Information Sheet # 45

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Your Reliable Guide for Power Solutions

To fulfill our commitment to be the leading supplier in the power generation industry, the Buckeye Power Sales team ensures they are always up-to-date with the current power industry standards as well as industry trends. As a service, our **Information Sheets** are circulated on a regular basis to existing and potential power customers to maintain their awareness of changes and developments in standards, codes and technology within the power industry.

Alternative Fuels Options for Generator Set Systems

1.0 Introduction

With the ever-increasing world-wide need to find new energy and power sources, there is a developing interest in the use and potential of alternative fuels to provide both transportation and stationary power.

This information sheet discusses the latter in particular and how this relates to the US market.

2.0 Alternative Fuels for Stationary Generator Set Systems

At the 1900 Paris World Exhibition, Rudolf Diesel demonstrated several engines running on peanut oil. Since those distant days, there have been many developments in the field of alternative fuels, especially in recent decades.

In addition to natural gas power and compressed natural gas in mobile applications, there is an ever-increasing interest in other alternative gas fuels that can be utilized to produce electricity.

100% of these applications are for stationary power due to the difficulties of providing such fuels to the mobile power unit. These potential fuels can be summed up as follows:

3.0 Digester Gas

Considerable quantities of biogas can be produced by sludge digestion in the tanks of sewage treatment plants. Since biomass is a source of energy with no net carbon dioxide emissions, its use as a fuel can help to reduce the usage of fossil fuels thus helping reduce the greenhouse gas effect from more traditional fuel sources. While digester gas has been an alternative gas engine fuel for almost half a century, the value of this high energy, high quality gaseous fuel is more enhanced today because of the numerous environmental, economic and technical advantages.

First of all, it utilizes a readily available source of free energy that is produced in large quantities daily in municipal and industrial wastewater treatment plants. Secondly, the production of electrical power from combustion of this gas does not compete with the growing needs of the community and therefore postpones the construction of new and expensive fossil power plants. Lastly, the exhaust emissions produced in the combustion process are easily controlled, either through the use of lean combustion or catalytic converter technology.

The anaerobic (absence of oxygen) digestion system applies heat to separate digestion tanks. This involves the decomposition of organic and inorganic matter which, in addition to the production of methane (CH4) and carbon dioxide (CO2) gas, also will reduce the volume of sludge by 45 to 50%. The digester gas contains about 65 – 75% methane by volume and 30 to 35% carbon dioxide with small amounts of nitrogen (N2), hydrogen (H2), and other gases. One cubic meter of methane at standard temperature and pressure has a low net saturated heating value of 960 Btu/ft3. Since digester gas is only 65% methane, the calorific value of digester gas is only about 600 Btu/ft3. By comparison, natural gas has a heating value of approximately 1,000 Btu/ ft3. The gas must be treated to remove any liquid water traces, passed though scrubbers to remove any sulfur components and the inlet temperature maintained between - 20ºF and 140ºF.

A rule of thumb or guideline is that an engine powered by digester gas will produce between 80 and 85% of its continuous natural gas rating for naturally aspirated units and 100% for turbocharged models.

4.0 Landfill Waste Gas

This is a win-win for the environment. Landfill gas is largely comprised of the greenhouse gas – methane (CH4). Burning landfill methane gas for electrical power production prevents it from escaping into the atmosphere where it is 32 times more damaging to the atmosphere's ozone layer than carbon dioxide.

While Europe has embraced the concept of operating units to produce electrical power for decades, the use in the U.S. is not so widespread but opportunities abound. The U. S. Environmental Protection Agency (EPA) informs that there are some 400 landfill sites with generators installed to produce electrical power, with some 600 potential sites. Such power plants also qualify for "green power" credits for the supply of electricity from a renewable energy source.

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The digester gas is collected via vertical pipes placed into the landfill which are vacuumed and compressed with fans, before being fed to the engine. California has some 70 landfills with potential to generate approximately 65.76MW of electricity. A suitable landfill must be at least 40 feet deep and have at least one million tons of waste for it to be technically and economically feasible for landfill gas collection and power production,

5.0 Coal Bed Methane (CBM)

Coal bed gas is a form of natural gas that can be extracted from coal beds. It has become an important source of energy in the United States, Canada and other countries – especially Australia, which has rich deposits where it is known as coal seam gas (CSG). Coal seam gas refers to methane that is absorbed into the solid matrix of coal. It is called "sweet gas" because it lacks hydrogen sulfide. This gas is well known in underground coal mining, where it presents a serious safety risk.

Coal bed methane gas is distinct as the methane is stored within the coal by a process called adsorption. The methane is in a near-liquid state, lining the pores within the coal. Unlike natural gas from conventional reservoirs, coal bed methane contains very little heavier hydrocarbons such as propane or butane. This is considered a renewable resource as the bacterial action that forms the methane is ongoing. The U.S. Geological Survey estimated in 1997 that there is more than 700 trillion cubic feet of coal bed methane within the U.S.

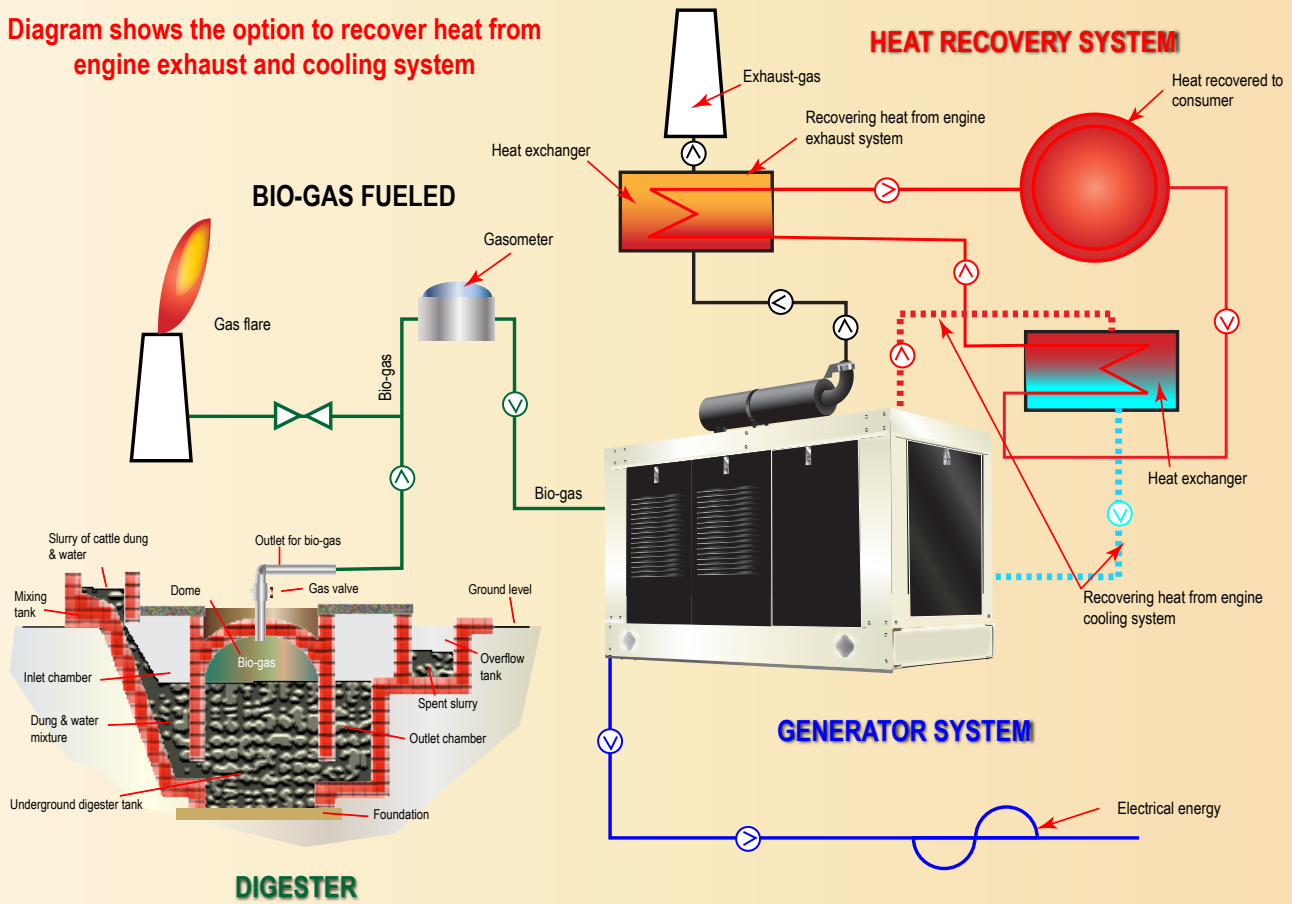
Areas with coal bed methane include: Alabama, Colorado, Kansas, Kentucky, Montana, New Mexico, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia and Wyoming.

6.0 Agricultural Waste Gases

A useable gas for power generation can be produced by a number of methods.

- Animal (chicken, cattle and hog) manure. This can be treated in anaerobic digesters to produce methane gas.
- Vegetable matter and waste. Many products such as wood chips, sawdust, straw. shells of nuts, grain husks, food waste, animal waste, etc. can be treated by fermentation methods to produce a fuel oil or with a gasifier process, that can be further processed to provide biomass or bio fuels such as diesel, gasoline or jet fuel.

EXAMPLE of BIO-GAS BEING RECOVERED to POWER GENERATOR SYSTEM



MEMBER EGSA Electrical Generating Systems Association

Columbus, OH
6850 Commerce Court Drive
P.O. Box 489
Blacklick OH 43004-0489
(614) 861-6000
(800) 523-3587
(614) 861-2291 fax

Cincinnati, OH
7782 Service Center Drive
West Chester, OH 45069
(513) 755-2323
(800) 368-7422
(513) 755-4515 fax

Cleveland, OH
8465 Tower Drive
P.O. Box 394
Twinsburg, OH 44087-0394
(330) 425-9165
(800) 966-2825
(330) 487-0229 fax

Indianapolis, IN
1229 Indy Place
Indianapolis, IN 46214
(317) 271-9661
(800) 632-0339
(317) 271-0242 fax

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www.buckeyepowersales.com