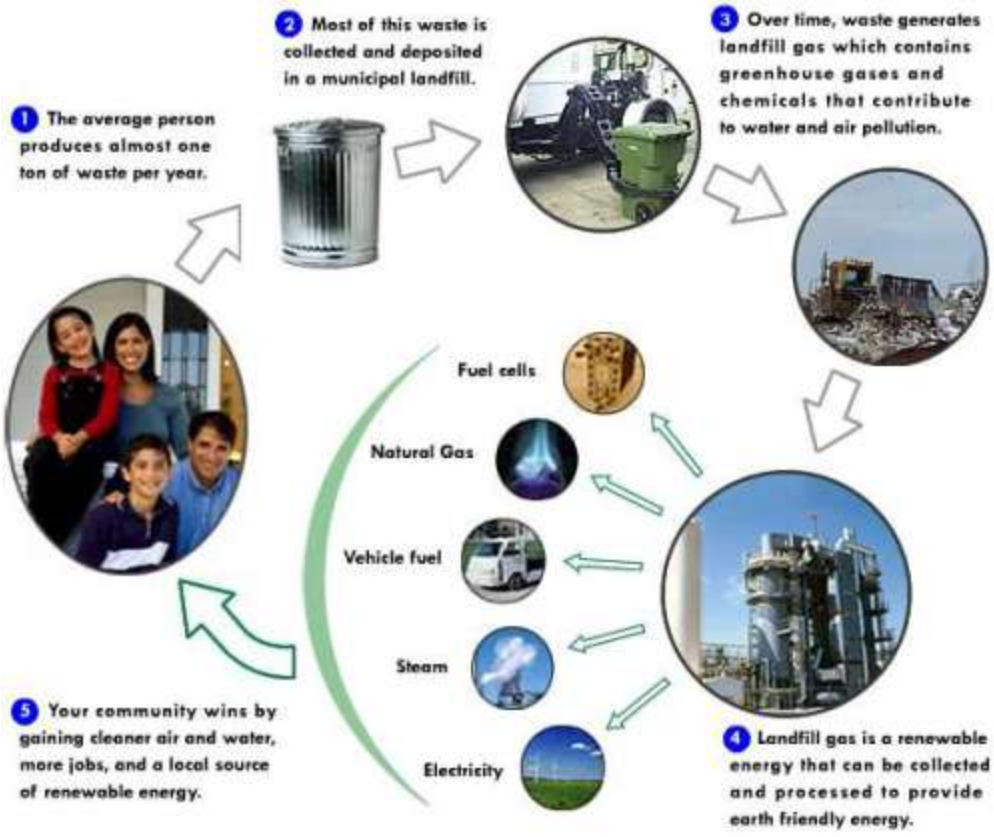
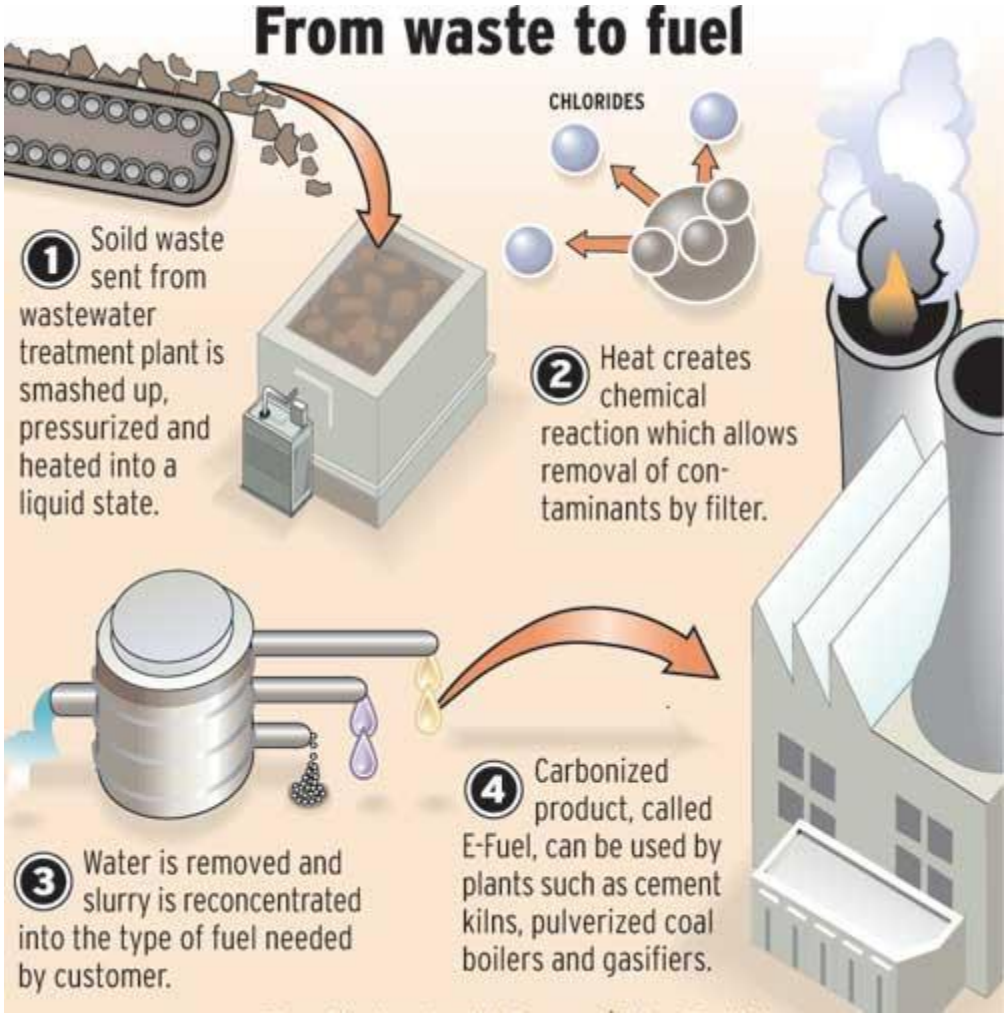
ENERGY FROM SEWAGE



Introduction - Sewage treatment, that is, the physical, chemical and biological processes used to clean industrial and domestic wastewater, has improved significantly over the past 20 years. However, the energy requirement to treat sewage to the highest standard has been quite large. Further tightening of water quality standards, especially in developed nations; suggest energy costs will increase substantially in future. We will discuss here about possibility of renewable energy generation from sewage, to offset the extra energy requirement for sewage treatment and also to use surplus energy for domestic purpose. In fact, the actual energy used will depend on the quality of sewage and intensity of treatment required.



1. Typically, there are three stages of treatment:

(a) Primary – Solids are physically settled out.

(b) Secondary – Bacteria convert organic matter to a carbon-rich sludge.

(c) Tertiary – Further treatment may be used to remove more organic matter and/or disinfect the water.

The effluent is generally discharged to fresh, ground or coastal water. Sludge is applied to agricultural land, incinerated, used for land reclamation or used for other purposes, such as composting or landfill etc.

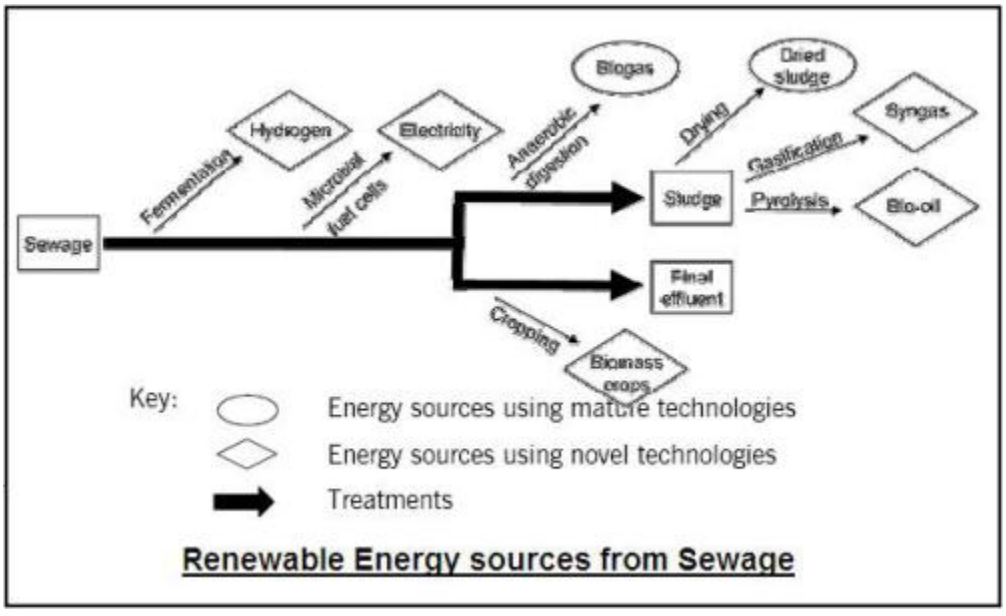
2. In order to increase energy efficiency of water treatment and reuse of treated water few points have been mentioned below. By implementing these measures energy savings and efficiency of about 40% may be achieved. These are:

(a) Choosing low-energy treatment options, if possible. However, local constraints may limit choice.

(b) Replacing machine parts, such as pumps and motors, with more efficient versions.

(c) Optimizing processes using sensor technology. For example, pumping can be adjusted according to flow.

(d) Reusing water. “Greywater” from bathing, laundry and washing dishes can be reused to flush WCs. This may provide savings of around a third of daily household water demand.



3. Energy generation - There are mature, widely-practiced technologies for generating fuels from sewage treatment. Moreover, research has identified future methods for exploiting sewage as an energy resource as well.

i. Current Technologies for Energy Production –

(a) Sludge Incineration – Most of the sewage sludge produced at sewage treatment plant is applied to agricultural land as a soil conditioner, reducing the need for fertilizer. Sludge may also be incinerated, with the option of energy recovery. However, to incinerate sludge, it must be dry enough to burn with no extra energy input other than that needed to fire up the incinerator. It therefore needs dewatering, using energy intensive processes such as centrifugation or thermal dehydration. Centrifugation requires less energy but surplus heat from incineration that can be used for thermal dehydration. There has been strong opposition from some sections of the public over incineration of wastes due to fears about impacts on human health. At present, reuse of sludge via application to land is generally considered a more acceptable option.

(b) Biogas – Biogas production from sewage sludge treatment, via a process called anaerobic digestion, is already a well established means of generating energy in many developed countries. Bacteria used to organic matter in sludge to produce a mixture of methane (CH_4 of 60 – 65%), carbon dioxide (CO_2 of 35 – 40%) and trace gases. Impurities, such as hydrogen sulfide and water, are removed and the resulting biogas is then commonly used in boilers or combined heat and power systems. Biogas may also be used for other applications, such as vehicle fuel, if CO_2 is also removed. Anaerobic digestion also reduces the solids content of sludge by up to 30%, reducing the energy costs involved in its transport.

ii. Future Technologies for Energy Production - There are several novel technologies that produce energy or fuel as a by-product of sewage treatment, although further work is needed to improve performance, reliability and cost-effectiveness.

(a) Conversion of sludge to oil and gas – Under carefully controlled conditions and extreme temperatures (450 – 1000 degree Celsius), sludge may undergo chemical reactions to produce fuels that may be used for energy production. Processes include gasification, which produces syngas (similar to natural gas), and pyrolysis, which produces bio-oil (similar to diesel oil). There is interest in these as

potential alternatives to incineration of sludge. However, operational costs are high, particularly those of maintaining high temperatures, and conditions must be carefully controlled to prevent formation of harmful by-products, such as hydrogen cyanide.

(b) Biomass Crops – In some of the European countries, sewage sludge is applied as fertilizer to willow plantations. The trees are periodically coppiced and the wood used for fuel. Research into applying partially-treated, liquid sewage to biomass crops is also underway. Passage of the sewage through the soil acts as a final polishing step for treatment, degrading organic matter, reducing nitrogen and phosphorus and producing a cleaner effluent. Little energy is required and capital and operational costs are low. However, it is not yet known how efficient this system will be at removing pollution and there must be appropriate land available.

(c) Hydrogen from Sewage – There is much interest in hydrogen as a fuel, because it can be produced from a wide range of materials and provides power with minimal air pollution. Bacteria use organic matter to produce hydrogen by fermentation. However, applications for hydrogen, such as fuel cells, are not yet in widespread use.

(d) Microbial Fuel Cells – These devices offer the possibility of simultaneous sewage treatment and energy production, with water, CO2 and inorganic residue as by-products. Bacteria use organic matter to produce electricity. To date, only lab-scale microbial fuel cells have been developed in some of the developed countries that are able to power small devices.

4. Discussion on energy conservation and renewable energy in relation to sewage treatment system –

(a) Energy conservation is possible through the twin practices of efficient water use by consumers and efficient energy use by the water industry.

(b) There are well-established renewable energy options, such as biogas, and novel technologies, such as gasification, for sewage treatment. Many need further investment and research.

(c) Economic and water quality considerations are key drivers for the water industry. Integration of energy related objectives into the existing regulatory framework will be necessary.

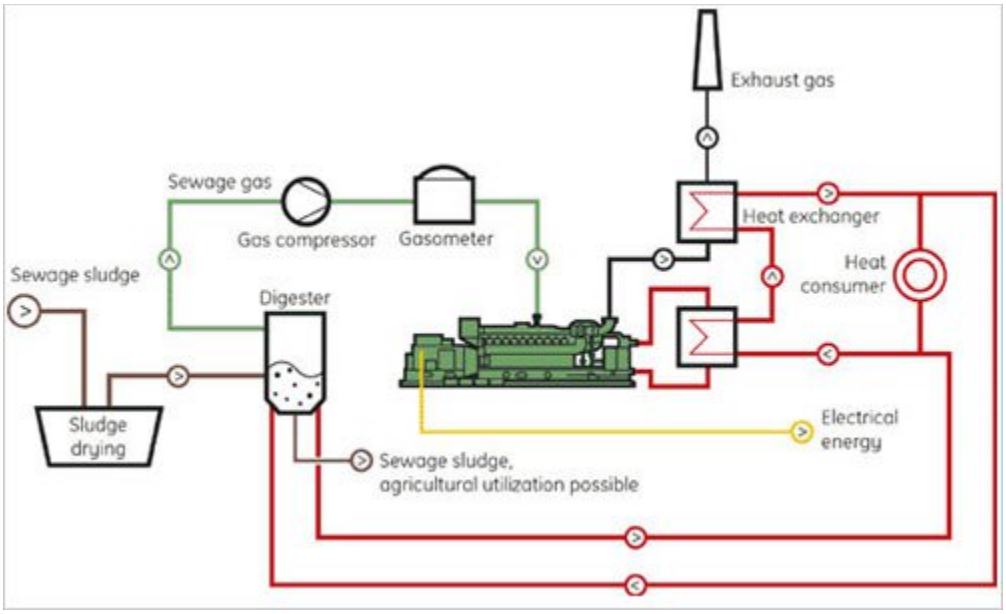
5. Methane from Biogas (Renewable source of green energy to be promoted):

Municipal waste contains about 150 to 250kg of organic carbon per ton. This organic carbon is biodegradable and converted into landfill gas in anaerobic conditions. It has a relatively high calorific value of about 5 kWh/m3N and can be effectively used to generate power. If this gas is continuously extracted under controlled conditions, a tremendous amount of energy can be harvested. Anaerobic digestion of wastes provides biogas. Biogas contains about 60% methane that can be used to generate electricity or used for heat or for fuel for vehicles.

Any animal manure, human sewage or food waste will produce methane during anaerobic digestion. Natural gas is methane. Biogas can be “cleaned” to yield purified methane that can be used in the natural gas pipelines.

Methane from biogas is an excellent alternative energy source. Using methane for energy helps the environment by replacing the use of non-renewable fossil fuels with renewable energy. Methane is a greenhouse gas that has 21 times the heating effect as of carbon dioxide. Biogas methane is renewable unlike natural gas which is mined from underground wells and is a non-renewable fossil fuel. Methane biogas is about to become much more important as an energy source than it has been in the past, due to the ever rising cost of natural gas.

To harvest this gas, perforated tubes are drilled into the landfill body and connected to a pipe system. A blower sucks the gas away from the landfill and it is then later compressed, dried, and fed to a gas engine. This energy is converted to electrical energy and fed into the local power grid.



Sewage gas is harvested in much the same way. Sewage sludge is first dried and then pumped into a digester. The gas emitted from the digester typically contains about 50 to 60% methane. The gaseous emissions are then compressed and fed to a gasometer. This acts a fuel tank to the actual electrical energy generator unit. Enough energy is generated to power the sewage treatment plant itself.

A. Some facts about methane biogas –

(a) Millions of cubic metres of methane in the form of swamp gas or biogas are produced every year by the decomposition of organic matter, both animal and vegetable.

(b) It is almost identical to the natural gas pumped out of the ground by the oil companies and used by many of us for heating our houses and cooking our meals.

(c) Many countries have for years been steadily building anaerobic digestion facilities for generating electricity from methane produced from manure, sewage and garbage.

(d) Villagers in many undeveloped countries use very simple technology to convert animal and human wastes to biogas for cooking and heating.

(e) Recently hundreds of farms in India, Mexico and South America have installed anaerobic digesters to collect and use methane from manure to provide energy for farm use. Many of these digesters have been paid for by a company that aggregates and sells carbon credits to factories and utility companies in countries that signed agreements under the Kyoto protocol to reduce greenhouse emissions. Carbon credits are earned by reducing greenhouse gas emissions such as carbon dioxide and methane. These credits have considerable value.

(f) In the U.S., which rejected the Kyoto protocol, most of the methane from wastes is allowed to escape into the atmosphere where it contributes to global warming. However there are about a hundred or so dairy farms, a few pig farms, some landfills and a few municipal sewage treatment plants in the U.S. that are collecting methane from waste and using it for fuel.

B. Unbelievable as it may seem, at this time of approaching energy crisis, most farmers can't get utility companies to purchase their green, renewable electricity. Possible reasons for this reluctance on the part of electrical utilities range from lack of familiarity with connecting farm generators to pressure from coal and oil companies to maintain monopoly of the utility market. Without the ability to sell the excess power generated from methane farmers or others with sources of methane can't afford to install the equipment for collecting methane and generating power as this usually means an investment of a million or more dollars.

C. This kind of situation needs change. Countries where the production of methane from biogas is not practiced, realizing the seriousness of global warming and problems associated with fossil fuel usage, "green energy" generated from sources such as wind, biomass and, in a few cases, bio-methane are to be encouraged by law. Moreover, consumer pressure will likely be needed to motivate more electric utilities to purchase electricity generated from renewable methane thus ensuring energy security.

D. Biogas from manure or other wastes can be purified to yield pipeline grade methane. With the increase in price of natural gas it has become economically feasible in some cases to remove impurities from the methane and sell it to companies supplying natural gas (methane is chemically the same as natural gas). Due to the energy that must be used to clean, compress and transport the gas this is usually not as efficient a route for using methane as feeding it directly into a generator but, unless electric utility companies become willing to pay a fair price for electricity generated from farm methane, selling gas for pipeline use may become a more common practice.

6. Conclusion – Bio-energy from sewage as the main source of energy worldwide must be accepted in order to have a better and cleaner future. This means that we need to take the necessary steps to improve our technology to be able to efficiently harness the enormous potential that bio-energy could bring. We must also research and work hard to be able to eliminate the disadvantages that bio-fuels have and turn them into usable advantages. It is certain, a good research in development of this form of bio-energy will provide an environmentally sustainable alternative to managing sewage sludge and biomass while producing renewable electrical power.

Source : http://saferenvironment.wordpress.com/2009/01/17/energy-from-sewage-%E2%80%93-renewable-energy-to-be-tapped-to-make-environment-green/