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Energy Production from Waste

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The current irrational use of fossil fuels and the impact of greenhouse gases on the environment are driving research into renewable energy production from organic resources and waste. The global energy demand is high, and most of this energy is produced from fossil resources.

Biogas is produced after organic materials (plant and animal products) are broken down by bacteria in an oxygen-free environment, a process called anaerobic digestion (AD). Biogas systems use AD to recycle these organic materials, turning them into biogas, which contains both energy (gas), and valuable soil products (liquids and solids) [1].

After biogas is captured, it can produce heat and electricity for use in engines, microturbines, and fuel cells. Biogas can also be upgraded into biomethane, also called renewable natural gas (RNG), and injected into natural gas pipelines or used as a vehicle fuel.

The process of biogas generation is divided into four steps:

1. Preparation of the input material
2. Digestion (fermentation) and other complex chemical reactions
3. Conversion of the biogas to renewable electricity and useful heat with cogeneration / combined heat and power
4. Biogas use for various purposes [2].

Initially the feedstock to the digesters is received in a primary pit or liquid storage tank. From here it is loaded into

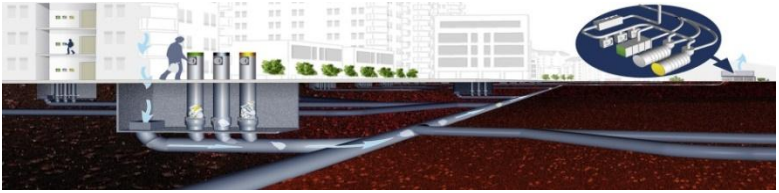
the digester by various means depending upon the composition of waste materials. In the digestion tanks a series of biological processes are harnessed in order to produce biogas. Hydrolysis is the process where the organic material is solubilized into the digestion liquid. Then it undergoes the intermediate steps of acidogenesis and acetogenesis which create the precursor molecules for methanogenesis. Methanogens feed off these precursors and produce methane as a cellular waste product. The biogas containing this biologically-derived methane is contained and captured in a gas storage tank which is located separately to the main digester, or alternatively can form its roof. The gas storage tank acts as a buffer in order to balance fluctuations in the production of gas in the digesters. The biogas is then converted into renewable power in the form of electricity and heat [3].

Biogas plant

In Europe, the production of biogas reached 1.35×10^7 t in 2014. Europe was prompt in applying sustainable waste management. European bodies implemented new research

programs to support an alternative-fuels future based on renewable resources. Germany is the leading biogas producer in Europe, with more than 8,000 biogas plants currently in operation, and its biogas amount corresponds to an approximate total electricity capacity of 4 TWh.

Swedes recycle nearly 100 % of their household waste. The southern Swedish city of Helsingborg even fitted public waste bins with loudspeakers playing pleasant music. They even have to import waste to have something to burn, to turn waste into energy. In 2014, Sweden even imported 2.7 million tonnes of waste from other countries [4].



Swedish waste sorting system

Conclusion

Biogas systems are waste management solutions that solve multiple problems and create multiple benefits.

References:

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