Biogas modification

The waste becomes a raw material used in industry and agriculture

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The production of biogas from natural raw materials and municipal waste materials has been safely in operation for a number of years. The development in the amount of facilities for the production of biogas has been rather unsteady. As a result, thermo-/energy- utilization of biogas is due to its high calorific capacity an obvious move. All this has made it possible to produce electrical power and waste heat in electrical power plants using the biogas. The energy effectiveness of such biogas utilization is within the range of 35% at max. However, together with the utilization of waste heat, it is possible to increase the effectiveness of the conventional use of biogas in the production of electrical power up to 65 or 75 %. This rather simple reasoning indicates that if there is no arrangement for the utilization of waste heat, the cost-effectiveness of the utilization of biogas in the production of electrical power remains somewhere near the edge.

Biogas contains valuable raw-components. This invites the option of substance-utilization of these raw-components, since these can be processed independently of the utilization process of waste heat. The cleaning of biogas in order to remove NH_3, H_2S and exsiccation is a tried-and-true method and has already been in use. Its implementation is a prerequisite for substance-utilization of main components CH_4 and CO_2 which are contained in biogas. The DGE GmbH Company has developed four different cleaning and modification techniques for different available options of substance-utilization of biogas – ref. to the following shortened versions of descriptions.

Means of biogas utilization BCM-0
Natural gas production

The basic method for the production of natural gas is the split-up of biogas into natural gas and carbon dioxide. As a result of a newly enacted Law of Renewable Energy Resources (EEG), the utilization of this method itself brings considerable advantages to everyone who operates a facility based on biogas, where this biogas is used to produce electrical power.

Means of biogas utilization BCM-1
Soda and natural gas production

Biogas that comes out of a container is always cleaned first, using one washer; forming NH_3 and H_2S, and having been modified in this way, the biogas is further taken into the waste-gas washer, in which CO_2 and NaOH are removed for the purpose of producing Na_2CO_3.

Subsequently, with the use of a compressor, the cleaned-up biogas is compressed like a natural gas to reach the desired pressure. Following the first compression phase, gas dehydration is prescribed, along with the so-called “police filter”.

The achieved quality of the natural gas is somewhere in the neighborhood of 98 vol. % CH_4 and 2 vol. % CO_2.

Means of biogas utilization BCM-2
Compressive condensation in the production of split mixtures CO_2/CH_4

Biogas that comes out of a container is always cleaned first, using one washer; forming NH_3 and H_2S, and having been modified in this way, the biogas is further taken into a compression device. The following condensation phase gives rise to the forming of a gas rich on methane, which is of the same quality as natural gas, and carbon dioxide saturated with methane is being obtained, as well. Following the first compression phase, gas dehydration is prescribed, along with the so-called “police filter”.
The cleaned-up gas, just like natural gas (high-caloric gas), may be supplied into the (distribution) system or be used as fuel.

The carbon dioxide (classified as low-caloric gas), which is obtained in a liquid-state, may be used after its expansion in an electrical power plant in the production of electric power.

The temperature of – 50°C is a condensation temperature at which methanol and carbon dioxide become disintegrated to form 1 kmol/h of biogas:

	gaseous phase rich gasgas	liquid phase poor gas	Total
Methane	0,385	0,275	0,66
Carbon dioxide	0,06	0,27	0,33

In addition, both parts are separately used to produce products such as methanol, hydrogen, or other hydrocarbons, using the “Fischer Tropsch Synthese“. It is possible to produce up to 70 1/h of methanol from 100 m³/h of biogas.

Means of biogas utilization BCM-3
Compressive washing for the production of carbon dioxide and natural gas

Biogas that comes out of a container is always cleaned first, using one washer; forming NH_3 and H_2S, and having been modified in this way, the biogas is further taken into a compressor. The compressed gas must be washed either after the first or the second compression stage, depending on the type of the washing medium used. The washing procedure of the compressed gas is when the biogas gets rid of CO_2 up to less than 1 vol. %, and in this condition, it may be supplied into the natural gas distribution system. The required compression phase, as well as exsiccation that might be possibly needed, must be adjusted to the current conditions.

Carbon dioxide, which has been removed from the washing solution, is of high cleanness and may be liquefied after it is submitted to another compression phase.

The achieved quality of the natural gas is higher than 99 vol. % CH_4 and less than 1 vol. % CO_2. It is technically possible to reduce the amount of CO_2 below 10 ppm. The thus produced carbon dioxide can be easily modified to achieve the quality commonly used in the food industry. There are, however, many ways of how the technically-clean carbon dioxide can be used, ranging from dry ice, through its applicability in fire extinguishers, to material tests or its use in coolants.

Means of biogas utilization BCM-4

Absorption caused by a change in pressure for the production of carbon dioxide and natural gas

Using a compressor, the previously cleaned biogas is compressed to the desired pressure of the natural gas from 12 to 20 bars and subsequently is brought to absorption by a change in pressure. The absorption, which is caused by the change in pressure, is preceded by desiccation using silica gel. The absorption, brought about by a pressure change, is composed of four absorbers, two of which are always absorption-active, one of the remaining absorbers is activated for the release and regressive conveyance of biogas, and the last of the absorbers serves for the separation of CO_2. This ensures that the absorption, along with a pressure change, yields the production of the same product CH_4 a CO_2 over time.

Special molecular sieves are used for the absorption.

Summary

The current knowledge concerning the installation and operation of facilities for the production of biogas forms a basis for any subsequent utilization of components that are contained in biogas. The available biogas resources in Germany have been estimated to amount to 12.4 up to 15.3 bil m^3/a /1/. Despite the fact that, since 1999, the total output power of facilities for the production of biogas has tripled from 45 MW to 150 MW in the year of 2002, the current available capacity is being utilized only at around 4-5 % of the total. If we count just the possibilities for the production of methanol, which result from the difference, we find a very big number. If we go even further take into consideration the fact that 80 % of methanol in the world (the annual consumption of 28,3 million T /3/) is currently being produced from natural gas, we come to a conclusion that there is a possible replacement of this type of production with natural raw-materials.

This proves that there is a need to start new ways of effective utilization of valuable natural resources or raw-materials /2/. Regardless of where this decision will take us, the conclusion is that we shall strive for improvement. Thus, there is a need for even some political decisions to be made.

Will our farmers become the sheikhs of tomorrow?

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