.00% | 0.00% | 0.00% | 0.00% | 4.70% | 4.70% | 29.00% | 9.70% | 0.00% | 2.80% | 2.80% | 0.00% | 100.00% | 6.60% | 0.00% | 0.03% | 0.03% | 0.40% | 0.50% | 0.00% | 0.00% | 6.60% | 0.00% | 48.90% |
| H2O | 100.00% | 100.00% | 0.00% | 0.00% | 33.10% | 33.60% | 27.60% | 31.50% | 1.10% | 22.70% | 22.70% | 3.80% | 0.00% | 33.90% | 1.10% | 1.08% | 1.08% | 5.40% | 6.30% | 0.00% | 0.00% | 33.90% | 0.00% | 0.50% |
| CH4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% |
| H2S | 0.00% | 0.00% | 0.00% | 0.00% | 0.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| NH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| COS | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CARBON | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SULFUR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CL2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCL | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCN | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SO2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C2H6 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C3H8 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| S2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2SO4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 96.20% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

## Table 18: Stream data for LOH Case

(Refer to Figure 2 for stream numbers)

| | As Received Coal | As Received Biomass | Oxygen to Gasifier | Ash | Raw Syngas | Sulfur Removal Outlet | WGS Outlet | Syngas to GT Combustor | GT Air Inlet | GT Outlet | HRSG Outlet | H2SO4 Product | CO2 Product | Syngas to Pre-ITM Combustor | Extracted GT Air | Extral Air Compressor Inlet | Air to Pre-ITM Combustor | Air to ITM Unit | Depleted Air | Oxygen from ITM Unit | Oxygen to H2SO4 Unit | Syngas to H2 Recovery | H2 Product | Tail Gas from H2 Recovery |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Number | 1A | 1B | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14A | 14B | 14C | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| Temperature, C | 15 | | 74.6 | 60 | 191.1 | 216.1 | 232.2 | 244.5 | 4.4 | 571.9 | 153.2 | 20 | 34.4 | 253.5 | 473.7 | 4.4444424 | 492.18209 | 850.1 | 678 | 850.1 | 10 | 253.5 | 5 | 131.6 |
| Pressure, bar | 1.014 | | 51.021 | 1.014 | 40.679 | 38.128 | 35.715 | 34.819 | 0.951 | 0.978 | 0.921 | 1.014 | 152.698 | 34.819 | 24.4 | 0.95147651 | 25.696318 | 25.145 | 24.4 | 1.278 | 8.584 | 34.819 | 33.233 | 44.106 |
| Solids, kg/hr | 198321 | | 0 | 24301 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vapor Frac (w/o Solids) | 0 | | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| kmol/hr (w/o Solids) | 6214 | | 4327 | 0 | 23272 | 23271 | 33417 | 14359 | 54751 | 68439 | 68439 | 63 | 9072 | 1623 | 25361 | 6970 | 32331 | 33463 | 29101 | 4362 | 35 | 7852 | 3980 | 1028 |
| kg/hr (w/o Solids) | 111943 | | 138470 | 0 | 471492 | 470489 | 653278 | 142107 | 1582158 | 1801515 | 1801515 | 5981 | 399248 | 15435 | 732854 | 201402 | 934256 | 949691 | 810105 | 139586 | 1115 | 74667 | 8077 | 15344 |
| Mole Frac (w/o Solids) | | | | | | | | | | | | | | | | | | | | | | | | |
| O2 | 0.00% | | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 5.20% | 5.20% | 0.00% | 0.00% | 0.00% | 20.80% | 20.82% | 20.82% | 18.60% | 6.50% | 100.00% | 100.00% | 0.00% | 0.00% | 0.00% |
| N2 | 0.00% | | 0.00% | 0.00% | 0.30% | 0.30% | 0.20% | 0.40% | 77.60% | 70.10% | 70.10% | 0.00% | 0.00% | 0.30% | 77.60% | 77.60% | 77.60% | 75.00% | 86.20% | 0.00% | 0.00% | 0.30% | 0.10% | 2.00% |
| AR | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% | 0.80% | 0.80% | 0.00% | 0.00% | 0.00% | 0.90% | 0.93% | 0.93% | 0.90% | 1.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2 | 0.00% | | 0.00% | 0.00% | 20.00% | 20.00% | 40.30% | 59.50% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 59.10% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 59.10% | 99.90% | 64.40% |
| CO | 0.00% | | 0.00% | 0.00% | 39.20% | 39.20% | 0.90% | 2.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.30% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.30% | 0.00% | 10.30% |
| CO2 | 0.00% | | 0.00% | 0.00% | 5.60% | 5.60% | 30.30% | 4.40% | 0.00% | 1.50% | 1.50% | 0.00% | 100.00% | 3.00% | 0.00% | 0.03% | 0.03% | 0.20% | 0.30% | 0.00% | 0.00% | 3.00% | 0.00% | 23.00% |
| H2O | 100.00% | | 0.00% | 0.00% | 34.60% | 34.90% | 28.20% | 33.70% | 0.60% | 22.40% | 22.40% | 4.60% | 0.00% | 36.30% | 0.60% | 0.62% | 0.62% | 5.20% | 6.00% | 0.00% | 0.00% | 36.30% | 0.00% | 0.20% |
| CH4 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% |
| H2S | 0.00% | | 0.00% | 0.00% | 0.20% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| NH3 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| COS | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CARBON | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SULFUR | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CL2 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCL | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCN | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SO2 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C2H6 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C3H8 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| S2 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2SO4 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 95.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

## Table 19: Stream data for LWH Case

(Refer to Figure 2 for stream numbers)

| | As Received Coal | As Received Biomass | Oxygen to Gasifier | Ash | Raw Syngas | Sulfur Removal Outlet | WGS Outlet | Syngas to GT Combustor | GT Air Inlet | GT Outlet | HRSG Outlet | H2SO4 Product | CO2 Product | Syngas to Pre-ITM Combustor | Extracted GT Air | Extral Air Compressor Inlet | Air to Pre-ITM Combustor | Air to ITM Unit | Depleted Air | Oxygen from ITM Unit | Oxygen to H2SO4 Unit | Syngas to H2 Recovery | H2 Product | Tail Gas from H2 Recovery |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Number | 1A | 1B | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14A | 14B | 14C | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| Temperature, C | 15 | 15 | 74.6 | 60 | 190.4 | 209.2 | 232.2 | 239.2 | 4.4 | 581.4 | 152.7 | 20 | 34.4 | 248.8 | 473.7 | 4.4444424 | 494.24907 | 850.1 | 678 | 850.1 | 10 | 248.8 | 5 | 120.1 |
| Pressure, bar | 1.014 | 1.014 | 51.021 | 1.014 | 40.679 | 38.128 | 35.715 | 34.819 | 0.951 | 0.978 | 0.921 | 1.014 | 152.698 | 34.819 | 24.4 | 0.95147651 | 25.696318 | 25.145 | 24.4 | 1.274 | 8.584 | 34.819 | 33.233 | 44.106 |
| Solids, kg/hr | 142365 | 61014 | 0 | 18225 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vapor Frac (w/o Solids) | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| kmol/hr (w/o Solids) | 4461 | 3387 | 4160 | 0 | 22248 | 22247 | 32421 | 15131 | 47843 | 64539 | 64539 | 46 | 7905 | 1643 | 22161 | 8842 | 31003 | 32175 | 27993 | 4183 | 25 | 7317 | 3766 | 973 |
| kg/hr (w/o Solids) | 80359 | 61014 | 133127 | 0 | 455790 | 455057 | 638347 | 184047 | 1382511 | 1706447 | 1706447 | 4355 | 347876 | 18216 | 640379 | 255511 | 895892 | 914108 | 780273 | 133835 | 810 | 81136 | 7643 | 27045 |
| Mole Frac (w/o Solids) | | | | | | | | | | | | | | | | | | | | | | | | |
| O2 | 0.00% | 0.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 4.50% | 4.50% | 0.00% | 0.00% | 0.00% | 20.80% | 20.82% | 20.82% | 18.60% | 6.40% | 100.00% | 100.00% | 0.00% | 0.00% | 0.00% |
| N2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.20% | 0.20% | 0.20% | 0.30% | 77.60% | 68.20% | 68.20% | 0.00% | 0.00% | 0.20% | 77.60% | 77.60% | 77.60% | 74.80% | 86.00% | 0.00% | 0.00% | 0.20% | 0.10% | 1.60% |
| AR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% | 0.80% | 0.80% | 0.00% | 0.00% | 0.00% | 0.90% | 0.93% | 0.93% | 0.90% | 1.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2 | 0.00% | 0.00% | 0.00% | 0.00% | 19.50% | 19.50% | 39.90% | 54.60% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 56.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 56.00% | 99.90% | 34.10% |
| CO | 0.00% | 0.00% | 0.00% | 0.00% | 40.00% | 40.00% | 0.90% | 1.80% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.30% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.30% | 0.00% | 9.60% |
| CO2 | 0.00% | 0.00% | 0.00% | 0.00% | 5.90% | 5.90% | 30.60% | 10.30% | 0.00% | 3.10% | 3.10% | 0.00% | 100.00% | 7.20% | 0.00% | 0.03% | 0.03% | 0.50% | 0.50% | 0.00% | 0.00% | 7.20% | 0.00% | 54.40% |
| H2O | 100.00% | 100.00% | 0.00% | 0.00% | 34.20% | 34.30% | 28.40% | 33.00% | 0.60% | 23.40% | 23.40% | 5.20% | 0.00% | 35.30% | 0.60% | 0.62% | 0.62% | 5.30% | 6.00% | 0.00% | 0.00% | 35.30% | 0.00% | 0.20% |
| CH4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% |
| H2S | 0.00% | 0.00% | 0.00% | 0.00% | 0.20% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| NH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| COS | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CARBON | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SULFUR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CL2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCL | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCN | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SO2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C2H6 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C3H8 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| S2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2SO4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 94.80% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

## Table 20: Stream data for LGH Case

(Refer to Figure 2 for stream numbers)

| | As Received Coal | As Received Biomass | Oxygen to Gasifier | Ash | Raw Syngas | Sulfur Removal Outlet | WGS Outlet | Syngas to GT Combustor | GT Air Inlet | GT Outlet | HRSG Outlet | H2SO4 Product | CO2 Product | Syngas to Pre-ITM Combustor | Extracted GT Air | Extral Air Compressor Inlet | Air to Pre-ITM Combustor | Air to ITM Unit | Depleted Air | Oxygen from ITM Unit | Oxygen to H2SO4 Unit | Syngas to H2 Recovery | H2 Product | Tail Gas from H2 Recovery |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Number | 1A | 1B | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14A | 14B | 14C | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| Temperature, C | 15 | 15 | 74.6 | 60 | 190.3 | 209.6 | 232.2 | 238.4 | 4.4 | 580.2 | 152.8 | 20 | 34.4 | 248.5 | 473.7 | 4.4444424 | 493.15208 | 850.1 | 678 | 850.1 | 10 | 248.5 | 5 | 120.6 |
| Pressure, bar | 1.014 | 1.014 | 51.021 | 1.014 | 40.679 | 38.128 | 35.715 | 34.819 | 0.951 | 0.978 | 0.921 | 1.014 | 152.698 | 34.819 | 24.4 | 0.95147651 | 25.696318 | 25.145 | 24.4 | 1.274 | 8.584 | 34.819 | 33.233 | 44.106 |
| Solids, kg/hr | 150572 | 64531 | 0 | 22280 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vapor Frac (w/o Solids) | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| kmol/hr (w/o Solids) | 4718 | 632 | 4142 | 0 | 22907 | 22905 | 33085 | 15293 | 50164 | 65778 | 65778 | 49 | 7943 | 1632 | 23236 | 7673 | 30909 | 32070 | 27901 | 4169 | 27 | 7864 | 4070 | 1051 |
| kg/hr (w/o Solids) | 84991 | 11388 | 132552 | 0 | 462303 | 461528 | 644936 | 185050 | 1449600 | 1740898 | 1740898 | 4577 | 349556 | 17915 | 671454 | 221729 | 893183 | 911098 | 777710 | 133388 | 850 | 86349 | 8260 | 28678 |
| Mole Frac (w/o Solids) | | | | | | | | | | | | | | | | | | | | | | | | |
| O2 | 0.00% | 0.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 4.60% | 4.60% | 0.00% | 0.00% | 0.00% | 20.80% | 20.82% | 20.82% | 18.60% | 6.40% | 100.00% | 100.00% | 0.00% | 0.00% | 0.00% |
| N2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.30% | 0.30% | 0.20% | 0.50% | 77.60% | 68.30% | 68.30% | 0.00% | 0.00% | 0.30% | 77.60% | 77.60% | 77.60% | 74.80% | 86.00% | 0.00% | 0.00% | 0.30% | 0.10% | 2.30% |
| AR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% | 0.80% | 0.80% | 0.00% | 0.00% | 0.00% | 0.90% | 0.93% | 0.93% | 0.90% | 1.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2 | 0.00% | 0.00% | 0.00% | 0.00% | 20.40% | 20.40% | 40.50% | 55.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 56.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 56.40% | 99.90% | 35.10% |
| CO | 0.00% | 0.00% | 0.00% | 0.00% | 39.40% | 39.40% | 0.90% | 1.90% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.30% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.30% | 0.00% | 9.60% |
| CO2 | 0.00% | 0.00% | 0.00% | 0.00% | 5.50% | 5.50% | 30.20% | 10.20% | 0.00% | 3.00% | 3.00% | 0.00% | 100.00% | 7.00% | 0.00% | 0.03% | 0.03% | 0.50% | 0.50% | 0.00% | 0.00% | 7.00% | 0.00% | 52.70% |
| H2O | 100.00% | 100.00% | 0.00% | 0.00% | 34.10% | 34.30% | 28.20% | 32.50% | 0.60% | 23.20% | 23.20% | 6.30% | 0.00% | 34.90% | 0.60% | 0.62% | 0.62% | 5.20% | 6.00% | 0.00% | 0.00% | 34.90% | 0.00% | 0.20% |
| CH4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% |
| H2S | 0.00% | 0.00% | 0.00% | 0.00% | 0.20% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| NH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| COS | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CARBON | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SULFUR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CL2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCL | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCN | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SO2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C2H6 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C3H8 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| S2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2SO4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 93.70% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

## Table 21: Stream data for BOM Case

(Refer to Figure 3 for stream numbers)

| | As Received Coal | As Received Biomass | Oxygen to Gasifier | Ash | Raw Syngas | Sulfur Removal Outlet | WGS Outlet | Syngas to GT Combustor | GT Air Inlet | GT Outlet | HRSG Outlet | H2SO4 Product | CO2 Product | Syngas to Pre-ITM Combustor | Extracted GT Air | Extral Air Compressor Inlet | Air to Pre-ITM Combustor | Air to ITM Unit | Depleted Air | Oxygen from ITM Unit | Oxygen to H2SO4 Unit | Syngas to MeOH Unit | Decarbonized Syngas to MeOH Unit | S Removed Syngas to MeOH Unit | Syngas Entering Synthesis Unit | MeOH Product | Purge Gas | Unconverted Gas |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Number | 1A | 1B | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14A | 14B | 14C | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| Temperature, C | 15 | | 33.9 | 60 | 186.1 | 248.5 | 232.2 | 248.8 | 15 | 585.3 | 151.5 | 20 | 34.4 | 248.8 | 485.5 | 15 | 502 | 850 | 678 | 850 | 19.4 | 248.5 | 248.8 | 248.4 | 50 | 86.1 | 80.3 | 26.7 |
| Pressure, bar | 1.014 | | 51.021 | 1.014 | 40.679 | 38.128 | 35.715 | 34.819 | 1.014 | 1.04 | 0.983 | 1.014 | 152.698 | 34.819 | 24.4 | 1.014 | 25.696 | 25.145 | 24.4 | 1.276 | 8.584 | 38.128 | 34.819 | 33.784 | 32.888 | 4.461 | 30 | 53.757 |
| Solids, kg/hr | 171423 | | 0 | 15041 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vapor Frac (w/o Solids) | 0 | | 1 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 |
| kmol/hr (w/o Solids) | 1190 | | 4271 | 0 | 23923 | 23921 | 31646 | 15730 | 59836 | 72752 | 72752 | 155 | 7384 | 1640 | 27716 | 4581 | 32297 | 33465 | 29109 | 4356 | 86 | 3239 | 5336 | 8574 | 5538 | 1558 | 501 | 17401 |
| kg/hr (w/o Solids) | 21447 | | 136655 | 0 | 462990 | 460531 | 595695 | 159575 | 1726269 | 1901284 | 1901284 | 14832 | 324967 | 16638 | 799607 | 132164 | 931771 | 948408 | 809009 | 139399 | 2764 | 62363 | 54131 | 116475 | 61785 | 49917 | 6047 | 152353 |
| Mole Frac (w/o Solids) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| O2 | 0.00% | | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 5.20% | 5.20% | 0.00% | 0.00% | 0.00% | 20.80% | 20.80% | 20.80% | 18.60% | 6.40% | 100.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| N2 | 0.00% | | 0.00% | 0.00% | 0.30% | 0.30% | 0.20% | 0.30% | 77.20% | 68.50% | 68.50% | 0.00% | 0.00% | 0.30% | 77.20% | 77.20% | 77.20% | 74.50% | 85.70% | 0.00% | 0.00% | 0.30% | 0.30% | 0.30% | 0.50% | 0.00% | 5.50% | 6.00% |
| AR | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% | 0.80% | 0.80% | 0.00% | 0.00% | 0.00% | 0.90% | 0.90% | 0.90% | 0.90% | 1.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2 | 0.00% | | 0.00% | 0.00% | 24.40% | 24.50% | 40.60% | 56.60% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 56.60% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 24.50% | 56.60% | 44.40% | 68.80% | 0.00% | 71.10% | 78.80% |
| CO | 0.00% | | 0.00% | 0.00% | 38.70% | 38.70% | 0.70% | 1.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 38.70% | 1.00% | 15.30% | 23.60% | 0.00% | 4.70% | 5.10% |
| CO2 | 0.00% | | 0.00% | 0.00% | 4.70% | 4.80% | 27.70% | 4.00% | 0.00% | 1.40% | 1.40% | 0.00% | 100.00% | 4.00% | 0.00% | 0.00% | 0.00% | 0.30% | 0.30% | 0.00% | 0.00% | 4.80% | 4.00% | 4.30% | 6.70% | 0.00% | 15.00% | 8.40% |
| H2O | 100.00% | | 0.00% | 0.00% | 31.10% | 31.60% | 30.70% | 38.10% | 1.10% | 24.10% | 24.10% | 3.00% | 0.00% | 38.10% | 1.10% | 1.10% | 1.10% | 5.70% | 6.50% | 0.00% | 0.00% | 31.60% | 38.10% | 35.70% | 0.40% | 0.10% | 0.00% | 0.00% |
| CH4 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.10% | 1.10% |
| H2S | 0.00% | | 0.00% | 0.00% | 0.60% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| NH3 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| COS | 0.00% | | 0.00% | 0.00% | 0.10% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CARBON | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SULFUR | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CL2 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCL | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCN | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SO2 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CH3OH | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 99.90% | 1.80% | 0.40% |
| C2H5OH | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 0.00% | 0.00% |
| CH3OCH3 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.30% | 0.10% |
| HCOOCH3 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.50% | 0.00% |
| C2H6 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C3H8 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C4H10 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C6H14 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C8H18 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C10H22 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| S2 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2SO4 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 97.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

## Table 22: Stream data for BWM Case

(Refer to Figure 3 for stream numbers)

| | As Received Coal | As Received Biomass | Oxygen to Gasifier | Ash | Raw Syngas | Sulfur Removal Outlet | WGS Outlet | Syngas to GT Combustor | GT Air Inlet | GT Outlet | HRSG Outlet | H2SO4 Product | CO2 Product | Syngas to Pre-ITM Combustor | Extracted GT Air | Extral Air Compressor Inlet | Air to Pre-ITM Combustor | Air to ITM Unit | Depleted Air | Oxygen from ITM Unit | Oxygen to H2SO4 Unit | Syngas to MeOH Unit | Decarbonized Syngas to MeOH Unit | S Removed Syngas to MeOH Unit | Syngas Entering Synthesis Unit | MeOH Product | Purge Gas | Unconverted Gas |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Number | 1A | 1B | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14A | 14B | 14C | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| Temperature, C | 15 | 15 | 33.9 | 60 | 186.5 | 235.4 | 232.2 | 244 | 15 | 592.6 | 152.7 | 20 | 34.4 | 244 | 485.5 | 15 | 504 | 849.8 | 678 | 849.8 | 19.4 | 235.4 | 244 | 241.8 | 50 | 87.1 | 79.9 | 26.7 |
| Pressure, bar | 1.014 | 1.014 | 51.021 | 1.014 | 40.679 | 38.128 | 35.715 | 34.819 | 1.014 | 1.04 | 0.983 | 1.014 | 152.698 | 34.819 | 24.4 | 1.014 | 25.696 | 25.145 | 24.4 | 1.273 | 8.584 | 38.128 | 34.819 | 33.784 | 32.888 | 4.461 | 30 | 53.757 |
| Solids, kg/hr | 129852 | 55651 | 0 | 12106 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vapor Frac (w/o Solids) | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 |
| kmol/hr (w/o Solids) | 902 | 3089 | 4190 | 0 | 23125 | 23122 | 31975 | 15875 | 53781 | 69306 | 69306 | 118 | 6471 | 1688 | 24912 | 6634 | 31546 | 32773 | 28519 | 4254 | 66 | 2041 | 6655 | 8695 | 5701 | 1466 | 588 | 20599 |
| kg/hr (w/o Solids) | 16246 | 55651 | 134083 | 0 | 454657 | 452782 | 609061 | 191229 | 1551578 | 1825641 | 1825641 | 11291 | 284773 | 20337 | 718693 | 191400 | 910093 | 930430 | 794297 | 136133 | 2106 | 39957 | 80169 | 120115 | 66178 | 46984 | 7233 | 192425 |
| Mole Frac (w/o Solids) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| O2 | 0.00% | 0.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 4.70% | 4.70% | 0.00% | 0.00% | 0.00% | 20.80% | 20.80% | 20.80% | 18.60% | 6.40% | 100.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| N2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.30% | 0.30% | 0.20% | 0.30% | 77.20% | 67.40% | 67.40% | 0.00% | 0.00% | 0.30% | 77.20% | 77.20% | 77.20% | 74.30% | 85.40% | 0.00% | 0.00% | 0.30% | 0.30% | 0.30% | 0.40% | 0.00% | 3.90% | 4.30% |
| AR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% | 0.80% | 0.80% | 0.00% | 0.00% | 0.00% | 0.90% | 0.90% | 0.90% | 0.90% | 1.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2 | 0.00% | 0.00% | 0.00% | 0.00% | 23.30% | 23.30% | 40.60% | 53.60% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 53.60% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 23.30% | 53.60% | 46.50% | 70.90% | 0.00% | 71.40% | 78.90% |
| CO | 0.00% | 0.00% | 0.00% | 0.00% | 39.50% | 39.50% | 0.80% | 1.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 39.50% | 1.00% | 10.10% | 15.30% | 0.00% | 3.70% | 4.10% |
| CO2 | 0.00% | 0.00% | 0.00% | 0.00% | 5.00% | 5.10% | 28.60% | 9.50% | 0.00% | 2.90% | 2.90% | 0.00% | 100.00% | 9.50% | 0.00% | 0.00% | 0.00% | 0.60% | 0.70% | 0.00% | 0.00% | 5.10% | 9.50% | 8.50% | 12.90% | 0.00% | 16.70% | 11.80% |
| H2O | 100.00% | 100.00% | 0.00% | 0.00% | 31.40% | 31.80% | 29.80% | 35.60% | 1.10% | 24.20% | 24.20% | 3.30% | 0.00% | 35.60% | 1.10% | 1.10% | 1.10% | 5.60% | 6.50% | 0.00% | 0.00% | 31.80% | 35.60% | 34.70% | 0.40% | 0.10% | 0.00% | 0.00% |
| CH4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.50% | 0.50% |
| H2S | 0.00% | 0.00% | 0.00% | 0.00% | 0.50% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| NH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| COS | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CARBON | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SULFUR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CL2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCL | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCN | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SO2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CH3OH | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 99.90% | 3.40% | 0.30% |
| C2H5OH | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CH3OCH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 0.00% |
| HCOOCH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.30% | 0.00% |
| C2H6 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C3H8 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C4H10 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C6H14 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C8H18 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C10H22 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| S2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2SO4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 96.70% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

## Table 23: Stream data for BGM Case

(Refer to Figure 3 for stream numbers)

| | As Received Coal | As Received Biomass | Oxygen to Gasifier | Ash | Raw Syngas | Sulfur Removal Outlet | WGS Outlet | Syngas to GT Combustor | GT Air Inlet | GT Outlet | HRSG Outlet | H2SO4 Product | CO2 Product | Syngas to Pre-ITM Combustor | Extracted GT Air | Extral Air Compressor Inlet | Air to Pre-ITM Combustor | Air to ITM Unit | Depleted Air | Oxygen from ITM Unit | Oxygen to H2SO4 Unit | Syngas to MeOH Unit | Decarbonized Syngas to MeOH Unit | S Removed Syngas to MeOH Unit | Syngas Entering Synthesis Unit | MeOH Product | Purge Gas | Unconverted Gas |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Number | 1A | 1B | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14A | 14B | 14C | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| Temperature, C | 15 | 15 | 33.9 | 60 | 186.6 | 236.4 | 232.2 | 243.7 | 15 | 592.1 | 153 | 20 | 34.4 | 243.7 | 485.5 | 15 | 503.4 | 849.8 | 678 | 849.8 | 19.4 | 236.4 | 243.7 | 241.8 | 50 | 87.3 | 78.8 | 26.7 |
| Pressure, bar | 1.014 | 1.014 | 51.021 | 1.014 | 40.679 | 38.128 | 35.715 | 34.819 | 1.014 | 1.04 | 0.983 | 1.014 | 152.7 | 34.819 | 24.4 | 1.014 | 25.696 | 25.145 | 24.4 | 1.272 | 8.584 | 38.128 | 34.819 | 33.784 | 32.888 | 4.461 | 30 | 53.757 |
| Solids, kg/hr | 136274 | 58403 | 0 | 15424 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vapor Frac (w/o Solids) | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 |
| kmol/hr (w/o Solids) | 946 | 572 | 4172 | 0 | 23802 | 23801 | 32440 | 15941 | 55060 | 69997 | 69997 | 124 | 6374 | 1686 | 25504 | 5961 | 31465 | 32690 | 28447 | 4242 | 69 | 2271 | 7064 | 9334 | 6129 | 1577 | 641 | 22512 |
| kg/hr (w/o Solids) | 17050 | 10306 | 133508 | 0 | 463338 | 461395 | 613918 | 191588 | 1588469 | 1844551 | 1844551 | 11823 | 280499 | 20258 | 735781 | 171987 | 907769 | 928027 | 792272 | 135755 | 2204 | 44031 | 84899 | 128917 | 71171 | 50545 | 7994 | 215789 |
| Mole Frac (w/o Solids) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| O2 | 0.00% | 0.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 4.70% | 4.70% | 0.00% | 0.00% | 0.00% | 20.80% | 20.80% | 20.80% | 18.60% | 6.40% | 100.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| N2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.40% | 0.40% | 0.30% | 0.30% | 77.20% | 67.40% | 67.40% | 0.00% | 0.00% | 0.30% | 77.20% | 77.20% | 77.20% | 74.30% | 85.40% | 0.00% | 0.00% | 0.40% | 0.30% | 0.30% | 0.50% | 0.00% | 5.00% | 5.50% |
| AR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% | 0.80% | 0.80% | 0.00% | 0.00% | 0.00% | 0.90% | 0.90% | 0.90% | 0.90% | 1.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2 | 0.00% | 0.00% | 0.00% | 0.00% | 23.90% | 23.90% | 40.90% | 53.70% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 53.70% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 23.90% | 53.70% | 46.50% | 70.80% | 0.00% | 70.60% | 77.80% |
| CO | 0.00% | 0.00% | 0.00% | 0.00% | 38.90% | 38.90% | 0.80% | 1.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 38.90% | 1.00% | 10.20% | 15.60% | 0.00% | 3.70% | 4.10% |
| CO2 | 0.00% | 0.00% | 0.00% | 0.00% | 4.80% | 4.90% | 28.30% | 9.50% | 0.00% | 2.90% | 2.90% | 0.00% | 100.00% | 9.50% | 0.00% | 0.00% | 0.00% | 0.60% | 0.70% | 0.00% | 0.00% | 4.90% | 9.50% | 8.40% | 12.70% | 0.00% | 16.40% | 11.60% |
| H2O | 100.00% | 100.00% | 0.00% | 0.00% | 31.50% | 31.90% | 29.80% | 35.40% | 1.10% | 24.10% | 24.10% | 3.70% | 0.00% | 35.40% | 1.10% | 1.10% | 1.10% | 5.60% | 6.50% | 0.00% | 0.00% | 31.90% | 35.40% | 34.60% | 0.40% | 0.00% | 0.00% | 0.00% |
| CH4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.50% | 0.50% |
| H2S | 0.00% | 0.00% | 0.00% | 0.00% | 0.50% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| NH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| COS | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CARBON | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SULFUR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CL2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCL | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCN | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SO2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CH3OH | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 99.90% | 3.30% | 0.30% |
| C2H5OH | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CH3OCH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 0.00% |
| HCOOCH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.30% | 0.00% |
| C2H6 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C3H8 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C4H10 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C6H14 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C8H18 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C10H22 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| S2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2SO4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 96.30% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

## Table 24: Stream data for LOM Case

(Refer to Figure 3 for stream numbers)

| | As Received Coal | As Received Biomass | Oxygen to Gasifier | Ash | Raw Syngas | Sulfur Removal Outlet | WGS Outlet | Syngas to GT Combustor | GT Air Inlet | GT Outlet | HRSG Outlet | H2SO4 Product | CO2 Product | Syngas to Pre-ITM Combustor | Extracted GT Air | Extral Air Compressor Inlet | Air to Pre-ITM Combustor | Air to ITM Unit | Depleted Air | Oxygen from ITM Unit | Oxygen to H2SO4 Unit | Syngas to MeOH Unit | Decarbonized Syngas to MeOH Unit | S Removed Syngas to MeOH Unit | Syngas Entering Synthesis Unit | MeOH Product | Purge Gas | Unconverted Gas |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Number | 1A | 1B | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14A | 14B | 14C | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| Temperature, C | 15 | 0 | 24.1 | 60 | 187.5 | 213.8 | 232.2 | 250.2 | 4.4 | 577.6 | 152.6 | 20 | 34.4 | 250.2 | 473.7 | 4.4 | 494.7 | 850 | 678 | 850 | 10 | 213.8 | 250.2 | 237.7 | 50 | 88.2 | 67.7 | 17.2 |
| Pressure, bar | 1.014 | 0 | 51.021 | 1.014 | 40.679 | 38.128 | 35.715 | 34.819 | 0.951 | 0.978 | 0.921 | 1.014 | 152.7 | 34.819 | 24.4 | 0.951 | 25.696 | 25.145 | 24.4 | 1.274 | 8.584 | 38.128 | 34.819 | 33.784 | 32.888 | 4.461 | 30 | 53.757 |
| Solids, kg/hr | 192273 | 0 | 0 | 23560 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vapor Frac (w/o Solids) | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 |
| kmol/hr (w/o Solids) | 6024 | 0 | 4208 | 0 | 21691 | 21689 | 29931 | 14360 | 47526 | 64497 | 64497 | 61 | 7492 | 1688 | 22014 | 9427 | 31441 | 32652 | 28411 | 4242 | 34 | 2439 | 4916 | 7354 | 4671 | 1302 | 427 | 14910 |
| kg/hr (w/o Solids) | 108530 | 0 | 134646 | 0 | 441805 | 440833 | 583672 | 149468 | 1373365 | 1682133 | 1682133 | 5797 | 329728 | 17568 | 636144 | 272409 | 908553 | 926121 | 790389 | 135732 | 1080 | 49570 | 51169 | 100729 | 52384 | 41715 | 5053 | 126514 |
| Mole Frac (w/o Solids) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| O2 | 0.00% | 0.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 4.50% | 4.50% | 0.00% | 0.00% | 0.00% | 20.80% | 20.80% | 20.80% | 18.60% | 6.40% | 100.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| N2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.30% | 0.30% | 0.20% | 0.30% | 77.60% | 68.60% | 68.60% | 0.00% | 0.00% | 0.30% | 77.60% | 77.60% | 77.60% | 74.70% | 85.90% | 0.00% | 0.00% | 0.30% | 0.30% | 0.30% | 0.40% | 0.00% | 4.80% | 5.20% |
| AR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% | 0.80% | 0.80% | 0.00% | 0.00% | 0.00% | 0.90% | 0.90% | 0.90% | 0.90% | 1.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2 | 0.00% | 0.00% | 0.00% | 0.00% | 20.70% | 20.70% | 38.80% | 55.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 55.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.70% | 55.40% | 43.90% | 69.10% | 0.00% | 72.40% | 80.10% |
| CO | 0.00% | 0.00% | 0.00% | 0.00% | 40.80% | 40.80% | 0.70% | 1.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 40.80% | 1.00% | 14.20% | 22.40% | 0.00% | 4.30% | 4.80% |
| CO2 | 0.00% | 0.00% | 0.00% | 0.00% | 5.80% | 5.80% | 29.30% | 4.40% | 0.00% | 1.50% | 1.50% | 0.00% | 100.00% | 4.40% | 0.00% | 0.00% | 0.00% | 0.30% | 0.40% | 0.00% | 0.00% | 5.80% | 4.40% | 4.80% | 7.60% | 0.00% | 15.60% | 8.70% |
| H2O | 100.00% | 0.00% | 0.00% | 0.00% | 32.10% | 32.40% | 31.00% | 38.90% | 0.60% | 24.50% | 24.50% | 4.50% | 0.00% | 38.90% | 0.60% | 0.60% | 0.60% | 5.50% | 6.30% | 0.00% | 0.00% | 32.40% | 38.90% | 36.70% | 0.40% | 0.10% | 0.00% | 0.00% |
| CH4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.00% | 1.00% |
| H2S | 0.00% | 0.00% | 0.00% | 0.00% | 0.20% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| NH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| COS | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CARBON | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SULFUR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CL2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCL | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCN | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SO2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CH3OH | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 99.90% | 1.00% | 0.20% |
| C2H5OH | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CH3OCH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.30% | 0.00% |
| HCOOCH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.50% | 0.00% |
| C2H6 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C3H8 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C4H10 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C6H14 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C8H18 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C10H22 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| S2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2SO4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 95.50% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

## Table 25: Stream data for LWM Case

(Refer to Figure 3 for stream numbers)

| | As Received Coal | As Received Biomass | Oxygen to Gasifier | Ash | Raw Syngas | Sulfur Removal Outlet | WGS Outlet | Syngas to GT Combustor | GT Air Inlet | GT Outlet | HRSG Outlet | H2SO4 Product | CO2 Product | Syngas to Pre-ITM Combustor | Extracted GT Air | Extral Air Compressor Inlet | Air to Pre-ITM Combustor | Air to ITM Unit | Depleted Air | Oxygen from ITM Unit | Oxygen to H2SO4 Unit | Syngas to MeOH Unit | Decarbonized Syngas to MeOH Unit | S Removed Syngas to MeOH Unit | Syngas Entering Synthesis Unit | MeOH Product | Purge Gas | Unconverted Gas |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Number | 1A | 1B | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14A | 14B | 14C | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| Temperature, C | 15 | 15 | 24.1 | 60 | 187.6 | 207.2 | 232.2 | 245 | 4.4 | 584.9 | 152.9 | 20 | 34.4 | 245 | 473.7 | 4.4 | 495.9 | 849.9 | 678 | 849.9 | 10 | 207.2 | 245 | 237.5 | 50 | 88 | 70.1 | 17.2 |
| Pressure, bar | 1.014 | 1.014 | 51.021 | 1.014 | 40.679 | 38.128 | 35.715 | 34.819 | 0.951 | 0.978 | 0.921 | 1.014 | 152.7 | 34.819 | 24.4 | 0.951 | 25.696 | 25.145 | 24.4 | 1.269 | 8.584 | 38.128 | 34.819 | 33.784 | 32.888 | 4.461 | 30 | 53.757 |
| Solids, kg/hr | 140079 | 60034 | 0 | 17932 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vapor Frac (w/o Solids) | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 |
| kmol/hr (w/o Solids) | 4389 | 3332 | 4106 | 0 | 21227 | 21225 | 30396 | 14679 | 43617 | 62247 | 62247 | 46 | 6525 | 1740 | 20204 | 10411 | 30614 | 31888 | 27760 | 4128 | 25 | 1477 | 6150 | 7627 | 4941 | 1251 | 511 | 17942 |
| kg/hr (w/o Solids) | 79069 | 60034 | 131378 | 0 | 436886 | 436169 | 597638 | 180958 | 1260413 | 1637812 | 1637812 | 4285 | 287155 | 21453 | 583822 | 300841 | 884663 | 906116 | 774030 | 132087 | 796 | 30359 | 75817 | 106171 | 57774 | 40091 | 6234 | 165405 |
| Mole Frac (w/o Solids) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| O2 | 0.00% | 0.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 4.00% | 4.00% | 0.00% | 0.00% | 0.00% | 20.80% | 20.80% | 20.80% | 18.50% | 6.40% | 100.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| N2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.30% | 0.30% | 0.20% | 0.20% | 77.60% | 67.40% | 67.40% | 0.00% | 0.00% | 0.20% | 77.60% | 77.60% | 77.60% | 74.50% | 85.60% | 0.00% | 0.00% | 0.30% | 0.20% | 0.20% | 0.40% | 0.00% | 3.40% | 3.70% |
| AR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% | 0.80% | 0.80% | 0.00% | 0.00% | 0.00% | 0.90% | 0.90% | 0.90% | 0.90% | 1.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2 | 0.00% | 0.00% | 0.00% | 0.00% | 20.00% | 20.00% | 39.00% | 52.50% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 52.50% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.00% | 52.50% | 46.20% | 71.40% | 0.00% | 72.00% | 79.60% |
| CO | 0.00% | 0.00% | 0.00% | 0.00% | 41.30% | 41.30% | 0.80% | 1.10% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.10% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 41.30% | 1.10% | 8.90% | 13.70% | 0.00% | 3.50% | 3.90% |
| CO2 | 0.00% | 0.00% | 0.00% | 0.00% | 6.10% | 6.10% | 30.00% | 10.00% | 0.00% | 3.10% | 3.10% | 0.00% | 100.00% | 10.00% | 0.00% | 0.00% | 0.00% | 0.60% | 0.70% | 0.00% | 0.00% | 6.10% | 10.00% | 9.20% | 14.20% | 0.00% | 17.10% | 12.10% |
| H2O | 100.00% | 100.00% | 0.00% | 0.00% | 32.20% | 32.40% | 30.00% | 36.20% | 0.60% | 24.60% | 24.60% | 5.10% | 0.00% | 36.20% | 0.60% | 0.60% | 0.60% | 5.40% | 6.20% | 0.00% | 0.00% | 32.40% | 36.20% | 35.50% | 0.40% | 0.10% | 0.00% | 0.00% |
| CH4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.40% | 0.50% |
| H2S | 0.00% | 0.00% | 0.00% | 0.00% | 0.20% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| NH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| COS | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CARBON | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SULFUR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CL2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCL | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCN | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SO2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CH3OH | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 99.90% | 3.20% | 0.20% |
| C2H5OH | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CH3OCH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 0.00% |
| HCOOCH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.30% | 0.00% |
| C2H6 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C3H8 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C4H10 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C6H14 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C8H18 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C10H22 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| S2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2SO4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 94.90% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

## Table 26: Stream data for LGM Case

(Refer to Figure 3 for stream numbers)

| | As Received Coal | As Received Biomass | Oxygen to Gasifier | Ash | Raw Syngas | Sulfur Removal Outlet | WGS Outlet | Syngas to GT Combustor | GT Air Inlet | GT Outlet | HRSG Outlet | H2SO4 Product | CO2 Product | Syngas to Pre-ITM Combustor | Extracted GT Air | Extral Air Compressor Inlet | Air to Pre-ITM Combustor | Air to ITM Unit | Depleted Air | Oxygen from ITM Unit | Oxygen to H2SO4 Unit | Syngas to MeOH Unit | Decarbonized Syngas to MeOH Unit | S Removed Syngas to MeOH Unit | Syngas Entering Synthesis Unit | MeOH Product | Purge Gas | Unconverted Gas |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Number | 1A | 1B | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14A | 14B | 14C | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| Temperature, C | 15 | 15 | 24.1 | 60 | 187.8 | 207.8 | 232.2 | 244.6 | 4.4 | 583.9 | 153.1 | 20 | 34.4 | 244.6 | 473.7 | 4.4 | 494.9 | 849.8 | 678 | 849.8 | 10 | 207.8 | 244.6 | 236.9 | 50 | 88.2 | 68.8 | 17.2 |
| Pressure, bar | 1.014 | 1.014 | 51.021 | 1.014 | 40.679 | 38.128 | 35.715 | 34.819 | 0.951 | 0.978 | 0.921 | 1.014 | 152.7 | 34.819 | 24.4 | 0.951 | 25.696 | 25.145 | 24.4 | 1.269 | 8.584 | 38.128 | 34.819 | 33.784 | 32.888 | 4.461 | 30 | 53.757 |
| Solids, kg/hr | 147994 | 63426 | 0 | 21899 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vapor Frac (w/o Solids) | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 |
| kmol/hr (w/o Solids) | 4637 | 621 | 4084 | 0 | 21878 | 21877 | 30812 | 14817 | 45627 | 63315 | 63315 | 48 | 6455 | 1732 | 21135 | 9340 | 30474 | 31740 | 27633 | 4108 | 26 | 1679 | 6506 | 8185 | 5319 | 1350 | 559 | 19677 |
| kg/hr (w/o Solids) | 83536 | 11193 | 130669 | 0 | 443314 | 442559 | 599812 | 181868 | 1318492 | 1666992 | 1666992 | 4498 | 284076 | 21260 | 610726 | 269893 | 880618 | 901878 | 770439 | 131439 | 834 | 33972 | 79859 | 113823 | 62185 | 43260 | 6921 | 186784 |
| Mole Frac (w/o Solids) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| O2 | 0.00% | 0.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 4.20% | 4.20% | 0.00% | 0.00% | 0.00% | 20.80% | 20.80% | 20.80% | 18.50% | 6.40% | 100.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| N2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.40% | 0.40% | 0.20% | 0.30% | 77.60% | 67.50% | 67.50% | 0.00% | 0.00% | 0.30% | 77.60% | 77.60% | 77.60% | 74.50% | 85.60% | 0.00% | 0.00% | 0.40% | 0.30% | 0.30% | 0.50% | 0.00% | 4.70% | 5.10% |
| AR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% | 0.80% | 0.80% | 0.00% | 0.00% | 0.00% | 0.90% | 0.90% | 0.90% | 0.90% | 1.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2 | 0.00% | 0.00% | 0.00% | 0.00% | 20.90% | 20.90% | 39.50% | 52.80% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 52.80% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.90% | 52.80% | 46.20% | 71.20% | 0.00% | 71.10% | 78.40% |
| CO | 0.00% | 0.00% | 0.00% | 0.00% | 40.50% | 40.50% | 0.80% | 1.10% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.10% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 40.50% | 1.10% | 9.10% | 14.10% | 0.00% | 3.60% | 3.90% |
| CO2 | 0.00% | 0.00% | 0.00% | 0.00% | 5.70% | 5.70% | 29.50% | 9.90% | 0.00% | 3.10% | 3.10% | 0.00% | 100.00% | 9.90% | 0.00% | 0.00% | 0.00% | 0.60% | 0.70% | 0.00% | 0.00% | 5.70% | 9.90% | 9.00% | 13.90% | 0.00% | 16.80% | 11.90% |
| H2O | 100.00% | 100.00% | 0.00% | 0.00% | 32.30% | 32.50% | 30.00% | 36.00% | 0.60% | 24.40% | 24.40% | 6.30% | 0.00% | 36.00% | 0.60% | 0.60% | 0.60% | 5.40% | 6.20% | 0.00% | 0.00% | 32.50% | 36.00% | 35.30% | 0.40% | 0.10% | 0.00% | 0.00% |
| CH4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.40% | 0.50% |
| H2S | 0.00% | 0.00% | 0.00% | 0.00% | 0.20% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| NH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| COS | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CARBON | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SULFUR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CL2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCL | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCN | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SO2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CH3OH | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 99.90% | 3.00% | 0.20% |
| C2H5OH | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CH3OCH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 0.00% |
| HCOOCH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.30% | 0.00% |
| C2H6 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C3H8 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C4H10 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C6H14 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C8H18 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C10H22 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| S2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2SO4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 93.70% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

## Table 27: Stream data for BOF Case

(Refer to Figure 4 for stream numbers)

| | As Received Coal | As Received Biomass | Oxygen to Gasifier | Ash | Raw Syngas | Sulfur Removal Outlet | WGS Outlet | Syngas to GT Combustor | GT Air Inlet | GT Outlet | HRSG Outlet | H2SO4 Product | CO2 Product (TDA Process) | Syngas to Pre-ITM Combustor | Extracted GT Air | Extral Air Compressor Inlet | Air to Pre-ITM Combustor | Air to ITM Unit | Depleted Air | Oxygen from ITM Unit | Oxygen to H2SO4 Unit | Oxygen to ATR | Syngas #1 to F-T Unit | Syngas #2 to F-T Unit | S Removed Syngas to F-T Unit | CO2 Product (MDEA Process) | Syngas Entering Synthesis | F-T Product | Purge Gas | Unconverted Gas |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Number | 1A | 1B | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14A | 14B | 14C | 15 | 16 | 17 | 18A | 18B | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| Temperature, C | 15 | | 33.9 | 60 | 191.3 | 249.7 | 232.2 | 244.7 | 15 | 601.4 | 152.7 | 20 | 34.4 | 244.7 | 485.5 | 15 | 513.6 | 849.5 | 681 | 849.5 | 19.4 | 203.4 | 249.7 | 232.2 | 245.3 | 26.7 | 245 | 55 | 62.9 | 198 |
| Pressure, bar | 1.014 | | 51.021 | 1.014 | 40.679 | 38.128 | 35.715 | 34.819 | 1.014 | 1.04 | 0.983 | 1.014 | 152.698 | 34.819 | 24.4 | 1.014 | 25.696 | 25.145 | 24.4 | 1.272 | 8.584 | 38 | 38.128 | 36.749 | 35.715 | 151.685 | 24.263 | 2.655 | 33.15 | 27.014 |
| Solids, kg/hr | 162494 | | 0 | 14258 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vapor Frac (w/o Solids) | 0 | | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 |
| kmol/hr (w/o Solids) | 1128 | | 4048 | 0 | 23970 | 23968 | 22630 | 14955 | 32345 | 57791 | 57791 | 147 | 4543 | 1797 | 14982 | 17270 | 32252 | 33589 | 29232 | 4358 | 82 | 225 | 8223 | 2216 | 10436 | 2191 | 8540 | 128 | 75 | 7246 |
| kg/hr (w/o Solids) | 20330 | | 129535 | 0 | 462173 | 459841 | 424462 | 168543 | 933138 | 1482970 | 1482970 | 14058 | 199917 | 20253 | 432230 | 498238 | 930468 | 950721 | 811285 | 139437 | 2623 | 7214 | 157761 | 41570 | 199282 | 96317 | 150141 | 25047 | 2234 | 172388 |
| Mole Frac (w/o Solids) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| O2 | 0.00% | | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 2.80% | 2.80% | 0.00% | 0.00% | 0.00% | 20.80% | 20.80% | 20.80% | 18.60% | 6.40% | 100.00% | 100.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| N2 | 0.00% | | 0.00% | 0.00% | 0.30% | 0.30% | 0.20% | 0.30% | 77.20% | 66.40% | 66.40% | 0.00% | 0.00% | 0.30% | 77.20% | 77.20% | 77.20% | 74.10% | 85.20% | 0.00% | 0.00% | 0.00% | 0.30% | 0.20% | 0.30% | 0.00% | 16.20% | 0.00% | 36.90% | 18.70% |
| AR | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% | 0.80% | 0.80% | 0.00% | 0.00% | 0.00% | 0.90% | 0.90% | 0.90% | 0.90% | 1.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.60% | 0.00% | 1.30% | 0.60% |
| H2 | 0.00% | | 0.00% | 0.00% | 23.10% | 23.10% | 37.40% | 50.60% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 50.60% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 23.10% | 35.00% | 25.70% | 0.10% | 40.70% | 0.00% | 18.80% | 11.10% |
| CO | 0.00% | | 0.00% | 0.00% | 36.60% | 36.70% | 0.40% | 0.60% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.60% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 36.70% | 2.90% | 29.50% | 0.10% | 41.00% | 0.00% | 1.60% | 5.90% |
| CO2 | 0.00% | | 0.00% | 0.00% | 4.50% | 4.50% | 25.60% | 4.80% | 0.00% | 1.70% | 1.70% | 0.00% | 100.00% | 4.80% | 0.00% | 0.00% | 0.00% | 0.30% | 0.40% | 0.00% | 0.00% | 0.00% | 4.50% | 23.20% | 8.50% | 99.80% | 0.90% | 2.90% | 38.80% | 19.00% |
| H2O | 100.00% | | 0.00% | 0.00% | 34.80% | 35.30% | 36.20% | 43.70% | 1.10% | 28.30% | 28.30% | 3.00% | 0.00% | 43.70% | 1.10% | 1.10% | 1.10% | 6.10% | 7.00% | 0.00% | 0.00% | 0.00% | 35.30% | 38.70% | 36.00% | 0.00% | 0.50% | 1.20% | 0.20% | 44.60% |
| CH4 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.60% | 0.00% |
| H2S | 0.00% | | 0.00% | 0.00% | 0.50% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| NH3 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| COS | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CARBON | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SULFUR | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CL2 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCL | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCN | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SO2 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C2H6 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C3H8 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| S2 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2SO4 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 97.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C4H10-01 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.30% | 0.20% | 0.00% |
| C9H20-01 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 9.10% | 0.00% | 0.00% |
| C15H3-01 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 3.20% | 0.00% | 0.00% |
| C21H4-01 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 12.80% | 0.00% | 0.00% |
| C4H8--01 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 5.90% | 1.40% | 0.00% |
| C9H18-01 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 23.30% | 0.00% | 0.00% |
| C15H3-02 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 7.10% | 0.00% | 0.00% |
| C20H4-01 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 31.40% | 0.00% | 0.00% |
| CH4O | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.80% | 0.10% | 0.00% |

## Table 28: Stream data for BWF Case

(Refer to Figure 4 for stream numbers)

| | As Received Coal | As Received Biomass | Oxygen to Gasifier | Ash | Raw Syngas | Sulfur Removal Outlet | WGS Outlet | Syngas to GT Combustor | GT Air Inlet | GT Outlet | HRSG Outlet | H2SO4 Product | CO2 Product (TDA Process) | Syngas to Pre-ITM Combustor | Extracted GT Air | Extral Air Compressor Inlet | Air to Pre-ITM Combustor | Air to ITM Unit | Depleted Air | Oxygen from ITM Unit | Oxygen to H2SO4 Unit | Oxygen to ATR | Syngas #1 to F-T Unit | Syngas #2 to F-T Unit | S Removed Syngas to F-T Unit | CO2 Product (MDEA Process) | Syngas Entering Synthesis | F-T Product | Purge Gas | Unconverted Gas |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Number | 1A | 1B | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14A | 14B | 14C | 15 | 16 | 17 | 18A | 18B | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| Temperature, C | 15 | 15 | 33.9 | 60 | 190.9 | 237.1 | 232.2 | 240.4 | 15 | 612.3 | 154.6 | 20 | 34.4 | 240.4 | 485.5 | 15 | 515.9 | 849.8 | 681 | 849.8 | 19.4 | 203.4 | 237.1 | 232.2 | 235.4 | 26.7 | 245 | 55 | 62.9 | 198 |
| Pressure, bar | 1.014 | 1.014 | 51.021 | 1.014 | 40.679 | 38.128 | 35.715 | 34.819 | 1.014 | 1.04 | 0.983 | 1.014 | 152.698 | 34.819 | 24.4 | 1.014 | 25.696 | 25.145 | 24.4 | 1.266 | 8.584 | 38 | 38.128 | 36.749 | 35.715 | 151.685 | 24.263 | 2.655 | 33.15 | 27.014 |
| Solids, kg/hr | 121976 | 52275 | 0 | 11372 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vapor Frac (w/o Solids) | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 |
| kmol/hr (w/o Solids) | 847 | 2902 | 3936 | 0 | 22755 | 22753 | 22080 | 15461 | 26084 | 54223 | 54223 | 111 | 3676 | 1871 | 12082 | 19086 | 31169 | 32593 | 28384 | 4209 | 62 | 210 | 7422 | 2451 | 9870 | 2154 | 7955 | 120 | 70 | 6748 |
| kg/hr (w/o Solids) | 15261 | 52275 | 125948 | 0 | 445694 | 443932 | 418412 | 203843 | 752529 | 1399068 | 1399068 | 10607 | 161801 | 24661 | 348572 | 550638 | 899210 | 923872 | 789189 | 134683 | 1979 | 6718 | 144804 | 46439 | 191203 | 94659 | 139805 | 23322 | 2080 | 160581 |
| Mole Frac (w/o Solids) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| O2 | 0.00% | 0.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 1.90% | 1.90% | 0.00% | 0.00% | 0.00% | 20.80% | 20.80% | 20.80% | 18.50% | 6.40% | 100.00% | 100.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| N2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.30% | 0.30% | 0.20% | 0.20% | 77.20% | 64.40% | 64.40% | 0.00% | 0.00% | 0.20% | 77.20% | 77.20% | 77.20% | 73.80% | 84.80% | 0.00% | 0.00% | 0.00% | 0.30% | 0.20% | 0.30% | 0.00% | 16.20% | 0.00% | 36.90% | 18.70% |
| AR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% | 0.80% | 0.80% | 0.00% | 0.00% | 0.00% | 0.90% | 0.90% | 0.90% | 0.90% | 1.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.60% | 0.00% | 1.30% | 0.60% |
| H2 | 0.00% | 0.00% | 0.00% | 0.00% | 22.20% | 22.20% | 37.00% | 47.10% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 47.10% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 22.20% | 34.50% | 25.30% | 0.10% | 40.80% | 0.00% | 18.80% | 11.10% |
| CO | 0.00% | 0.00% | 0.00% | 0.00% | 37.70% | 37.70% | 0.50% | 0.60% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.60% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 37.70% | 2.90% | 29.10% | 0.10% | 41.10% | 0.00% | 1.60% | 5.90% |
| CO2 | 0.00% | 0.00% | 0.00% | 0.00% | 4.80% | 4.80% | 26.10% | 10.10% | 0.00% | 3.50% | 3.50% | 0.00% | 100.00% | 10.10% | 0.00% | 0.00% | 0.00% | 0.60% | 0.70% | 0.00% | 0.00% | 0.00% | 4.80% | 23.60% | 9.50% | 99.80% | 0.90% | 2.90% | 38.80% | 19.00% |
| H2O | 100.00% | 100.00% | 0.00% | 0.00% | 34.50% | 34.90% | 36.20% | 42.00% | 1.10% | 29.40% | 29.40% | 3.30% | 0.00% | 42.00% | 1.10% | 1.10% | 1.10% | 6.10% | 7.10% | 0.00% | 0.00% | 0.00% | 34.90% | 38.70% | 35.90% | 0.00% | 0.50% | 1.20% | 0.20% | 44.60% |
| CH4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.60% | 0.00% |
| H2S | 0.00% | 0.00% | 0.00% | 0.00% | 0.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| NH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| COS | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CARBON | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SULFUR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CL2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCL | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCN | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SO2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C2H6 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C3H8 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| S2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2SO4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 96.70% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C4H10-01 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.30% | 0.20% | 0.00% |
| C9H20-01 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 9.10% | 0.00% | 0.00% |
| C15H3-01 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 3.20% | 0.00% | 0.00% |
| C21H4-01 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 12.80% | 0.00% | 0.00% |
| C4H8--01 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 5.90% | 1.40% | 0.00% |
| C9H18-01 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 23.30% | 0.00% | 0.00% |
| C15H3-02 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 7.10% | 0.00% | 0.00% |
| C20H4-01 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 31.40% | 0.00% | 0.00% |
| CH4O | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.80% | 0.10% | 0.00% |

## Table 29: Stream data for BGF Case

(Refer to Figure 4 for stream numbers)

| | As Received Coal | As Received Biomass | Oxygen to Gasifier | Ash | Raw Syngas | Sulfur Removal Outlet | WGS Outlet | Syngas to GT Combustor | GT Air Inlet | GT Outlet | HRSG Outlet | H2SO4 Product | CO2 Product (TDA Process) | Syngas to Pre-ITM Combustor | Extracted GT Air | Extral Air Compressor Inlet | Air to Pre-ITM Combustor | Air to ITM Unit | Depleted Air | Oxygen from ITM Unit | Oxygen to H2SO4 Unit | Oxygen to ATR | Syngas #1 to F-T Unit | Syngas #2 to F-T Unit | S Removed Syngas to F-T Unit | CO2 Product (MDEA Process) | Syngas Entering Synthesis | F-T Product | Purge Gas | Unconverted Gas |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Number | 1A | 1B | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14A | 14B | 14C | 15 | 16 | 17 | 18A | 18B | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| Temperature, C | 15 | 15 | 33.9 | 60 | 190.8 | 238 | 232.2 | 240 | 15 | 611.9 | 153.8 | 20 | 34.4 | 240 | 485.5 | 15 | 515.4 | 849.8 | 681 | 849.8 | 19.4 | 203.4 | 238 | 232.2 | 236.3 | 26.7 | 245 | 55 | 62.9 | 198.1 |
| Pressure, bar | 1.014 | 1.014 | 51.021 | 1.014 | 40.679 | 38.128 | 35.715 | 34.819 | 1.014 | 1.04 | 0.983 | 1.014 | 152.698 | 34.819 | 24.4 | 1.014 | 25.696 | 25.145 | 24.4 | 1.266 | 8.584 | 38 | 38.128 | 36.749 | 35.715 | 151.685 | 24.263 | 2.655 | 33.15 | 27.014 |
| Solids, kg/hr | 127588 | 54681 | 0 | 14441 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vapor Frac (w/o Solids) | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 |
| kmol/hr (w/o Solids) | 886 | 536 | 3899 | 0 | 23289 | 23287 | 22122 | 15627 | 26954 | 54686 | 54686 | 116 | 3556 | 1869 | 12485 | 18521 | 31007 | 32430 | 28244 | 4186 | 64 | 222 | 8025 | 2241 | 10263 | 2174 | 8422 | 127 | 74 | 7148 |
| kg/hr (w/o Solids) | 15963 | 9650 | 124751 | 0 | 449751 | 447907 | 415424 | 205831 | 777618 | 1410651 | 1410651 | 11071 | 156509 | 24613 | 360194 | 534341 | 894534 | 919147 | 785194 | 133953 | 2062 | 7118 | 154346 | 42091 | 196386 | 95533 | 148131 | 24711 | 2204 | 170074 |
| Mole Frac (w/o Solids) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| O2 | 0.00% | 0.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 2.00% | 2.00% | 0.00% | 0.00% | 0.00% | 20.80% | 20.80% | 20.80% | 18.50% | 6.40% | 100.00% | 100.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| N2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.40% | 0.40% | 0.20% | 0.30% | 77.20% | 64.30% | 64.30% | 0.00% | 0.00% | 0.30% | 77.20% | 77.20% | 77.20% | 73.80% | 84.80% | 0.00% | 0.00% | 0.00% | 0.40% | 0.20% | 0.30% | 0.00% | 16.30% | 0.00% | 36.90% | 18.70% |
| AR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% | 0.80% | 0.80% | 0.00% | 0.00% | 0.00% | 0.90% | 0.90% | 0.90% | 0.90% | 1.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.60% | 0.00% | 1.30% | 0.60% |
| H2 | 0.00% | 0.00% | 0.00% | 0.00% | 23.10% | 23.10% | 37.20% | 47.10% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 47.10% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 23.10% | 34.80% | 25.70% | 0.10% | 40.70% | 0.00% | 18.80% | 11.10% |
| CO | 0.00% | 0.00% | 0.00% | 0.00% | 37.00% | 37.00% | 0.40% | 0.60% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.60% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 37.00% | 2.80% | 29.50% | 0.10% | 41.00% | 0.00% | 1.60% | 5.90% |
| CO2 | 0.00% | 0.00% | 0.00% | 0.00% | 4.50% | 4.60% | 25.60% | 10.00% | 0.00% | 3.50% | 3.50% | 0.00% | 100.00% | 10.00% | 0.00% | 0.00% | 0.00% | 0.60% | 0.70% | 0.00% | 0.00% | 0.00% | 4.60% | 23.20% | 8.60% | 99.80% | 0.90% | 2.90% | 38.80% | 19.00% |
| H2O | 100.00% | 100.00% | 0.00% | 0.00% | 34.40% | 34.90% | 36.50% | 42.10% | 1.10% | 29.50% | 29.50% | 3.80% | 0.00% | 42.10% | 1.10% | 1.10% | 1.10% | 6.20% | 7.10% | 0.00% | 0.00% | 0.00% | 34.90% | 38.90% | 35.80% | 0.00% | 0.50% | 1.20% | 0.20% | 44.60% |
| CH4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.60% | 0.00% |
| H2S | 0.00% | 0.00% | 0.00% | 0.00% | 0.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| NH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| COS | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CARBON | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SULFUR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CL2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCL | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCN | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SO2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C2H6 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C3H8 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| S2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2SO4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 96.20% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C4H10-01 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.30% | 0.20% | 0.00% |
| C9H20-01 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 9.10% | 0.00% | 0.00% |
| C15H3-01 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 3.20% | 0.00% | 0.00% |
| C21H4-01 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 12.80% | 0.00% | 0.00% |
| C4HB-01 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 5.90% | 1.40% | 0.00% |
| C9H18-01 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 23.30% | 0.00% | 0.00% |
| C15H3-02 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 7.10% | 0.00% | 0.00% |
| C20H4-01 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 31.40% | 0.00% | 0.00% |
| CH4O | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.80% | 0.10% | 0.00% |

## Table 30: Stream data for LOF Case

(Refer to Figure 4 for stream numbers)

| | As Received Coal | As Received Biomass | Oxygen to Gasifier | Ash | Raw Syngas | Sulfur Removal Outlet | WGS Outlet | Syngas to GT Combustor | GT Air Inlet | GT Outlet | HRSG Outlet | H2SO4 Product | CO2 Product (TDA Process) | Syngas to Pre-ITM Combustor | Extracted GT Air | Extral Air Compressor Inlet | Air to Pre-ITM Combustor | Air to ITM Unit | Depleted Air | Oxygen from ITM Unit | Oxygen to H2SO4 Unit | Oxygen to ATR | Syngas #1 to F-T Unit | Syngas #2 to F-T Unit | S Removed Syngas to F-T Unit | CO2 Product (MDEA Process) | Syngas Entering Synthesis | F-T Product | Purge Gas | Unconverted Gas |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Number | 1A | 1B | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14A | 14B | 14C | 15 | 16 | 17 | 18A | 18B | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| Temperature, C | 15 | | 24.1 | 60 | 192.1 | 216.7 | 232.2 | 246 | 4.4 | 593.6 | 152.7 | 20 | 34.4 | 246 | 473.7 | 4.4 | 504.8 | 849.9 | 681 | 849.9 | 10 | 188.8 | 216.7 | 232.2 | 221.5 | 17.2 | 245 | 55 | 62.9 | 198 |
| Pressure, bar | 1.014 | | 51.021 | 1.014 | 40.679 | 38.128 | 35.715 | 34.819 | 0.951 | 0.978 | 0.921 | 1.014 | 152.698 | 34.819 | 24.4 | 0.951 | 25.696 | 25.145 | 24.4 | 1.268 | 8.584 | 38 | 38.128 | 36.749 | 35.715 | 151.685 | 24.263 | 2.655 | 33.15 | 27.014 |
| Solids, kg/hr | 184816 | | 0 | 22646 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vapor Frac (w/o Solids) | 0 | | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 |
| kmol/hr (w/o Solids) | 5791 | | 4045 | 0 | 21913 | 21911 | 21529 | 13686 | 24524 | 52183 | 52183 | 59 | 4729 | 1863 | 11360 | 20257 | 31617 | 33008 | 28738 | 4270 | 32 | 194 | 6575 | 3009 | 9583 | 2226 | 7335 | 110 | 64 | 6221 |
| kg/hr (w/o Solids) | 104320 | | 129423 | 0 | 443819 | 442884 | 417429 | 156635 | 708684 | 1337299 | 1337299 | 5573 | 208131 | 21317 | 328263 | 585381 | 913644 | 934960 | 798325 | 136635 | 1039 | 6200 | 132903 | 58349 | 191220 | 97864 | 128909 | 21505 | 1918 | 148013 |
| Mole Frac (w/o Solids) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| O2 | 0.00% | | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 2.10% | 2.10% | 0.00% | 0.00% | 0.00% | 20.80% | 20.80% | 20.80% | 18.50% | 6.40% | 100.00% | 100.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| N2 | 0.00% | | 0.00% | 0.00% | 0.30% | 0.30% | 0.20% | 0.20% | 77.60% | 66.70% | 66.70% | 0.00% | 0.00% | 0.20% | 77.60% | 77.60% | 77.60% | 74.30% | 85.40% | 0.00% | 0.00% | 0.00% | 0.30% | 0.20% | 0.20% | 0.00% | 16.20% | 0.00% | 36.90% | 18.70% |
| AR | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% | 0.80% | 0.80% | 0.00% | 0.00% | 0.00% | 0.90% | 0.90% | 0.90% | 0.90% | 1.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.60% | 0.00% | 1.30% | 0.60% |
| H2 | 0.00% | | 0.00% | 0.00% | 19.70% | 19.70% | 36.10% | 50.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 50.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 19.70% | 33.50% | 24.00% | 0.10% | 40.80% | 0.00% | 18.80% | 11.10% |
| CO | 0.00% | | 0.00% | 0.00% | 38.80% | 38.80% | 0.50% | 0.70% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.70% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 38.80% | 3.10% | 27.60% | 0.10% | 41.10% | 0.00% | 1.60% | 5.90% |
| CO2 | 0.00% | | 0.00% | 0.00% | 5.50% | 5.50% | 27.20% | 5.10% | 0.00% | 1.80% | 1.80% | 0.00% | 100.00% | 5.10% | 0.00% | 0.00% | 0.00% | 0.40% | 0.40% | 0.00% | 0.00% | 0.00% | 5.50% | 24.70% | 11.50% | 99.80% | 0.90% | 2.90% | 38.80% | 19.00% |
| H2O | 100.00% | | 0.00% | 0.00% | 35.40% | 35.60% | 36.00% | 44.00% | 0.60% | 28.60% | 28.60% | 4.50% | 0.00% | 44.00% | 0.60% | 0.60% | 0.60% | 5.90% | 6.80% | 0.00% | 0.00% | 0.00% | 35.60% | 38.60% | 36.60% | 0.00% | 0.50% | 1.20% | 0.20% | 44.60% |
| CH4 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.60% | 0.00% |
| H2S | 0.00% | | 0.00% | 0.00% | 0.20% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| NH3 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| COS | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CARBON | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SULFUR | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CL2 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCL | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCN | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SO2 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C2H6 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C3H8 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| S2 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2SO4 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 95.50% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C4H10-01 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.30% | 0.20% | 0.00% |
| C9H20-01 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 9.10% | 0.00% | 0.00% |
| C15H3-01 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 3.20% | 0.00% | 0.00% |
| C21H4-01 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 12.80% | 0.00% | 0.00% |
| C4H8--01 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 5.90% | 1.40% | 0.00% |
| C9H18-01 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 23.30% | 0.00% | 0.00% |
| C15H3-02 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 7.10% | 0.00% | 0.00% |
| C20H4-01 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 31.40% | 0.00% | 0.00% |
| CH4O | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.80% | 0.10% | 0.00% |

## Table 31: Stream data for LWF Case

(Refer to Figure 4 for stream numbers)

| | As Received Coal | As Received Biomass | Oxygen to Gasifier | Ash | Raw Syngas | Sulfur Removal Outlet | WGS Outlet | Syngas to GT Combustor | GT Air Inlet | GT Outlet | HRSG Outlet | H2SO4 Product | CO2 Product (TDA Process) | Syngas to Pre-ITM Combustor | Extracted GT Air | Extral Air Compressor Inlet | Air to Pre-ITM Combustor | Air to ITM Unit | Depleted Air | Oxygen from ITM Unit | Oxygen to H2SO4 Unit | Oxygen to ATR | Syngas #1 to F-T Unit | Syngas #2 to F-T Unit | S Removed Syngas to F-T Unit | CO2 Product (MDEA Process) | Syngas Entering Synthesis | F-T Product | Purge Gas | Unconverted Gas |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Number | 1A | 1B | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14A | 14B | 14C | 15 | 16 | 17 | 18A | 18B | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| Temperature, C | 15 | 15 | 24.0739 | 60 | 191.7 | 210.2 | 232.2 | 241.2 | 4.4 | 604.8 | 153.4 | 20 | 34.4 | 241.2 | 473.7 | 4.4 | 506.6 | 850.4 | 681 | 850.4 | 10 | 188.8 | 210.2 | 232.2 | 217.6 | 17.2 | 245 | 55 | 62.9 | 197.9 |
| Pressure, bar | 1.014 | 1.014 | 51.0212 | 1.014 | 40.679 | 38.128 | 35.715 | 34.819 | 0.951 | 0.978 | 0.921 | 1.014 | 152.698 | 34.819 | 24.4 | 0.951 | 25.696 | 25.145 | 24.4 | 1.262 | 8.584 | 38 | 38.128 | 36.749 | 35.715 | 151.685 | 24.263 | 2.655 | 33.15 | 27.014 |
| Solids, kg/hr | 133315 | 57135 | 0 | 17066 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vapor Frac (w/o Solids) | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 |
| kmol/hr (w/o Solids) | 4177 | 3171 | 3907 | 0 | 21111 | 21109 | 21119 | 14312 | 19601 | 49380 | 49380 | 43 | 3781 | 1944 | 9079 | 21410 | 30489 | 31976 | 27862 | 4114 | 24 | 184 | 6139 | 3075 | 9212 | 2190 | 6984 | 105 | 61 | 5921 |
| kg/hr (w/o Solids) | 75250 | 57135 | 125034 | 0 | 432163 | 431477 | 412162 | 191855 | 566423 | 1273204 | 1273204 | 4078 | 166389 | 26065 | 262368 | 618684 | 881052 | 907117 | 775468 | 131650 | 759 | 5901 | 125478 | 60013 | 185464 | 96277 | 122705 | 20470 | 1826 | 140874 |
| Mole Frac (w/o Solids) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| O2 | 0.00% | 0.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 1.20% | 1.20% | 0.00% | 0.00% | 0.00% | 20.80% | 20.80% | 20.80% | 18.40% | 6.40% | 100.00% | 100.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| N2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.20% | 0.20% | 0.20% | 0.20% | 77.60% | 64.60% | 64.60% | 0.00% | 0.00% | 0.20% | 77.60% | 77.60% | 77.60% | 74.00% | 84.90% | 0.00% | 0.00% | 0.00% | 0.20% | 0.20% | 0.20% | 0.00% | 16.10% | 0.00% | 36.90% | 18.70% |
| AR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% | 0.80% | 0.80% | 0.00% | 0.00% | 0.00% | 0.90% | 0.90% | 0.90% | 0.90% | 1.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.60% | 0.00% | 1.30% | 0.60% |
| H2 | 0.00% | 0.00% | 0.00% | 0.00% | 19.10% | 19.10% | 35.80% | 46.50% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 46.50% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 19.10% | 33.20% | 23.80% | 0.10% | 40.80% | 0.00% | 18.80% | 11.10% |
| CO | 0.00% | 0.00% | 0.00% | 0.00% | 39.50% | 39.50% | 0.50% | 0.60% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.60% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 39.50% | 3.10% | 27.40% | 0.10% | 41.10% | 0.00% | 1.60% | 5.90% |
| CO2 | 0.00% | 0.00% | 0.00% | 0.00% | 5.80% | 5.80% | 27.60% | 10.60% | 0.00% | 3.80% | 3.80% | 0.00% | 100.00% | 10.60% | 0.00% | 0.00% | 0.00% | 0.70% | 0.80% | 0.00% | 0.00% | 0.00% | 5.80% | 24.90% | 12.20% | 99.80% | 0.90% | 2.90% | 38.80% | 19.00% |
| H2O | 100.00% | 100.00% | 0.00% | 0.00% | 35.10% | 35.30% | 36.00% | 42.10% | 0.60% | 29.70% | 29.70% | 5.10% | 0.00% | 42.10% | 0.60% | 0.60% | 0.60% | 6.00% | 6.90% | 0.00% | 0.00% | 0.00% | 35.30% | 38.60% | 36.40% | 0.00% | 0.50% | 1.20% | 0.20% | 44.60% |
| CH4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.60% | 0.00% |
| H2S | 0.00% | 0.00% | 0.00% | 0.00% | 0.20% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| NH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| COS | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CARBON | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SULFUR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CL2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCL | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCN | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SO2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C2H6 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C3H8 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| S2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2SO4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 94.90% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C4H10-01 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.30% | 0.20% | 0.00% |
| C9H20-01 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 9.10% | 0.00% | 0.00% |
| C15H3-01 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 3.20% | 0.00% | 0.00% |
| C21H4-01 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 12.80% | 0.00% | 0.00% |
| C4HB-01 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 5.90% | 1.40% | 0.00% |
| C9H18-01 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 23.30% | 0.00% | 0.00% |
| C15H3-02 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 7.10% | 0.00% | 0.00% |
| C20H4-01 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 31.40% | 0.00% | 0.00% |
| CH4O | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.80% | 0.10% | 0.00% |

## Table 32: Stream data for LGF Case

(Refer to Figure 4 for stream numbers)

| | As Received Coal | As Received Biomass | Oxygen to Gasifier | Ash | Raw Syngas | Sulfur Removal Outlet | WGS Outlet | Syngas to GT Combustor | GT Air Inlet | GT Outlet | HRSG Outlet | H2SO4 Product | CO2 Product (TDA Process) | Syngas to Pre-ITM Combustor | Extracted GT Air | Extral Air Compressor Inlet | Air to Pre-ITM Combustor | Air to ITM Unit | Depleted Air | Oxygen from ITM Unit | Oxygen to H2SO4 Unit | Oxygen to ATR | Syngas #1 to F-T Unit | Syngas #2 to F-T Unit | S Removed Syngas to F-T Unit | CO2 Product (MDEA Process) | Syngas Entering Synthesis | F-T Product | Purge Gas | Unconverted Gas |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Number | 1A | 1B | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14A | 14B | 14C | 15 | 16 | 17 | 18A | 18B | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| Temperature, C | 15 | 15 | 24.1 | 60 | 191.6 | 210.5 | 232.2 | 240.6 | 4.4 | 604.5 | 154.2 | 20 | 34.4 | 240.6 | 473.7 | 4.4 | 506.2 | 850.2 | 681 | 850.2 | 10 | 188.8 | 210.5 | 232.2 | 217 | 17.2 | 245 | 55 | 62.9 | 198.1 |
| Pressure, bar | 1.014 | 1.014 | 51.021 | 1.014 | 40.679 | 38.128 | 35.715 | 34.819 | 0.951 | 0.978 | 0.921 | 1.014 | 152.698 | 34.819 | 24.4 | 0.951 | 25.696 | 25.145 | 24.4 | 1.261 | 8.584 | 38 | 38.128 | 36.749 | 35.715 | 151.685 | 24.263 | 2.655 | 33.15 | 27.014 |
| Solids, kg/hr | 140486 | 60208 | 0 | 20788 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vapor Frac (w/o Solids) | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 |
| kmol/hr (w/o Solids) | 4402 | 590 | 3868 | 0 | 21619 | 21618 | 21064 | 14465 | 20305 | 49746 | 49746 | 46 | 3667 | 1943 | 9405 | 20920 | 30325 | 31811 | 27720 | 4091 | 25 | 199 | 6777 | 2886 | 9661 | 2211 | 7515 | 113 | 66 | 6378 |
| kg/hr (w/o Solids) | 79298 | 10625 | 123761 | 0 | 433784 | 433060 | 405803 | 193880 | 586757 | 1282255 | 1282255 | 4271 | 161378 | 26040 | 271786 | 604523 | 876310 | 902350 | 771436 | 130914 | 792 | 6357 | 135758 | 55599 | 191319 | 97176 | 132161 | 22047 | 1967 | 151746 |
| Mole Frac (w/o Solids) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| O2 | 0.00% | 0.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 1.20% | 1.20% | 0.00% | 0.00% | 0.00% | 20.80% | 20.80% | 20.80% | 18.40% | 6.40% | 100.00% | 100.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| N2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.30% | 0.30% | 0.20% | 0.30% | 77.60% | 64.40% | 64.40% | 0.00% | 0.00% | 0.30% | 77.60% | 77.60% | 77.60% | 74.00% | 84.90% | 0.00% | 0.00% | 0.00% | 0.30% | 0.20% | 0.30% | 0.00% | 16.20% | 0.00% | 36.90% | 18.70% |
| AR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% | 0.80% | 0.80% | 0.00% | 0.00% | 0.00% | 0.90% | 0.90% | 0.90% | 0.90% | 1.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.60% | 0.00% | 1.30% | 0.60% |
| H2 | 0.00% | 0.00% | 0.00% | 0.00% | 20.40% | 20.40% | 36.20% | 46.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 46.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.40% | 33.60% | 24.40% | 0.10% | 40.70% | 0.00% | 18.80% | 11.10% |
| CO | 0.00% | 0.00% | 0.00% | 0.00% | 38.70% | 38.70% | 0.50% | 0.60% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.60% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 38.70% | 3.00% | 28.00% | 0.10% | 41.00% | 0.00% | 1.60% | 5.90% |
| CO2 | 0.00% | 0.00% | 0.00% | 0.00% | 5.30% | 5.30% | 26.80% | 10.50% | 0.00% | 3.70% | 3.70% | 0.00% | 100.00% | 10.50% | 0.00% | 0.00% | 0.00% | 0.70% | 0.80% | 0.00% | 0.00% | 0.00% | 5.30% | 24.30% | 11.00% | 99.80% | 0.90% | 2.90% | 38.80% | 19.00% |
| H2O | 100.00% | 100.00% | 0.00% | 0.00% | 35.00% | 35.20% | 36.30% | 42.20% | 0.60% | 29.80% | 29.80% | 6.40% | 0.00% | 42.20% | 0.60% | 0.60% | 0.60% | 6.00% | 6.90% | 0.00% | 0.00% | 0.00% | 35.20% | 38.90% | 36.30% | 0.00% | 0.50% | 1.20% | 0.20% | 44.60% |
| CH4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.60% | 0.00% |
| H2S | 0.00% | 0.00% | 0.00% | 0.00% | 0.20% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| NH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| COS | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CARBON | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SULFUR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CL2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCL | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCN | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SO2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C2H6 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C3H8 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| S2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2SO4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 93.60% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C4H10-01 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.30% | 0.20% |
| C9H20-01 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 9.10% | 0.00% |
| C15H3-01 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 3.20% | 0.00% |
| C21H4-01 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 12.80% | 0.00% |
| C4HB--01 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 5.90% | 1.40% |
| C9H18-01 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 23.30% | 0.00% |
| C15H3-02 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 7.10% | 0.00% |
| C20H4-01 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 31.40% | 0.00% |
| CH4O | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.80% | 0.10% |

## Table 33: Stream data for BOA Case

(Refer to Figure 5 for stream numbers)

| | As Received Coal | As Received Biomass | Oxygen to Gasifier | Ash | Raw Syngas | Sulfur Removal Outlet | WGS Outlet | Syngas to GT Combustor | GT Air Inlet | GT Outlet | HRSG Outlet | H2SO4 Product | CO2 Product (TDA Process) | Syngas to Pre-ITM Combustor | Extracted GT Air | Extral Air Compressor Inlet | Air to Pre-ITM Combustor | Air to ITM Unit | Depleted Air | Excess Depleted Air | Oxygen from ITM Unit | Oxygen to H2SO4 Unit | Oxygen to ATR | Syngas #1 to Alcohol Unit | Syngas #2 to Alcohol Unit | S Removed Syngas to F-T Unit | CO2 Product (MDEA Process) | Syngas Entering Synthesis | Alcohol Product | Purge Gas | Unconverted Gas |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Number | 1A | 1B | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14A | 14B | 14C | 15 | 16A | 16B | 17 | 18A | 18B | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| Temperature, C | 15 | | 33.9 | 60 | 188.9 | 249.2 | 232.2 | 244.2 | 15 | 597.9 | 153.4 | 20 | 34.4 | 244.2 | 485.5 | 15 | 515.9 | 850 | 629 | 242.3 | 850 | 19.4 | 203.4 | 249.2 | 232.2 | 248.8 | 26.7 | 255 | 20.6 | 60.3 | 198 |
| Pressure, bar | 1.014 | | 51.021 | 1.014 | 40.679 | 38.128 | 35.715 | 34.819 | 1.014 | 1.04 | 0.983 | 1.014 | 152.698 | 34.819 | 24.4 | 1.014 | 26.041 | 25.489 | 24.4 | 1.034 | 1.277 | 8.584 | 38 | 38.128 | 36.749 | 35.715 | 151.685 | 16.911 | 4.461 | 25.66 | 20.767 |
| Solids, kg/hr | 175885 | | 0 | 15433 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vapor Frac (w/o Solids) | 0 | | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 |
| kmol/hr (w/o Solids) | 1221 | | 4382 | 0 | 25283 | 25280 | 24260 | 15315 | 43430 | 63694 | 63694 | 159 | 4746 | 2568 | 20117 | 20668 | 40785 | 42748 | 27943 | 9314 | 5491 | 89 | 1020 | 11533 | 0 | 11530 | 3278 | 56011 | 568 | 1278 | 60223 |
| kg/hr (w/o Solids) | 22005 | | 140213 | 0 | 488321 | 485797 | 453563 | 173560 | 1252940 | 1633626 | 1633626 | 15218 | 208860 | 29104 | 580363 | 596278 | 1176641 | 1205744 | 772533 | 257511 | 175701 | 2840 | 32646 | 221621 | 3 | 221563 | 143130 | 643700 | 26269 | 14955 | 781025 |
| Mole Frac (w/o Solids) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| O2 | 0.00% | | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 3.50% | 3.50% | 0.00% | 0.00% | 0.00% | 20.80% | 20.80% | 20.80% | 18.40% | 6.40% | 6.40% | 100.00% | 100.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| N2 | 0.00% | | 0.00% | 0.00% | 0.30% | 0.30% | 0.20% | 0.30% | 77.20% | 65.50% | 65.50% | 0.00% | 0.00% | 0.30% | 77.20% | 77.20% | 77.20% | 73.70% | 84.50% | 84.50% | 0.00% | 0.00% | 0.00% | 0.30% | 0.20% | 0.30% | 0.00% | 2.70% | 0.00% | 3.00% | 2.40% |
| AR | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% | 0.80% | 0.80% | 0.00% | 0.00% | 0.00% | 0.90% | 0.90% | 0.90% | 0.90% | 1.00% | 1.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2 | 0.00% | | 0.00% | 0.00% | 23.70% | 23.70% | 34.50% | 46.80% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 46.80% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 23.70% | 32.70% | 23.70% | 0.60% | 60.50% | 0.00% | 60.80% | 51.80% |
| CO | 0.00% | | 0.00% | 0.00% | 37.60% | 37.60% | 0.30% | 0.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 37.60% | 2.00% | 37.60% | 0.30% | 28.50% | 0.00% | 24.90% | 19.30% |
| CO2 | 0.00% | | 0.00% | 0.00% | 4.60% | 4.60% | 23.60% | 2.80% | 0.00% | 1.60% | 1.60% | 0.00% | 100.00% | 2.80% | 0.00% | 0.00% | 0.00% | 0.20% | 0.30% | 0.30% | 0.00% | 0.00% | 0.00% | 4.60% | 21.90% | 4.60% | 99.00% | 0.10% | 0.00% | 2.60% | 4.60% |
| H2O | 100.00% | | 0.00% | 0.00% | 33.10% | 33.60% | 41.40% | 49.80% | 1.10% | 28.60% | 28.60% | 3.00% | 0.00% | 49.80% | 1.10% | 1.10% | 1.10% | 6.80% | 7.80% | 7.80% | 0.00% | 0.00% | 0.00% | 33.60% | 43.10% | 33.60% | 0.00% | 0.30% | 0.00% | 0.00% | 15.40% |
| CH4 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 7.00% | 0.00% | 8.30% | 6.50% |
| H2S | 0.00% | | 0.00% | 0.00% | 0.60% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| NH3 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| COS | 0.00% | | 0.00% | 0.00% | 0.10% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CARBON | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SULFUR | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CL2 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCL | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCN | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SO2 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C2H6 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 0.00% |
| C3H6 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C3H8 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C4H10 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C6H14 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CH3OH | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.70% | 0.50% | 0.10% | 0.00% |
| C2H5OH | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 97.80% | 0.10% | 0.00% |
| C3H7OH | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.60% | 0.00% | 0.00% |
| C4H9OH | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CH3COCH3 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 0.00% | 0.00% |
| CH3COH | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 0.30% | 0.00% |
| S2 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2SO4 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 97.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

## Table 34: Stream data for BWA Case

(Refer to Figure 5 for stream numbers)

| | As Received Coal | As Received Biomass | Oxygen to Gasifier | Ash | Raw Syngas | Sulfur Removal Outlet | WGS Outlet | Syngas to GT Combustor | GT Air Inlet | GT Outlet | HRSG Outlet | H2SO4 Product | CO2 Product (TDA Process) | Syngas to Pre-ITM Combustor | Extracted GT Air | Extral Air Compressor Inlet | Air to Pre-ITM Combustor | Air to ITM Unit | Depleted Air | Excess Depleted Air | Oxygen from ITM Unit | Oxygen to H2SO4 Unit | Oxygen to ATR | Syngas #1 to Alcohol Unit | Syngas #2 to Alcohol Unit | S Removed Syngas to F-T Unit | CO2 Product (MDEA Process) | Syngas Entering Synthesis | Alcohol Product | Purge Gas | Unconverted Gas |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Number | 1A | 1B | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14A | 14B | 14C | 15 | 16A | 16B | 17 | 18A | 18B | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| Temperature, C | 15 | 15 | 33.9 | 60 | 188.6 | 236.2 | 232.2 | 239.8 | 15 | 609 | 156.2 | 20 | 34.4 | 239.8 | 485.5 | 15 | 517.7 | 849.9 | 629 | 245.3 | 849.9 | 19.4 | 203.4 | 236.2 | 232.2 | 235.9 | 26.7 | 255 | 20.6 | 60.2 | 198 |
| Pressure, bar | 1.014 | 1.014 | 51.021 | 1.014 | 40.679 | 38.128 | 35.715 | 34.819 | 1.014 | 1.04 | 0.983 | 1.014 | 152.698 | 34.819 | 24.4 | 1.014 | 26.041 | 25.489 | 24.4 | 1.034 | 1.267 | 8.584 | 38 | 38.128 | 36.749 | 35.715 | 151.685 | 16.911 | 4.461 | 25.66 | 20.767 |
| Solids, kg/hr | 131877 | 56519 | 0 | 12295 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vapor Frac (w/o Solids) | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 |
| kmol/hr (w/o Solids) | 916 | 3137 | 4256 | 0 | 24003 | 24000 | 23985 | 16135 | 36341 | 59652 | 59652 | 120 | 3828 | 2713 | 16833 | 22137 | 38970 | 41089 | 26891 | 8964 | 5234 | 67 | 911 | 10560 | 0 | 10558 | 3106 | 49936 | 535 | 1134 | 53560 |
| kg/hr (w/o Solids) | 16499 | 56519 | 136172 | 0 | 471067 | 469163 | 452702 | 214980 | 1048438 | 1536168 | 1536168 | 11468 | 168456 | 36143 | 485638 | 638646 | 1124280 | 1160432 | 744718 | 248239 | 167471 | 2139 | 29158 | 206432 | 2 | 206385 | 135690 | 589331 | 24732 | 13670 | 710014 |
| Mole Frac (w/o Solids) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| O2 | 0.00% | 0.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 2.50% | 2.50% | 0.00% | 0.00% | 0.00% | 20.80% | 20.80% | 20.80% | 18.20% | 6.30% | 6.30% | 100.00% | 100.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| N2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.30% | 0.30% | 0.20% | 0.20% | 77.20% | 63.20% | 63.20% | 0.00% | 0.00% | 0.20% | 77.20% | 77.20% | 77.20% | 73.20% | 83.90% | 83.90% | 0.00% | 0.00% | 0.00% | 0.30% | 0.20% | 0.30% | 0.00% | 2.40% | 0.00% | 2.70% | 2.20% |
| AR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% | 0.80% | 0.80% | 0.00% | 0.00% | 0.00% | 0.90% | 0.90% | 0.90% | 0.90% | 1.00% | 1.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2 | 0.00% | 0.00% | 0.00% | 0.00% | 22.80% | 22.80% | 34.10% | 43.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 43.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 22.80% | 32.30% | 22.80% | 0.60% | 59.30% | 0.00% | 59.40% | 50.90% |
| CO | 0.00% | 0.00% | 0.00% | 0.00% | 38.60% | 38.60% | 0.30% | 0.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 38.60% | 2.10% | 38.60% | 0.30% | 29.90% | 0.00% | 26.30% | 20.30% |
| CO2 | 0.00% | 0.00% | 0.00% | 0.00% | 4.90% | 5.00% | 24.10% | 8.40% | 0.00% | 3.40% | 3.40% | 0.00% | 100.00% | 8.40% | 0.00% | 0.00% | 0.00% | 0.60% | 0.70% | 0.70% | 0.00% | 0.00% | 0.00% | 5.00% | 22.30% | 5.00% | 99.00% | 0.10% | 0.00% | 2.70% | 4.80% |
| H2O | 100.00% | 100.00% | 0.00% | 0.00% | 32.80% | 33.30% | 41.30% | 47.60% | 1.10% | 30.10% | 30.10% | 3.30% | 0.00% | 47.60% | 1.10% | 1.10% | 1.10% | 7.00% | 8.10% | 8.10% | 0.00% | 0.00% | 0.00% | 33.30% | 43.10% | 33.30% | 0.00% | 0.20% | 0.00% | 0.00% | 15.20% |
| CH4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 7.00% | 0.00% | 8.40% | 6.60% |
| H2S | 0.00% | 0.00% | 0.00% | 0.00% | 0.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| NH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| COS | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CARBON | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SULFUR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CL2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCL | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCN | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SO2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C2H6 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 0.00% |
| C3H6 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C3H8 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C4H10 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C6H14 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CH3OH | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.70% | 0.60% | 0.10% | 0.00% |
| C2H5OH | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 97.70% | 0.10% | 0.00% |
| C3H7OH | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.60% | 0.00% | 0.00% |
| C4H9OH | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CH3COCH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 0.00% | 0.00% |
| CH3COH | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 0.00% | 0.30% | 0.00% |
| S2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2SO4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 96.70% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

## Table 35: Stream data for BGA Case

(Refer to Figure 5 for stream numbers)

| | As Received Coal | As Received Biomass | Oxygen to Gasifier | Ash | Raw Syngas | Sulfur Removal Outlet | WGS Outlet | Syngas to GT Combustor | GT Air Inlet | GT Outlet | HRSG Outlet | H2SO4 Product | CO2 Product (TDA Process) | Syngas to Pre-ITM Combustor | Extracted GT Air | Extral Air Compressor Inlet | Air to Pre-ITM Combustor | Air to ITM Unit | Depleted Air | Excess Depleted Air | Oxygen from ITM Unit | Oxygen to H2SO4 Unit | Oxygen to ATR | Syngas #1 to Alcohol Unit | Syngas #2 to Alcohol Unit | S Removed Syngas to F-T Unit | CO2 Product (MDEA Process) | Syngas Entering Synthesis | Alcohol Product | Purge Gas | Unconverted Gas |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Number | 1A | 1B | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14A | 14B | 14C | 15 | 16A | 16B | 17 | 18A | 18B | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| Temperature, C | 15 | 15 | 33.9 | 60 | 188.5 | 237.2 | 232.2 | 239.3 | 15 | 609.2 | 153.3 | 20 | 34.4 | 239.3 | 485.5 | 15 | 518 | 849.9 | 629 | 245.5 | 849.9 | 19.4 | 203.4 | 237.2 | 232.2 | 236.8 | 26.7 | 255 | 20.6 | 60.3 | 198 |
| Pressure, bar | 1.014 | 1.014 | 51.021 | 1.014 | 40.679 | 38.128 | 35.715 | 34.819 | 1.014 | 1.04 | 0.983 | 1.014 | 152.698 | 34.819 | 24.4 | 1.014 | 26.041 | 25.489 | 24.4 | 1.034 | 1.266 | 8.584 | 38 | 38.128 | 36.749 | 35.715 | 151.685 | 16.911 | 4.461 | 25.66 | 20.767 |
| Solids, kg/hr | 136903 | 58673 | 0 | 15495 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vapor Frac (w/o Solids) | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 |
| kmol/hr (w/o Solids) | 951 | 575 | 4183 | 0 | 24359 | 24356 | 23499 | 15871 | 35656 | 59292 | 59292 | 125 | 3586 | 2753 | 16516 | 22584 | 39100 | 41255 | 27004 | 9001 | 5250 | 69 | 997 | 11253 | 0 | 11249 | 3227 | 54866 | 560 | 1251 | 58950 |
| kg/hr (w/o Solids) | 17128 | 10354 | 133861 | 0 | 471222 | 469243 | 439731 | 212043 | 1028673 | 1526652 | 1526652 | 11879 | 157827 | 36780 | 476482 | 651539 | 1128022 | 1164799 | 747612 | 249204 | 167985 | 2214 | 31908 | 216790 | 2 | 216730 | 140912 | 636919 | 25880 | 14805 | 770548 |
| Mole Frac (w/o Solids) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| O2 | 0.00% | 0.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 2.50% | 2.50% | 0.00% | 0.00% | 0.00% | 20.80% | 20.80% | 20.80% | 18.20% | 6.30% | 6.30% | 100.00% | 100.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| N2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.40% | 0.40% | 0.20% | 0.30% | 77.20% | 63.20% | 63.20% | 0.00% | 0.00% | 0.30% | 77.20% | 77.20% | 77.20% | 73.20% | 83.80% | 83.80% | 0.00% | 0.00% | 0.00% | 0.40% | 0.20% | 0.40% | 0.00% | 3.00% | 0.00% | 3.30% | 2.80% |
| AR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% | 0.80% | 0.80% | 0.00% | 0.00% | 0.00% | 0.90% | 0.90% | 0.90% | 0.90% | 1.00% | 1.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2 | 0.00% | 0.00% | 0.00% | 0.00% | 23.70% | 23.70% | 34.10% | 43.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 43.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 23.70% | 32.40% | 23.80% | 0.60% | 60.10% | 0.00% | 60.30% | 51.40% |
| CO | 0.00% | 0.00% | 0.00% | 0.00% | 37.90% | 37.90% | 0.30% | 0.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 37.90% | 2.00% | 38.00% | 0.30% | 28.70% | 0.00% | 25.10% | 19.40% |
| CO2 | 0.00% | 0.00% | 0.00% | 0.00% | 4.70% | 4.70% | 23.50% | 8.30% | 0.00% | 3.40% | 3.40% | 0.00% | 100.00% | 8.30% | 0.00% | 0.00% | 0.00% | 0.60% | 0.70% | 0.70% | 0.00% | 0.00% | 0.00% | 4.70% | 21.80% | 4.70% | 99.00% | 0.10% | 0.00% | 2.50% | 4.60% |
| H2O | 100.00% | 100.00% | 0.00% | 0.00% | 32.70% | 33.20% | 41.90% | 48.00% | 1.10% | 30.10% | 30.10% | 3.70% | 0.00% | 48.00% | 1.10% | 1.10% | 1.10% | 7.10% | 8.10% | 8.10% | 0.00% | 0.00% | 0.00% | 33.20% | 43.60% | 33.20% | 0.00% | 0.20% | 0.00% | 0.00% | 15.30% |
| CH4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 7.00% | 0.00% | 8.20% | 6.50% |
| H2S | 0.00% | 0.00% | 0.00% | 0.00% | 0.50% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| NH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| COS | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CARBON | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SULFUR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CL2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCL | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCN | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SO2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C2H6 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 0.00% |
| C3H6 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C3H8 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C4H10 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C6H14 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CH3OH | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.70% | 0.50% | 0.10% | 0.00% |
| C2H5OH | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 97.70% | 0.10% | 0.00% |
| C3H7OH | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.60% | 0.00% | 0.00% |
| C4H9OH | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CH3COCH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 0.00% | 0.00% |
| CH3COH | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 0.00% | 0.30% | 0.00% |
| S2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2SO4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 96.30% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

## Table 36: Stream data for LOA Case

(Refer to Figure 5 for stream numbers)

| | As Received Coal | As Received Biomass | Oxygen to Gasifier | Ash | Raw Syngas | Sulfur Removal Outlet | WGS Outlet | Syngas to GT Combustor | GT Air Inlet | GT Outlet | HRSG Outlet | H2SO4 Product | CO2 Product (TDA Process) | Syngas to Pre-ITM Combustor | Extracted GT Air | Extral Air Compressor Inlet | Air to Pre-ITM Combustor | Air to ITM Unit | Depleted Air | Excess Depleted Air | Oxygen from ITM Unit | Oxygen to H2SO4 Unit | Oxygen to ATR | Syngas #1 to Alcohol Unit | Syngas #2 to Alcohol Unit | S Removed Syngas to F-T Unit | CO2 Product (MDEA Process) | Syngas Entering Synthesis | Alcohol Product | Purge Gas | Unconverted Gas |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Number | 1A | 1B | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14A | 14B | 14C | 15 | 16A | 16B | 17 | 18A | 18B | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| Temperature, C | 15 | | 24.1 | 60 | 190.2 | 215.6 | 232.2 | 245.3 | 4.4 | 589.8 | 153.1 | 20 | 34.4 | 245.3 | 473.7 | 4.4 | 505.6 | 849.7 | 629 | 235.7 | 849.7 | 10 | 188.8 | 215.6 | 232.2 | 215.1 | 17.22222 | 255 | 9.9 | 60.1 | 198 |
| Pressure, bar | 1.014 | | 51.021 | 1.014 | 40.679 | 38.128 | 35.715 | 34.819 | 0.951 | 0.978 | 0.921 | 1.014 | 152.698 | 34.819 | 24.4 | 0.951 | 26.041 | 25.489 | 24.4 | 1.034 | 1.28 | 8.584 | 38 | 38.128 | 36.749 | 35.715 | 151.68466 | 16.911 | 4.461 | 25.66 | 20.767 |
| Solids, kg/hr | 203114 | | 0 | 24888 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vapor Frac (w/o Solids) | 0 | | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 |
| kmol/hr (w/o Solids) | 6364 | | 4445 | 0 | 23580 | 23578 | 24172 | 14936 | 36927 | 58647 | 58647 | 65 | 5132 | 2502 | 17105 | 21982 | 39086 | 41007 | 26797 | 8932 | 5279 | 36 | 798 | 10023 | 0 | 10021 | 3085 | 43189 | 526 | 968 | 45670 |
| kg/hr (w/o Solids) | 114649 | | 142236 | 0 | 478717 | 477690 | 465883 | 172592 | 1067092 | 1500323 | 1500323 | 6124 | 225850 | 28913 | 494278 | 635202 | 1129480 | 1158393 | 742111 | 247370 | 168912 | 1141 | 25539 | 203066 | 3 | 203030 | 134929 | 554850 | 24295 | 12806 | 647877 |
| Mole Frac (w/o Solids) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| O2 | 0.00% | | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 3.00% | 3.00% | 0.00% | 0.00% | 0.00% | 20.80% | 20.80% | 20.80% | 18.40% | 6.40% | 6.40% | 100.00% | 100.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| N2 | 0.00% | | 0.00% | 0.00% | 0.30% | 0.30% | 0.20% | 0.20% | 77.60% | 65.10% | 65.10% | 0.00% | 0.00% | 0.20% | 77.60% | 77.60% | 77.60% | 74.00% | 84.90% | 84.90% | 0.00% | 0.00% | 0.00% | 0.30% | 0.20% | 0.30% | 0.01% | 2.60% | 0.00% | 2.90% | 2.40% |
| AR | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% | 0.80% | 0.80% | 0.00% | 0.00% | 0.00% | 0.90% | 0.90% | 0.90% | 0.90% | 1.00% | 1.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2 | 0.00% | | 0.00% | 0.00% | 20.10% | 20.10% | 33.20% | 46.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 46.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.10% | 31.30% | 20.10% | 0.47% | 55.40% | 0.00% | 55.30% | 48.00% |
| CO | 0.00% | | 0.00% | 0.00% | 39.60% | 39.60% | 0.30% | 0.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 39.60% | 2.20% | 39.70% | 0.28% | 33.40% | 0.00% | 29.60% | 22.90% |
| CO2 | 0.00% | | 0.00% | 0.00% | 5.60% | 5.70% | 25.10% | 3.20% | 0.00% | 1.80% | 1.80% | 0.00% | 100.00% | 3.20% | 0.00% | 0.00% | 0.00% | 0.30% | 0.30% | 0.30% | 0.00% | 0.00% | 0.00% | 5.70% | 23.20% | 5.70% | 99.15% | 0.10% | 0.00% | 3.20% | 5.60% |
| H2O | 100.00% | | 0.00% | 0.00% | 34.00% | 34.30% | 41.20% | 50.10% | 0.60% | 29.30% | 29.30% | 4.40% | 0.00% | 50.10% | 0.60% | 0.60% | 0.60% | 6.50% | 7.40% | 7.40% | 0.00% | 0.00% | 0.00% | 34.30% | 43.10% | 34.30% | 0.00% | 0.40% | 0.00% | 0.00% | 14.60% |
| CH4 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 6.90% | 0.00% | 8.40% | 6.50% |
| H2S | 0.00% | | 0.00% | 0.00% | 0.20% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| NH3 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| COS | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CARBON | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SULFUR | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CL2 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCL | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCN | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SO2 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C2H6 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 0.00% |
| C3H6 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C3H8 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C4H10 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C6H14 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CH3OH | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% | 0.60% | 0.10% | 0.00% |
| C2H5OH | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 97.70% | 0.10% | 0.00% |
| C3H7OH | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.60% | 0.00% | 0.00% |
| C4H9OH | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CH3COCH3 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 0.00% | 0.00% |
| CH3CO2H | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.20% | 0.30% | 0.00% |
| S2 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2SO4 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 95.60% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

## Table 37: Stream data for LWA Case

(Refer to Figure 5 for stream numbers)

| | As Received Coal | As Received Biomass | Oxygen to Gasifier | Ash | Raw Syngas | Sulfur Removal Outlet | WGS Outlet | Syngas to GT Combustor | GT Air Inlet | GT Outlet | HRSG Outlet | H2SO4 Product | CO2 Product (TDA Process) | Syngas to Pre-ITM Combustor | Extracted GT Air | Extral Air Compressor Inlet | Air to Pre-ITM Combustor | Air to ITM Unit | Depleted Air | Excess Depleted Air | Oxygen from ITM Unit | Oxygen to H2SO4 Unit | Oxygen to ATR | Syngas #1 to Alcohol Unit | Syngas #2 to Alcohol Unit | S Removed Syngas to F-T Unit | CO2 Product (MDEA Process) | Syngas Entering Synthesis | Alcohol Product | Purge Gas | Unconverted Gas |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Number | 1A | 1B | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14A | 14B | 14C | 15 | 16A | 16B | 17 | 18A | 18B | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| Temperature, C | 15 | 15 | 24.1 | 60 | 189.6 | 208.7 | 232.2 | 240.5 | 4.4 | 601.4 | 152.8 | 20 | 34.4 | 240.5 | 473.7 | 4.4 | 507.3 | 850 | 629 | 239 | 850 | 10 | 188.8 | 208.7 | 232.2 | 208.2 | 17.2 | 255 | 9.9 | 60.1 | 198 |
| Pressure, bar | 1.014 | 1.014 | 51.021 | 1.014 | 40.679 | 38.128 | 35.715 | 34.819 | 0.951 | 0.978 | 0.921 | 1.014 | 152.698 | 34.819 | 24.4 | 0.951 | 26.041 | 25.489 | 24.4 | 1.034 | 1.269 | 8.584 | 38 | 38.128 | 36.749 | 35.715 | 151.685 | 16.911 | 4.461 | 25.66 | 20.767 |
| Solids, kg/hr | 145747 | 62463 | 0 | 18658 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vapor Frac (w/o Solids) | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 |
| kmol/hr (w/o Solids) | 4567 | 3467 | 4272 | 0 | 22543 | 22541 | 23796 | 15702 | 30646 | 55096 | 55096 | 47 | 4067 | 2657 | 14195 | 23168 | 37363 | 39448 | 25812 | 8604 | 5032 | 26 | 734 | 9366 | 0 | 9364 | 2958 | 39732 | 502 | 887 | 41949 |
| kg/hr (w/o Solids) | 82268 | 62463 | 136694 | 0 | 462799 | 462049 | 461405 | 212614 | 885575 | 1415936 | 1415936 | 4458 | 178984 | 35974 | 410199 | 669492 | 1079691 | 1115666 | 715983 | 238661 | 161022 | 829 | 23492 | 191981 | 2 | 191951 | 129441 | 518822 | 23184 | 11959 | 603608 |
| Mole Frac (w/o Solids) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| O2 | 0.00% | 0.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 2.10% | 2.10% | 0.00% | 0.00% | 0.00% | 20.80% | 20.80% | 20.80% | 18.30% | 6.30% | 6.30% | 100.00% | 100.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| N2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.20% | 0.20% | 0.10% | 0.20% | 77.60% | 62.70% | 62.70% | 0.00% | 0.00% | 0.20% | 77.60% | 77.60% | 77.60% | 73.50% | 84.30% | 84.30% | 0.00% | 0.00% | 0.00% | 0.20% | 0.10% | 0.20% | 0.00% | 2.30% | 0.00% | 2.60% | 2.20% |
| AR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% | 0.80% | 0.80% | 0.00% | 0.00% | 0.00% | 0.90% | 0.90% | 0.90% | 0.90% | 1.00% | 1.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2 | 0.00% | 0.00% | 0.00% | 0.00% | 19.60% | 19.60% | 32.90% | 42.70% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 42.70% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 19.60% | 31.00% | 19.60% | 0.40% | 54.60% | 0.00% | 54.30% | 47.40% |
| CO | 0.00% | 0.00% | 0.00% | 0.00% | 40.40% | 40.40% | 0.30% | 0.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 40.40% | 2.20% | 40.40% | 0.30% | 34.50% | 0.00% | 30.80% | 23.70% |
| CO2 | 0.00% | 0.00% | 0.00% | 0.00% | 5.90% | 6.00% | 25.40% | 8.80% | 0.00% | 3.70% | 3.70% | 0.00% | 100.00% | 8.80% | 0.00% | 0.00% | 0.00% | 0.70% | 0.70% | 0.70% | 0.00% | 0.00% | 0.00% | 6.00% | 23.50% | 6.00% | 99.20% | 0.10% | 0.00% | 3.20% | 5.80% |
| H2O | 100.00% | 100.00% | 0.00% | 0.00% | 33.60% | 33.80% | 41.20% | 47.90% | 0.60% | 30.80% | 30.80% | 5.10% | 0.00% | 47.90% | 0.60% | 0.60% | 0.60% | 6.70% | 7.70% | 7.70% | 0.00% | 0.00% | 0.00% | 33.80% | 43.10% | 33.80% | 0.00% | 0.30% | 0.00% | 0.00% | 14.40% |
| CH4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 6.90% | 0.00% | 8.50% | 6.50% |
| H2S | 0.00% | 0.00% | 0.00% | 0.00% | 0.20% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| NH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| COS | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CARBON | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SULFUR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CL2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCL | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCN | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SO2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C2H6 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 0.00% |
| C3H6 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C3H8 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C4H10 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C6H14 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CH3OH | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% | 0.70% | 0.10% | 0.00% |
| C2H5OH | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 97.60% | 0.10% | 0.00% |
| C3H7OH | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.50% | 0.00% | 0.00% |
| C4H9OH | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CH3COCH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 0.00% | 0.00% |
| CH3COH | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.20% | 0.00% | 0.30% | 0.00% |
| S2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2SO4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 94.90% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

## Table 38: Stream data for LGA Case

(Refer to Figure 5 for stream numbers)

| | As Received Coal | As Received Biomass | Oxygen to Gasifier | Ash | Raw Syngas | Sulfur Removal Outlet | WGS Outlet | Syngas to GT Combustor | GT Air Inlet | GT Outlet | HRSG Outlet | H2SO4 Product | CO2 Product (TDA Process) | Syngas to Pre-ITM Combustor | Extracted GT Air | Extral Air Compressor Inlet | Air to Pre-ITM Combustor | Air to ITM Unit | Depleted Air | Excess Depleted Air | Oxygen from ITM Unit | Oxygen to H2SO4 Unit | Oxygen to ATR | Syngas #1 to Alcohol Unit | Syngas #2 to Alcohol Unit | S Removed Syngas to F-T Unit | CO2 Product (MDEA Process) | Syngas Entering Synthesis | Alcohol Product | Purge Gas | Unconverted Gas |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Number | 1A | 1B | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14A | 14B | 14C | 15 | 16A | 16B | 17 | 18A | 18B | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| Temperature, C | 15 | 15 | 24.1 | 60 | 189.4 | 209 | 232.2 | 240 | 4.4 | 601.7 | 152.1 | 20 | 34.4 | 240 | 473.7 | 4.4 | 507.5 | 850 | 629 | 239.3 | 850 | 10 | 188.8 | 209 | 232.2 | 208.5 | 17.2 | 255 | 9.9 | 60.1 | 198 |
| Pressure, bar | 1.014 | 1.014 | 51.021 | 1.014 | 40.679 | 38.128 | 35.715 | 34.819 | 0.951 | 0.978 | 0.921 | 1.014 | 152.698 | 34.819 | 24.4 | 0.951 | 26.041 | 25.489 | 24.4 | 1.034 | 1.267 | 8.584 | 38 | 38.128 | 36.749 | 35.715 | 151.685 | 16.911 | 4.461 | 25.66 | 20.767 |
| Solids, kg/hr | 152160 | 65211 | 0 | 22515 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vapor Frac (w/o Solids) | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 |
| kmol/hr (w/o Solids) | 4767 | 639 | 4199 | 0 | 22888 | 22887 | 23368 | 15504 | 30016 | 54764 | 54764 | 50 | 3816 | 2696 | 13904 | 23513 | 37417 | 39538 | 25876 | 8625 | 5038 | 27 | 812 | 10038 | 0 | 10036 | 3091 | 44192 | 529 | 992 | 46793 |
| kg/hr (w/o Solids) | 85887 | 11508 | 134348 | 0 | 462895 | 462112 | 448940 | 210522 | 867377 | 1406705 | 1406705 | 4625 | 167942 | 36611 | 401770 | 679463 | 1081233 | 1117845 | 717480 | 239160 | 161204 | 858 | 25989 | 202682 | 2 | 202640 | 135192 | 566507 | 24435 | 13092 | 662458 |
| Mole Frac (w/o Solids) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| O2 | 0.00% | 0.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 2.00% | 2.00% | 0.00% | 0.00% | 0.00% | 20.80% | 20.80% | 20.80% | 18.20% | 6.30% | 6.30% | 100.00% | 100.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| N2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.30% | 0.30% | 0.20% | 0.20% | 77.60% | 62.70% | 62.70% | 0.00% | 0.00% | 0.20% | 77.60% | 77.60% | 77.60% | 73.50% | 84.20% | 84.20% | 0.00% | 0.00% | 0.00% | 0.30% | 0.20% | 0.30% | 0.00% | 3.10% | 0.00% | 3.50% | 2.90% |
| AR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% | 0.80% | 0.80% | 0.00% | 0.00% | 0.00% | 0.90% | 0.90% | 0.90% | 0.90% | 1.00% | 1.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2 | 0.00% | 0.00% | 0.00% | 0.00% | 20.60% | 20.60% | 32.90% | 42.20% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 42.20% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.60% | 31.10% | 20.60% | 0.50% | 55.60% | 0.00% | 55.30% | 48.10% |
| CO | 0.00% | 0.00% | 0.00% | 0.00% | 39.80% | 39.80% | 0.30% | 0.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 39.80% | 2.10% | 39.80% | 0.30% | 32.90% | 0.00% | 29.20% | 22.60% |
| CO2 | 0.00% | 0.00% | 0.00% | 0.00% | 5.60% | 5.60% | 24.70% | 8.70% | 0.00% | 3.70% | 3.70% | 0.00% | 100.00% | 8.70% | 0.00% | 0.00% | 0.00% | 0.60% | 0.70% | 0.70% | 0.00% | 0.00% | 0.00% | 5.60% | 22.90% | 5.60% | 99.10% | 0.10% | 0.00% | 3.00% | 5.40% |
| H2O | 100.00% | 100.00% | 0.00% | 0.00% | 33.50% | 33.60% | 41.90% | 48.40% | 0.60% | 30.90% | 30.90% | 6.20% | 0.00% | 48.40% | 0.60% | 0.60% | 0.60% | 6.80% | 7.80% | 7.80% | 0.00% | 0.00% | 0.00% | 33.60% | 43.70% | 33.70% | 0.00% | 0.30% | 0.00% | 0.00% | 14.50% |
| CH4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 6.80% | 0.00% | 8.30% | 6.50% |
| H2S | 0.00% | 0.00% | 0.00% | 0.00% | 0.20% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| NH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| COS | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CARBON | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SULFUR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CL2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCL | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCN | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SO2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C2H6 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 0.00% |
| C3H6 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C3H8 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C4H10 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C6H14 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CH3OH | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.80% | 0.60% | 0.10% | 0.00% |
| C2H5OH | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 97.80% | 0.10% | 0.00% |
| C3H7OH | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.60% | 0.00% | 0.00% |
| C4H9OH | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CH3COCH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 0.00% | 0.00% |
| CH3COH | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.20% | 0.00% | 0.30% | 0.00% |
| S2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2SO4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 93.80% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

## Table 39: Stream data for BOU Case

(Refer to Figure 6 for stream numbers)

| | As Received Coal | As Received Biomass | Oxygen to Gasifier | Ash | Raw Syngas | Sulfur Removal Outlet | WGS Outlet | Syngas to GT Combustor | GT Air Inlet | GT Outlet | HRSG Outlet | H2SO4 Product | CO2 Product | Syngas to Pre-ITM Combustor | Extracted GT Air | Extral Air Compressor Inlet | Air to Pre-ITM Combustor | Air to ITM Unit | Depleted Air | Oxygen from ITM Unit | Oxygen to H2SO4 Unit | Decarbonized Syngas to PSA Unit | H2 to NH3 Synthesis | Tail Gas from PSA | CO2 to Urea Synthesis | Air to Cryo-ASU | O2 from Cryo-ASU | N2 to NH3 Synthesis | Urea Product | Purge Gas |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Number | 1A | 1B | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14A | 14B | 14C | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| Temperature, C | 15 | | 86.1 | 60 | 191.2 | 249.5 | 232.2 | 242.2 | 15 | 579.2 | 153.3 | 20 | 34.3 | 253.2 | 485.5 | | 497.753613 | 849.3 | 678 | 849.3 | 19.4 | 253.2 | 14.5 | 146.5 | 34.4 | 15 | 32.2 | 105.4 | 68.3 | -37 |
| Pressure, bar | 1.014 | | 51.021 | 1.014 | 40.679 | 38.128 | 35.715 | 34.819 | 1.014 | 1.04 | 0.983 | 1.014 | 152.698 | 34.819 | 24.4 | | 25.6963184 | 25.145 | 24.4 | 1.278 | 8.584 | 34.819 | 33.233 | 44.106 | 158 | 1.014 | 8.618 | 65.155 | 137.584 | 45.242 |
| Solids, kg/hr | 192498 | | 0 | 16891 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vapor Frac (w/o Solids) | 0 | | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 |
| kmol/hr (w/o Solids) | 1337 | | 4813 | 0 | 28444 | 28441 | 39229 | 16273 | 70862 | 78819 | 78819 | 183 | 8087 | 1549 | 32078 | | 32078 | 33153 | 28829 | 4324 | 97 | 12454 | 6415 | 1652 | 1960 | 2847 | 586 | 2143 | 1953 | 687 |
| kg/hr (w/o Solids) | 24084 | | 154111 | 0 | 548501 | 545736 | 740078 | 161473 | 2044353 | 2081967 | 2081967 | 16814 | 355906 | 14502 | 925438 | | 925438 | 939940 | 801575 | 138365 | 3112 | 116614 | 13019 | 24572 | 86248 | 82135 | 18854 | 60150 | 117300 | 6382 |
| Mole Frac (w/o Solids) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| O2 | 0.00% | | 99.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 6.10% | 6.10% | 0.00% | 0.00% | 0.00% | 20.80% | | 20.76% | 18.70% | 6.50% | 100.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 95.00% | 0.50% | 0.00% | 0.00% |
| N2 | 0.00% | | 0.20% | 0.00% | 0.40% | 0.40% | 0.30% | 1.50% | 77.20% | 69.70% | 69.70% | 0.00% | 0.00% | 0.90% | 77.20% | | 77.19% | 74.70% | 85.90% | 0.00% | 0.00% | 0.90% | 0.10% | 6.80% | 0.00% | 77.20% | 1.80% | 99.20% | 0.00% | 24.00% |
| AR | 0.00% | | 0.40% | 0.00% | 0.10% | 0.10% | 0.00% | 0.10% | 0.90% | 0.90% | 0.90% | 0.00% | 0.00% | 0.10% | 0.90% | | 0.94% | 0.90% | 1.10% | 0.00% | 0.00% | 0.10% | 0.00% | 0.60% | 0.00% | 0.90% | 3.30% | 0.20% | 0.00% | 0.70% |
| H2 | 0.00% | | 0.00% | 0.00% | 23.20% | 23.20% | 42.40% | 60.10% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 59.80% | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 59.80% | 99.90% | 62.90% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 71.90% |
| CO | 0.00% | | 0.00% | 0.00% | 36.60% | 36.60% | 0.90% | 2.10% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.30% | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.30% | 0.00% | 9.70% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CO2 | 0.00% | | 0.00% | 0.00% | 4.50% | 4.50% | 28.90% | 4.30% | 0.00% | 1.40% | 1.40% | 0.00% | 100.00% | 2.60% | 0.00% | | 0.03% | 0.20% | 0.20% | 0.00% | 0.00% | 2.60% | 0.00% | 19.70% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% |
| H2O | 100.00% | | 0.00% | 0.00% | 34.70% | 35.30% | 27.50% | 31.70% | 1.10% | 21.80% | 21.80% | 7.70% | 0.00% | 35.20% | 1.10% | | 1.08% | 5.50% | 6.30% | 0.00% | 0.00% | 35.20% | 0.00% | 0.20% | 0.00% | 1.10% | 0.00% | 0.00% | 0.00% | 0.00% |
| CH4 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2S | 0.00% | | 0.00% | 0.00% | 0.50% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| NH3 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 2.40% |
| COS | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CARBON | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SULFUR | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CL2 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCL | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCN | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SO2 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C2H6 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C3H8 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| S2 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2SO4 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 92.30% | 0.00% | 0.00% | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| UREA | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 100.00% | 0.00% |
| CARB | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

## Table 40: Stream data for BWU Case

(Refer to Figure 6 for stream numbers)

| | As Received Coal | As Received Biomass | Oxygen to Gasifier | Ash | Raw Syngas | Sulfur Removal Outlet | WGS Outlet | Syngas to GT Combustor | GT Air Inlet | GT Outlet | HRSG Outlet | H2SO4 Product | CO2 Product | Syngas to Pre-ITM Combustor | Extracted GT Air | Extral Air Compressor Inlet | Air to Pre-ITM Combustor | Air to ITM Unit | Depleted Air | Oxygen from ITM Unit | Oxygen to H2SO4 Unit | Decarbonized Syngas to PSA Unit | H2 to NH3 Synthesis | Tail Gas from PSA | CO2 to Urea Synthesis | Air to Cryo-ASU | O2 from Cryo-ASU | N2 to NH3 Synthesis | Urea Product | Purge Gas |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Number | 1A | 1B | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14A | 14B | 14C | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| Temperature, C | 15 | 15 | 86.1 | 60 | 191 | 237 | 232.2 | 237.3 | 15 | 588.5 | 155.1 | 20 | 34.3 | 248.9 | 485.5 | 15 | 499.8 | 850.2 | 678 | 850.2 | 19.4 | 248.9 | 14.5 | 134.9 | 34.4 | 15 | 32.2 | 105.4 | 68.3 | -37 |
| Pressure, bar | 1.014 | 1.014 | 51.021 | 1.014 | 40.679 | 38.128 | 35.715 | 34.819 | 1.014 | 1.04 | 0.983 | 1.014 | 152.698 | 34.819 | 24.4 | 1.014 | 25.696 | 25.145 | 24.4 | 1.275 | 8.584 | 34.819 | 33.233 | 44.106 | 158 | 1.014 | 8.618 | 65.155 | 137.584 | 45.242 |
| Solids, kg/hr | 144751 | 62036 | 0 | 13495 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vapor Frac (w/o Solids) | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 |
| kmol/hr (w/o Solids) | 1005 | 3444 | 4686 | 0 | 27122 | 27119 | 37971 | 17209 | 62752 | 74179 | 74179 | 140 | 7029 | 1589 | 29067 | 2190 | 31256 | 32384 | 28172 | 4213 | 73 | 11457 | 5969 | 1541 | 1823 | 2649 | 545 | 1994 | 1817 | 640 |
| kg/hr (w/o Solids) | 18110 | 62036 | 150056 | 0 | 531136 | 529042 | 724537 | 211178 | 1810390 | 1967170 | 1967170 | 12733 | 309359 | 17247 | 838572 | 63172 | 901741 | 918988 | 784182 | 134807 | 2345 | 124341 | 12114 | 41135 | 80241 | 76416 | 17541 | 55962 | 109125 | 5943 |
| Mole Frac (w/o Solids) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| O2 | 0.00% | 0.00% | 99.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 5.30% | 5.30% | 0.00% | 0.00% | 0.00% | 20.80% | 20.80% | 20.80% | 18.60% | 6.40% | 100.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 95.00% | 0.50% | 0.00% | 0.00% |
| N2 | 0.00% | 0.00% | 0.20% | 0.00% | 0.30% | 0.30% | 0.20% | 1.30% | 77.20% | 67.90% | 67.90% | 0.00% | 0.00% | 0.80% | 77.20% | 77.20% | 77.20% | 74.50% | 85.70% | 0.00% | 0.00% | 0.80% | 0.10% | 6.00% | 0.00% | 77.20% | 1.80% | 99.20% | 0.00% | 24.00% |
| AR | 0.00% | 0.00% | 0.40% | 0.00% | 0.10% | 0.10% | 0.00% | 0.10% | 0.90% | 0.90% | 0.90% | 0.00% | 0.00% | 0.10% | 0.90% | 0.90% | 0.90% | 0.90% | 1.00% | 0.00% | 0.00% | 0.10% | 0.00% | 0.60% | 0.00% | 0.90% | 3.30% | 0.20% | 0.00% | 0.70% |
| H2 | 0.00% | 0.00% | 0.00% | 0.00% | 22.20% | 22.20% | 41.70% | 54.80% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 56.80% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 56.80% | 99.90% | 35.10% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 71.90% |
| CO | 0.00% | 0.00% | 0.00% | 0.00% | 37.50% | 37.50% | 0.90% | 1.90% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.20% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.20% | 0.00% | 9.20% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CO2 | 0.00% | 0.00% | 0.00% | 0.00% | 4.80% | 4.80% | 29.30% | 10.30% | 0.00% | 3.00% | 3.00% | 0.00% | 100.00% | 6.50% | 0.00% | 0.00% | 0.00% | 0.40% | 0.50% | 0.00% | 0.00% | 6.50% | 0.00% | 48.60% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% |
| H2O | 100.00% | 100.00% | 0.00% | 0.00% | 34.60% | 35.00% | 27.70% | 31.50% | 1.10% | 22.90% | 22.90% | 8.90% | 0.00% | 34.50% | 1.10% | 1.10% | 1.10% | 5.50% | 6.30% | 0.00% | 0.00% | 34.50% | 0.00% | 0.50% | 0.00% | 1.10% | 0.00% | 0.00% | 0.00% | 0.00% |
| CH4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2S | 0.00% | 0.00% | 0.00% | 0.00% | 0.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| NH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 2.40% |
| COS | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CARBON | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SULFUR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CL2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCL | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCN | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SO2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C2H6 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C3H8 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| S2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2SO4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 91.10% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| UREA | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 100.00% | 0.00% |
| CARB | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

## Table 41: Stream data for BGU Case

(Refer to Figure 6 for stream numbers)

| | As Received Coal | As Received Biomass | Oxygen to Gasifier | Ash | Raw Syngas | Sulfur Removal Outlet | WGS Outlet | Syngas to GT Combustor | GT Air Inlet | GT Outlet | HRSG Outlet | H2SO4 Product | CO2 Product | Syngas to Pre-ITM Combustor | Extracted GT Air | Extral Air Compressor Inlet | Air to Pre-ITM Combustor | Air to ITM Unit | Depleted Air | Oxygen from ITM Unit | Oxygen to H2SO4 Unit | Decarbonized Syngas to PSA Unit | H2 to NH3 Synthesis | Tail Gas from PSA | CO2 to Urea Synthesis | Air to Cryo-ASU | O2 from Cryo-ASU | N2 to NH3 Synthesis | Urea Product | Purge Gas |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Number | 1A | 1B | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14A | 14B | 14C | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| Temperature, C | 15 | 15 | 86.1 | 60 | 191 | 237.9 | 232.2 | 236.3 | 15 | 587 | 152.6 | 20 | 34.3 | 248.4 | 485.5 | 15 | 498.1 | 850.3 | 678 | 850.3 | 19.4444 | 248.4 | 14.5 | 135.4 | 34.4 | 15 | 32.2 | 105.4 | 68.3 | -37 |
| Pressure, bar | 1.014 | 1.014 | 51.021 | 1.014 | 40.679 | 38.128 | 35.715 | 34.819 | 1.014 | 1.04 | 0.983 | 1.014 | 152.698 | 34.819 | 24.4 | 1.014 | 25.696 | 25.145 | 24.4 | 1.275 | 8.58353 | 34.819 | 33.233 | 44.106 | 158 | 1.014 | 8.618 | 65.155 | 137.584 | 45.242 |
| Solids, kg/hr | 153226 | 65668 | 0 | 17343 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vapor Frac (w/o Solids) | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 |
| kmol/hr (w/o Solids) | 1064 | 643 | 4699 | 0 | 28088 | 28085 | 38950 | 17492 | 66272 | 76093 | 76093 | 149 | 6992 | 1579 | 30697 | 408 | 31105 | 32222 | 28032 | 4190 | 77 | 12205 | 6400 | 1653 | 1955 | 2840 | 584 | 2138 | 1948 | 686 |
| kg/hr (w/o Solids) | 19171 | 11589 | 150481 | 0 | 542408 | 540192 | 735921 | 213568 | 1911923 | 2020159 | 2020159 | 13453 | 307720 | 16972 | 885606 | 11767 | 897373 | 914345 | 780267 | 134078 | 2477 | 131152 | 12989 | 43362 | 86037 | 81924 | 18805 | 59995 | 117012 | 6371 |
| Mole Frac (w/o Solids) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| O2 | 0.00% | 0.00% | 99.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 5.50% | 5.50% | 0.00% | 0.00% | 0.00% | 20.80% | 20.80% | 20.80% | 18.60% | 6.40% | 100.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 95.00% | 0.50% | 0.00% | 0.00% |
| N2 | 0.00% | 0.00% | 0.20% | 0.00% | 0.40% | 0.40% | 0.30% | 1.50% | 77.20% | 68.00% | 68.00% | 0.00% | 0.00% | 0.90% | 77.20% | 77.20% | 77.20% | 74.60% | 85.70% | 0.00% | 0.00% | 0.90% | 0.10% | 6.70% | 0.00% | 77.20% | 1.80% | 99.20% | 0.00% | 24.00% |
| AR | 0.00% | 0.00% | 0.40% | 0.00% | 0.10% | 0.10% | 0.00% | 0.10% | 0.90% | 0.90% | 0.90% | 0.00% | 0.00% | 0.10% | 0.90% | 0.90% | 0.90% | 0.90% | 1.00% | 0.00% | 0.00% | 0.10% | 0.00% | 0.60% | 0.00% | 0.90% | 3.30% | 0.20% | 0.00% | 0.70% |
| H2 | 0.00% | 0.00% | 0.00% | 0.00% | 23.10% | 23.10% | 42.30% | 55.30% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 57.30% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 57.30% | 99.90% | 35.90% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 71.90% |
| CO | 0.00% | 0.00% | 0.00% | 0.00% | 36.80% | 36.80% | 0.90% | 2.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.20% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.20% | 0.00% | 9.10% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CO2 | 0.00% | 0.00% | 0.00% | 0.00% | 4.50% | 4.60% | 28.90% | 10.20% | 0.00% | 3.00% | 3.00% | 0.00% | 100.00% | 6.40% | 0.00% | 0.00% | 0.00% | 0.40% | 0.50% | 0.00% | 0.00% | 6.40% | 0.00% | 47.10% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% |
| H2O | 100.00% | 100.00% | 0.00% | 0.00% | 34.50% | 35.00% | 27.50% | 30.90% | 1.10% | 22.70% | 22.70% | 9.40% | 0.00% | 34.10% | 1.10% | 1.10% | 1.10% | 5.50% | 6.30% | 0.00% | 0.00% | 34.10% | 0.00% | 0.50% | 0.00% | 1.10% | 0.00% | 0.00% | 0.00% | 0.00% |
| CH4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2S | 0.00% | 0.00% | 0.00% | 0.00% | 0.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| NH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 2.40% |
| COS | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CARBON | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SULFUR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CL2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCL | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCN | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SO2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C2H6 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C3H8 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| S2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2SO4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 90.60% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| UREA | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 100.00% | 0.00% |
| CARB | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

## Table 42: Stream data for LOU Case

(Refer to Figure 6 for stream numbers)

| | As Received Coal | As Received Biomass | Oxygen to Gasifier | Ash | Raw Syngas | Sulfur Removal Outlet | WGS Outlet | Syngas to GT Combustor | GT Air Inlet | GT Outlet | HRSG Outlet | H2SO4 Product | CO2 Product | Syngas to Pre-ITM Combustor | Extracted GT Air | Extral Air Compressor Inlet | Air to Pre-ITM Combustor | Air to ITM Unit | Depleted Air | Oxygen from ITM Unit | Oxygen to H2SO4 Unit | Decarbonized Syngas to PSA Unit | H2 to NH3 Synthesis | Tail Gas from PSA | CO2 to Urea Synthesis | Air to Cryo-ASU | O2 from Cryo-ASU | N2 to NH3 Synthesis | Urea Product | Purge Gas |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Number | 1A | 1B | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14A | 14B | 14C | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| Temperature, C | 15 | | 74.7 | 60 | 191.9 | 216.6 | 232.2 | 243.1 | 4.4 | 571.6 | 153 | 20 | 34.3 | 255.2 | 473.7 | 4.4 | 491 | 850.9 | 678 | 850.9 | 10 | 255.2 | 5 | 132.1 | 34.4 | 4.4 | 32.2 | 93.5 | 68.3 | -37 |
| Pressure, bar | 1.014 | | 51.021 | 1.014 | 40.679 | 38.128 | 35.715 | 34.819 | 0.951 | 0.978 | 0.921 | 1.014 | 152.698 | 34.819 | 24.4 | 0.951 | 25.696 | 25.145 | 24.4 | 1.275 | 8.584 | 34.819 | 33.233 | 44.106 | 158 | 0.951 | 8.618 | 65.155 | 137.584 | 45.242 |
| Solids, kg/hr | 216531 | | 0 | 26532 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vapor Frac (w/o Solids) | 0 | | 1 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 |
| kmol/hr (w/o Solids) | 6784 | | 4751 | 0 | 25690 | 25688 | 36504 | 14861 | 56678 | 69456 | 69456 | 77 | 8224 | 1637 | 26253 | 5545 | 31799 | 32950 | 28662 | 4287 | 38 | 10974 | 5515 | 1424 | 1685 | 2434 | 502 | 1842 | 1679 | 590 |
| kg/hr (w/o Solids) | 122222 | | 152135 | 0 | 520350 | 519254 | 714111 | 152957 | 1637825 | 1829714 | 1829714 | 6663 | 361923 | 15885 | 758642 | 160240 | 918882 | 934767 | 797574 | 137193 | 1215 | 106472 | 11192 | 22590 | 74150 | 70335 | 16157 | 51694 | 100843 | 5475 |
| Mole Frac (w/o Solids) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| O2 | 0.00% | | 99.50% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 5.30% | 5.30% | 0.00% | 0.00% | 0.00% | 20.80% | 20.80% | 20.80% | 18.60% | 6.40% | 100.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 95.00% | 0.50% | 0.00% | 0.00% |
| N2 | 0.00% | | 0.20% | 0.00% | 0.30% | 0.30% | 0.20% | 1.40% | 77.60% | 69.80% | 69.80% | 0.00% | 0.00% | 0.90% | 77.60% | 77.60% | 77.60% | 74.90% | 86.10% | 0.00% | 0.00% | 0.90% | 0.10% | 6.40% | 0.00% | 77.60% | 1.80% | 99.20% | 0.00% | 24.00% |
| AR | 0.00% | | 0.30% | 0.00% | 0.10% | 0.10% | 0.00% | 0.10% | 0.90% | 0.90% | 0.90% | 0.00% | 0.00% | 0.10% | 0.90% | 0.90% | 0.90% | 0.90% | 1.00% | 0.00% | 0.00% | 0.10% | 0.00% | 0.60% | 0.00% | 0.90% | 3.20% | 0.20% | 0.00% | 0.70% |
| H2 | 0.00% | | 0.00% | 0.00% | 19.80% | 19.80% | 40.30% | 58.30% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 58.10% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 58.10% | 99.90% | 60.60% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 71.90% |
| CO | 0.00% | | 0.00% | 0.00% | 38.80% | 38.80% | 0.90% | 2.10% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.30% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.30% | 0.00% | 10.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CO2 | 0.00% | | 0.00% | 0.00% | 5.50% | 5.50% | 30.30% | 4.70% | 0.00% | 1.60% | 1.60% | 0.00% | 100.00% | 2.90% | 0.00% | 0.00% | 0.00% | 0.20% | 0.30% | 0.00% | 0.00% | 2.90% | 0.00% | 22.20% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% |
| H2O | 100.00% | | 0.00% | 0.00% | 35.30% | 35.50% | 28.20% | 33.30% | 0.60% | 22.40% | 22.40% | 13.80% | 0.00% | 36.80% | 0.60% | 0.60% | 0.60% | 5.30% | 6.10% | 0.00% | 0.00% | 36.80% | 0.00% | 0.20% | 0.00% | 0.60% | 0.00% | 0.00% | 0.00% | 0.00% |
| CH4 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2S | 0.00% | | 0.00% | 0.00% | 0.20% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| NH3 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 2.40% |
| COS | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CARBON | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SULFUR | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CL2 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCL | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCN | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SO2 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C2H6 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C3H8 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| S2 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2SO4 | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 86.20% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| UREA | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 100.00% | 0.00% |
| CARB | 0.00% | | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

## Table 43: Stream data for LWU Casealcohols

(Refer to Figure 6 for stream numbers)

| | As Received Coal | As Received Biomass | Oxygen to Gasifier | Ash | Raw Syngas | Sulfur Removal Outlet | WGS Outlet | Syngas to GT Combustor | GT Air Inlet | GT Outlet | HRSG Outlet | H2SO4 Product | CO2 Product | Syngas to Pre-ITM Combustor | Extracted GT Air | Extral Air Compressor Inlet | Air to Pre-ITM Combustor | Air to ITM Unit | Depleted Air | Oxygen from ITM Unit | Oxygen to H2SO4 Unit | Decarbonized Syngas to PSA Unit | H2 to NH3 Synthesis | Tail Gas from PSA | CO2 to Urea Synthesis | Air to Cryo-ASU | O2 from Cryo-ASU | N2 to NH3 Synthesis | Urea Product | Purge Gas |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Number | 1A | 1B | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14A | 14B | 14C | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| Temperature, C | 15 | 15 | 74.7 | 60 | 191.6 | 210.1 | 232.2 | 237.6 | 4.4 | 581.5 | 154.4 | 20 | 34.3 | 250.2 | 473.7 | 4.4 | 493 | 850.2 | 678 | 850.2 | 10 | 250.2 | 5 | 120.7 | 34.4 | 4.4 | 32.2 | 93.5 | 68.3 | -37 |
| Pressure, bar | 1.014 | 1.014 | 51.021 | 1.014 | 40.679 | 38.128 | 35.715 | 34.819 | 0.951 | 0.978 | 0.921 | 1.014 | 152.698 | 34.819 | 24.4 | 0.951 | 25.696 | 25.145 | 24.4 | 1.272 | 8.584 | 34.819 | 33.233 | 44.106 | 158 | 0.951 | 8.618 | 65.155 | 137.584 | 45.242 |
| Solids, kg/hr | 154694 | 66297 | 0 | 19803 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vapor Frac (w/o Solids) | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 |
| kmol/hr (w/o Solids) | 4847 | 3680 | 4536 | 0 | 24530 | 24529 | 35119 | 15746 | 49668 | 65486 | 65486 | 57 | 7012 | 1639 | 23006 | 7340 | 30347 | 31521 | 27430 | 4091 | 27 | 10098 | 5170 | 1335 | 1579 | 2282 | 471 | 1727 | 1574 | 553 |
| kg/hr (w/o Solids) | 87318 | 66297 | 145243 | 0 | 499526 | 498727 | 689522 | 198805 | 1435259 | 1733572 | 1733572 | 4859 | 308599 | 18320 | 664812 | 212113 | 876924 | 895244 | 764325 | 130919 | 879 | 112901 | 10492 | 37687 | 69512 | 65933 | 15146 | 48458 | 94536 | 5131 |
| Mole Frac (w/o Solids) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| O2 | 0.00% | 0.00% | 99.50% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 4.50% | 4.50% | 0.00% | 0.00% | 0.00% | 20.80% | 20.80% | 20.80% | 18.60% | 6.40% | 100.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 95.00% | 0.50% | 0.00% | 0.00% |
| N2 | 0.00% | 0.00% | 0.20% | 0.00% | 0.30% | 0.30% | 0.20% | 1.20% | 77.60% | 67.90% | 67.90% | 0.00% | 0.00% | 0.80% | 77.60% | 77.60% | 77.60% | 74.70% | 85.90% | 0.00% | 0.00% | 0.80% | 0.10% | 5.60% | 0.00% | 77.60% | 1.80% | 99.20% | 0.00% | 24.00% |
| AR | 0.00% | 0.00% | 0.30% | 0.00% | 0.10% | 0.10% | 0.00% | 0.10% | 0.90% | 0.80% | 0.80% | 0.00% | 0.00% | 0.10% | 0.90% | 0.90% | 0.90% | 0.90% | 1.00% | 0.00% | 0.00% | 0.10% | 0.00% | 0.60% | 0.00% | 0.90% | 3.20% | 0.20% | 0.00% | 0.70% |
| H2 | 0.00% | 0.00% | 0.00% | 0.00% | 19.50% | 19.50% | 40.10% | 53.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 55.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 55.40% | 99.90% | 31.70% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 72.00% |
| CO | 0.00% | 0.00% | 0.00% | 0.00% | 39.20% | 39.20% | 0.90% | 1.90% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.20% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.20% | 0.00% | 9.30% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CO2 | 0.00% | 0.00% | 0.00% | 0.00% | 5.70% | 5.70% | 30.40% | 10.80% | 0.00% | 3.30% | 3.30% | 0.00% | 100.00% | 7.00% | 0.00% | 0.00% | 0.00% | 0.50% | 0.50% | 0.00% | 0.00% | 7.00% | 0.00% | 52.60% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% |
| H2O | 100.00% | 100.00% | 0.00% | 0.00% | 35.10% | 35.30% | 28.30% | 32.60% | 0.60% | 23.50% | 23.50% | 16.80% | 0.00% | 35.60% | 0.60% | 0.60% | 0.60% | 5.30% | 6.10% | 0.00% | 0.00% | 35.60% | 0.00% | 0.20% | 0.00% | 0.60% | 0.00% | 0.00% | 0.00% | 0.00% |
| CH4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2S | 0.00% | 0.00% | 0.00% | 0.00% | 0.20% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| NH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 2.40% |
| COS | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CARBON | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SULFUR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CL2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCL | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCN | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SO2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C2H6 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C3H8 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| S2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2SO4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 83.20% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| UREA | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 100.00% | 0.00% |
| CARB | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

## Table 44: Stream data for LGU Case

(Refer to Figure 6 for stream numbers)

| | As Received Coal | As Received Biomass | Oxygen to Gasifier | Ash | Raw Syngas | Sulfur Removal Outlet | WGS Outlet | Syngas to GT Combustor | GT Air Inlet | GT Outlet | HRSG Outlet | H2SO4 Product | CO2 Product | Syngas to Pre-ITM Combustor | Extracted GT Air | Extral Air Compressor Inlet | Air to Pre-ITM Combustor | Air to ITM Unit | Depleted Air | Oxygen from ITM Unit | Oxygen to H2SO4 Unit | Decarbonized Syngas to PSA Unit | H2 to NH3 Synthesis | Tail Gas from PSA | CO2 to Urea Synthesis | Air to Cryo-ASU | O2 from Cryo-ASU | N2 to NH3 Synthesis | Urea Product | Purge Gas |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Number | 1A | 1B | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14A | 14B | 14C | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| Temperature, C | 15 | 15 | 74.7 | 60 | 191.6 | 210.5 | 232.2 | 236.2 | 4.4 | 579.8 | 153.6 | 20 | 34.3 | 249.6 | 473.7 | 4.4 | 491.5 | 850.6 | 678 | 850.6 | 10 | 249.6 | 5 | 121.3 | 34.4 | 4.4 | 32.2 | 93.5 | 68.3 | -37 |
| Pressure, bar | 1.014 | 1.014 | 51.021 | 1.014 | 40.679 | 38.128 | 35.715 | 34.819 | 0.951 | 0.978 | 0.921 | 1.014 | 152.698 | 34.819 | 24.4 | 0.951 | 25.696 | 25.145 | 24.4 | 1.272 | 8.584 | 34.819 | 33.233 | 44.106 | 158 | 0.951 | 8.618 | 65.155 | 137.584 | 45.242 |
| Solids, kg/hr | 165075 | 70746 | 0 | 24426 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vapor Frac (w/o Solids) | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 |
| kmol/hr (w/o Solids) | 5172 | 693 | 4559 | 0 | 25484 | 25482 | 36154 | 15981 | 52590 | 67060 | 67060 | 62 | 6987 | 1626 | 24360 | 5847 | 30207 | 31369 | 27299 | 4071 | 29 | 10947 | 5643 | 1457 | 1724 | 2491 | 514 | 1885 | 1718 | 604 |
| kg/hr (w/o Solids) | 93177 | 12485 | 145968 | 0 | 511258 | 510406 | 702660 | 201177 | 1519678 | 1777576 | 1777576 | 5156 | 307501 | 18002 | 703918 | 168975 | 872894 | 890895 | 760640 | 130255 | 932 | 121176 | 11451 | 40414 | 75874 | 71978 | 16535 | 52902 | 103192 | 5606 |
| Mole Frac (w/o Solids) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| O2 | 0.00% | 0.00% | 99.40% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 4.70% | 4.70% | 0.00% | 0.00% | 0.00% | 20.80% | 20.80% | 20.80% | 18.60% | 6.40% | 100.00% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 20.80% | 95.00% | 0.50% | 0.00% | 0.00% |
| N2 | 0.00% | 0.00% | 0.20% | 0.00% | 0.40% | 0.40% | 0.30% | 1.40% | 77.60% | 68.00% | 68.00% | 0.00% | 0.00% | 0.90% | 77.60% | 77.60% | 77.60% | 74.80% | 85.90% | 0.00% | 0.00% | 0.90% | 0.10% | 6.50% | 0.00% | 77.60% | 1.80% | 99.20% | 0.00% | 24.00% |
| AR | 0.00% | 0.00% | 0.40% | 0.00% | 0.10% | 0.10% | 0.00% | 0.10% | 0.90% | 0.80% | 0.80% | 0.00% | 0.00% | 0.10% | 0.90% | 0.90% | 0.90% | 0.90% | 1.00% | 0.00% | 0.00% | 0.10% | 0.00% | 0.60% | 0.00% | 0.90% | 3.20% | 0.20% | 0.00% | 0.70% |
| H2 | 0.00% | 0.00% | 0.00% | 0.00% | 20.40% | 20.50% | 40.70% | 53.70% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 55.90% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 55.90% | 99.90% | 32.50% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 71.90% |
| CO | 0.00% | 0.00% | 0.00% | 0.00% | 38.50% | 38.50% | 0.90% | 2.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.20% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 1.20% | 0.00% | 9.20% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CO2 | 0.00% | 0.00% | 0.00% | 0.00% | 5.30% | 5.30% | 30.00% | 10.80% | 0.00% | 3.30% | 3.30% | 0.00% | 100.00% | 6.80% | 0.00% | 0.00% | 0.00% | 0.40% | 0.50% | 0.00% | 0.00% | 6.80% | 0.00% | 50.90% | 100.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.90% |
| H2O | 100.00% | 100.00% | 0.00% | 0.00% | 35.00% | 35.20% | 28.10% | 32.00% | 0.60% | 23.20% | 23.20% | 18.00% | 0.00% | 35.20% | 0.60% | 0.60% | 0.60% | 5.30% | 6.10% | 0.00% | 0.00% | 35.20% | 0.00% | 0.20% | 0.00% | 0.60% | 0.00% | 0.00% | 0.00% | 0.00% |
| CH4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.10% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2S | 0.00% | 0.00% | 0.00% | 0.00% | 0.20% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| NH3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 2.40% |
| COS | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CARBON | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SULFUR | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| CL2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCL | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| HCN | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| SO2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C2H6 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| C3H8 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| S2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| H2SO4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 82.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| UREA | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 100.00% | 0.00% |
| CARB | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

**Table 45: Plant Cost and Economics for Electricity Only Cases**

**(Year 2007 $)**

| | BOE | LOE |
|---|---|---|
| **Net Power, kW** | **398,833** | **373,550** |
| **Plant Cost, $1000** | | |
| Fuel Preparation System | 146,555 | 213,044 |
| Air Separation Unit | 42,117 | 44,014 |
| Gasification System | 320,397 | 328,403 |
| Gas Cleanup & Conditioning Systems | 267,384 | 251,914 |
| Power Island | 184,749 | 180,513 |
| Co-production Unit | - | - |
| General Facilities | 155,693 | 153,790 |
| **Total Plant Cost (TPC), $1000** | **1,116,895** | **1,171,678** |
| **Total Fixed operating cost for Initial Year, $1000/yr** | **45,236** | **47,169** |
| **Total Variable Operating Costs for Initial Year, $1000/yr** | **71,207** | **56,962** |
| **1st Year Cost of Electricity (COE), $/MWh** | **102.9** | **108.1** |

**Table 46: Plant Cost and Economics for Hydrogen Coproduction Cases**

**(Year 2007 $)**

| | BOH | BWH | BGH | LOH | LWH | LGH |
|---|---|---|---|---|---|---|
| **Net Power, kW** | **377,310** | **348,004** | **372,484** | **318,764** | **301,916** | **326,126** |
| **Plant Cost, $1000** | | | | | | |
| Fuel Preparation System | 189,609 | 229,090 | 206,916 | 258,007 | 277,762 | 258,715 |
| Air Separation Unit | 54,495 | 52,982 | 52,874 | 53,312 | 51,765 | 51,644 |
| Gasification System | 414,522 | 395,131 | 409,788 | 397,712 | 380,333 | 395,272 |
| Gas Cleanup & Conditioning Systems | 354,720 | 312,981 | 316,469 | 310,678 | 277,303 | 279,842 |
| Power Island | 191,486 | 188,015 | 189,492 | 181,404 | 179,399 | 180,841 |
| Co-production Unit | 10,736 | 10,121 | 10,619 | 9,506 | 9,117 | 9,628 |
| General Facilities | 175,684 | 170,780 | 173,222 | 166,857 | 163,733 | 166,128 |
| **Total Plant Cost (TPC), $1000** | **1,391,251** | **1,359,100** | **1,359,380** | **1,377,476** | **1,339,412** | **1,342,070** |
| **Total Fixed Operating Cost for Initial Year, $1000/yr** | **54,834** | **53,852** | **53,929** | **54,512** | **53,302** | **53,464** |
| **Total Variable Operating Costs + Coproduct Credit for Initial Year, $1000/yr** | **3,812** | **-12,566** | **5,393** | **-23,477** | **-30,558** | **-12,360** |
| **Hydrogen Cost for Initial Year, $/kg** | **1.42** | **2.39** | **1.83** | **1.69** | **2.77** | **2.08** |
| **1st Year Cost of Electricity (COE), $/MWh** | **102.9** | **102.9** | **102.9** | **108.1** | **108.1** | **108.1** |

**Table 47: Plant Cost and Economics for Methanol Coproduction Cases**

**(Year 2007 $)**

| | BOM | BWM | BGM | LOM | LWM | LGM |
|---|---|---|---|---|---|---|
| **Net Power, kW** | **335,021** | **313,444** | **337,250** | **280,001** | **267,834** | **290,538** |
| **Plant Cost, $1000** | | | | | | |
| Fuel Preparation System | 184,971 | 226,383 | 204,133 | 252,474 | 274,633 | 255,606 |
| Air Separation Unit | 53,262 | 52,385 | 52,283 | 52,277 | 51,290 | 51,114 |
| Gasification System | 404,382 | 390,462 | 404,276 | 389,183 | 376,047 | 390,522 |
| Gas Cleanup & Conditioning Systems | 310,388 | 274,443 | 276,583 | 274,759 | 245,194 | 245,454 |
| Power Island | 181,740 | 179,676 | 180,551 | 171,919 | 171,066 | 172,201 |
| Co-production Unit | 81,735 | 78,342 | 82,453 | 72,084 | 70,108 | 73,943 |
| General Facilities | 167,610 | 164,607 | 166,330 | 159,821 | 157,852 | 159,952 |
| **Total Plant Cost (TPC), $1000** | **1,384,088** | **1,366,298** | **1,366,609** | **1,372,517** | **1,346,191** | **1,348,792** |
| **Total Fixed Operating Cost for Initial Year, $1000/yr** | **55,283** | **54,775** | **54,856** | **54,999** | **54,180** | **54,350** |
| **Total Variable Operating Costs + Coproduct Credit for Initial Year, $1000/yr** | **-26,000** | **-39,150** | **-21,857** | **-52,338** | **-58,089** | **-41,113** |
| **Methanol Cost for Initial Year, $/MT** | **345.02** | **518.64** | **408.96** | **415.57** | **617.29** | **483.36** |
| **1st Year Cost of Electricity (COE), $/MWh** | **102.9** | **102.9** | **102.9** | **108.1** | **108.1** | **108.1** |

**Table 48: Plant Cost and Economics for Fischer-Tropsch Liquids Coproduction Cases**

**(Year 2007 $)**

| | BOF | BWF | BGF | LOF | LWF | LGF |
|---|---|---|---|---|---|---|
| **Net Power, kW** | **325,920** | **304,625** | **325,037** | **279,738** | **266,600** | **287,798** |
| **Plant Cost, $1000** | | | | | | |
| Fuel Preparation System | 178,173 | 216,682 | 194,935 | 245,579 | 265,280 | 246,459 |
| Air Separation Unit | 53,272 | 51,994 | 51,797 | 52,520 | 51,172 | 50,971 |
| Gasification System | 389,521 | 373,729 | 386,060 | 378,554 | 363,241 | 376,547 |
| Gas Cleanup & Conditioning Systems | 240,139 | 202,908 | 200,855 | 208,586 | 177,033 | 172,580 |
| Power Island | 190,047 | 186,582 | 187,633 | 182,036 | 179,684 | 180,666 |
| Co-production Unit | 118,997 | 113,223 | 117,836 | 106,977 | 103,364 | 108,804 |
| General Facilities | 168,200 | 164,960 | 166,539 | 160,600 | 158,616 | 160,356 |
| **Total Plant Cost (TPC), $1000** | **1,338,348** | **1,310,079** | **1,305,656** | **1,334,852** | **1,298,390** | **1,296,385** |
| **Total Fixed Operating Cost for Initial Year, $1000/yr** | **54,518** | **53,636** | **53,591** | **54,452** | **53,281** | **53,336** |
| **Total Variable Operating Costs + Coproduct Credit for Initial Year, $1000/yr** | **-24,182** | **-35,434** | **-19,584** | **-45,613** | **-50,288** | **-33,685** |
| **Fischer-Tropsch Liquids Cost for Initial Year, $/bbl** | **64.78** | **97.62** | **77.85** | **73.72** | **111.91** | **86.56** |
| **1st Year Cost of Electricity (COE), $/MWh** | **102.9** | **102.9** | **102.9** | **108.1** | **108.1** | **108.1** |

**Table 49: Plant Cost and Economics for Higher Alcohols Coproduction Cases**

**(Year 2007 $)**

| | BOA | BWA | BGA | LOA | LWA | LGA |
|---|---|---|---|---|---|---|
| **Net Power, kW** | **223,402** | **212,800** | **222,547** | **206,583** | **197,143** | **207,928** |
| **Plant Cost, 1000 2007$** | | | | | | |
| Fuel Preparation System | 188,329 | 228,848 | 204,792 | 262,356 | 282,365 | 260,622 |
| Air Separation Unit | 62,629 | 60,561 | 60,691 | 60,925 | 58,919 | 58,966 |
| Gasification System | 411,722 | 394,714 | 405,581 | 404,416 | 386,635 | 398,185 |
| Gas Cleanup & Conditioning Systems | 250,805 | 211,491 | 207,671 | 223,654 | 189,015 | 183,110 |
| Power Island | 186,718 | 184,022 | 184,098 | 180,791 | 178,531 | 178,204 |
| Co-production Unit | 452,530 | 417,896 | 446,073 | 378,220 | 356,962 | 384,246 |
| General Facilities | 165,388 | 162,853 | 164,139 | 160,221 | 158,127 | 158,701 |
| **Total Plant Cost (TPC), $1000** | **1,718,121** | **1,660,385** | **1,673,045** | **1,670,584** | **1,610,555** | **1,622,033** |
| **Total Fixed Operating Cost for Initial Year, $1000/yr** | **68,551** | **66,573** | **67,195** | **66,761** | **64,736** | **65,328** |
| **Total Variable Operating Costs + Coproduct Credit for Initial Year, $1000/yr** | **-169,802** | **-167,606** | **-162,843** | **-163,324** | **-161,786** | **-155,614** |
| **Alcohol Cost for Initial Year, $/gal** | **4.52** | **5.39** | **4.91** | **4.37** | **5.43** | **4.84** |
| **1st Year Cost of Electricity (COE), $/MWh** | **102.9** | **102.9** | **102.9** | **108.9** | **108.1** | **108.1** |

**Table 50: Plant Cost and Economics for Urea Coproduction Cases**

**(Year 2007 $)**

| | BOU | BWU | BGU | LOU | LWU | LGU |
|---|---|---|---|---|---|---|
| **Net Power, kW** | **343,339** | **321,530** | **347,083** | **294,813** | **279,470** | **302,231** |
| **Plant Cost, $1000** | | | | | | |
| Fuel Preparation System | 200,611 | 244,268 | 221,593 | 274,370 | 294,389 | 275,916 |
| Air Separation Unit | 96,114 | 93,032 | 94,882 | 91,385 | 87,975 | 90,137 |
| Gasification System | 438,575 | 421,310 | 438,855 | 422,936 | 403,100 | 421,553 |
| Gas Cleanup & Conditioning Systems | 369,651 | 327,258 | 332,308 | 325,146 | 286,362 | 291,955 |
| Power Island | 193,313 | 190,681 | 192,876 | 183,104 | 181,133 | 182,820 |
| Co-production Unit | 548,558 | 521,512 | 547,616 | 493,429 | 471,620 | 501,444 |
| General Facilities | 188,404 | 183,843 | 187,484 | 178,168 | 174,177 | 178,094 |
| **Total Plant Cost (TPC), $1000** | **2,035,226** | **1,981,903** | **2,015,613** | **1,968,538** | **1,898,754** | **1,941,920** |
| **Total Fixed Operating Cost for Initial Year, $1000/yr** | **76,586** | **74,921** | **76,107** | **74,531** | **72,287** | **73,788** |
| **Total Variable Operating Costs + Coproduct Credit for Initial Year, $1000/yr** | **-139,918** | **-146,716** | **-134,501** | **-150,903** | **-151,021** | **-141,465** |
| **Urea Cost for Initial Year, $/MT** | **306.99** | **391.32** | **340.06** | **331.24** | **428.03** | **365.75** |
| **1st Year Cost of Electricity (COE), $/MWh** | **102.9** | **102.9** | **102.9** | **108.1** | **108.1** | **108.1** |

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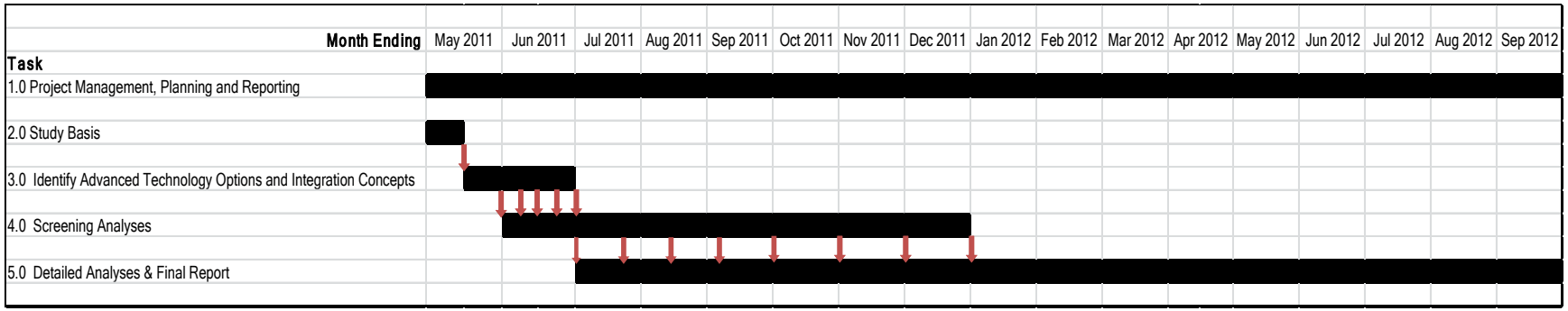
## COST AND SCHEDULE STATUS

The project schedule based on the information flow among the proposed tasks is shown in Figure 11. The various activities / tasks, along with the time for the accomplishment of these activities / tasks and the dates for the release of outcomes are identified.

A summary of budget and costs is presented in Table 51 for the entire period of this study since this study is completed now.

## Figure 11: Project Schedule




## Table 51: Summary of Budget and Costs

| | October 2011 - September 2012 | | | |
|---|---|---|---|---|
| | Current Budget | Expense to Date | Cost Share Expense to Date | Balance Remaining |
| Direct Labor | $ 225,717.00 | 223,110.71 | 73,023.43 | $ 2,606.29 |
| Fringe Benefits | $ 51,499.00 | 44,021.22 | - | $ 7,477.78 |
| Materials | $ 2,500.00 | 2,000.00 | - | $ 500.00 |
| Travel | $ 3,300.00 | 492.20 | - | $ 2,807.80 |
| Misc. | $ 13,245.00 | 32,079.01 | - | $ (18,834.01) |
| Indirect | $ 150,634.00 | 145,191.86 | 38,702.42 | $ 5,442.14 |
| **Total** | **$ 446,895.00** | **$ 446,895.00** | **$ 111,725.85** | **$ 0.00** |