

Municipal Solid Waste Gasification with Solid Oxide Fuel Cells and Stirling Engine - DTU Orbit (08/11/2017)

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Municipal Solid Waste (MSW) can be considered a valid biomass to be used in a power plant. The major advantage is the reduction of pollutants and greenhouse gases emissions not only within large cities but also globally. Another advantage is that by their use it is possible to reduce the waste storage in landfills and devote these spaces to other human activities. It is also important to point out that this kind of renewable energy suffers significantly less availability which characterizes other type of renewable energy sources such as in wind and solar energy. In a gasification process, waste is subject to chemical treatments through air or/and steam utilization; the result is a synthesis gas, called "Syngas" which is principally composed of hydrogen and carbon monoxide. Traces of hydrogen sulfide could also be present which can easily be separated in a desulfurization reactor. The gasification process is usually based on an atmospheric - pressure circulating fluidized bed gasifier coupled to a tar - cracking vessel. Syngas can be used as fuel in different kind of power plant such as gas turbine cycle, steam cycle, combined cycle, internal and external combustion engine and Solid Oxide Fuel Cell (SOFC). In the present study, a MSW gasification plant integrated with SOFC is combined with a Stirling engine to recover the energy of the off - gases from the topping SOFC cycle. Detailed plant design is proposed and thermodynamic analysis is performed. Relevant parameters have been studied to optimize the plant efficiency in terms of operating conditions. Compared with modern waste incinerators with heat recovery, the gasification process integrated with SOFC and Stirling engine permits an increase in electricity output up of 50%, which means that the solid waste gasification process can compete with incineration technology. Moreover waste incinerators require the installation of sophisticated exhaust gas cleaning equipment that can be large and expensive and are not necessary in the studied plant.

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