Providing energy for rural Indian communities- Anaerobic Digestion at Loughborough University

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Rural Hybrid Energy Enterprise Systems (RHEES) is a research partnership between 6 UK and 7 Indian Universities. The aim of this project is to develop best practise at a smaller community scale which makes use of hybrid and combinations of biofuels. The idea is to improve rural energy availability, equity of cost and to generate an economic stimulus from the desire to provide greater energy security and reduced environmental impact.
Our part of the project is AD and here we describe the typical Assam design. We summarise how a novel gas monitoring device for remotely controlled, autonomous monitoring of AD might avoid shock loadings from heterogeneous feedstocks.

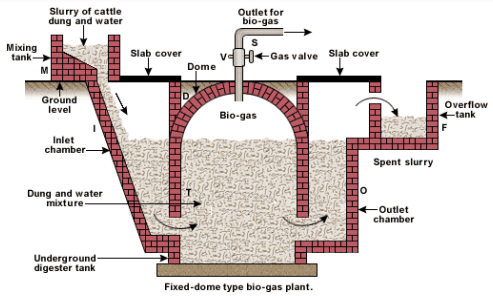
CASE STUDY

Why is AD beneficial for Indian communities?

- **Remote un-electrified rural areas**
- **The digestate can be used as a fertilizer**
- **Biogas burners more efficient than burning wood or dung**
- **Reduced health risk with less smoke pollution from biogas**
- **Potential for biomass resources (domestic waste, animal and agro-residues)**
- **Opportunity for energy crop plantation in unused lands**
- **Small scale reactors would provide cooking/heating energy and bring immediate improvement of quality of life for rural communities**

- **Type of Digester: Deenbandhu model Dimension: 3 m^3**

Total cows	12	Feeding per day	60 Kgs
Total solid (Cowdung:water/1:1)	8.43%	Average biogas burning duration (Summer and Winter)	8 hrs daily
Average summer temperature	30-32 °C	No. of users	12
Average winter temperature	10-12 °C	Total solid of Slurry (can be reutilized for biogas production)	6.5%
HRT	55 days	Total solid to biogas conversion	23%



Detailed structural design of fixed dome biogas plant

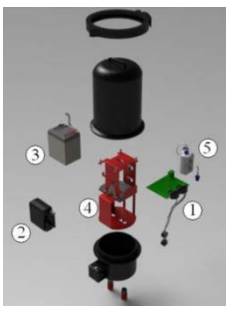


inlet tank **digester** **outlet tank**

Typically small communities would have 4 different sources of waste: sewage, animal dung, domestic food waste and food processing waste, and crop residues. The aim is to balance and blend these different feedstocks to avoid shocking a small scale digester. Waste characterisation helps but real time monitoring provides necessary sensitivity.

SENSING/MONITORING

- **Aiming for autonomous remote monitoring of: CH_4, CO_2, O_2, pressure, temperature, H_2S**
- **Using autonomous wireless gas sensing platforms- reliable long term performance and reduction in component cost**
- **The data to be sent to the cloud via GSM transmissions, and will be accessible via an online portal for remote monitoring by the facility management**
- **CO_2 and CH_4 sensing: high-accuracy infrared absorbance sensors,**
- **Pressure sensing: piezoelectric sensors (critical for understanding gas flows)**
- **Autonomous operation is achieved by custom-programmed microcontroller circuitry, which also manages data logging and remote transmission (GSM communications)**
- **Hybrid solar thermal heating of the digesters**



Autonomous landfill gas monitoring platform developed at Dublin City University, (left) exploded view, (right) as deployed on borehole well (with casing removed).
Components: (1) control board, (2) GSM module, (3) battery, (4) extraction pump, (5) sampling chamber and sensors, (6) protective casing

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