Biogas – Energy to Reckon With

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Biogas is a green energy calling on more and more leading edge technical installations. Undoubtedly, the produced kW cost is not yet a competitor against nuclear or fossil fuel energies, but the systems installed are more and more efficient, and their financial profitability is increasing. In this field, Germany has built itself a world-leading position. Germany built 820 systems in 2006, increasing the total installed production units to 3700 and is now the No.1 world biogas based energy producer, and also the technological leader.

CIAT plays a major role in this country, with approximately a 35% share of the market and has acquired significant know how in gas treatment, enabling it to propose systems adapted to ever widening scopes of application. This forward looking concept has brought about specific developments in this field. Two installations produced with the German partners of CIAT, SEVA AG and SILOXA AG, perfectly illustrate this progress.

European Biogas electricity production in 2006 was 17272 GWh per year, of which 7338 GWh was by Germany alone. Biogas now represents 1.2% of the annual production of electricity and nearly 10% of renewable energy, with an installed power close to 1500 MW. In particular, this success is due to efficient regulations, intended to promote renewable energies. In fact, the German law stipulates the purchase price per kWh by energy distributing companies for 20 years. This price takes into account the "green" nature of the energy and recompenses the operators, based on efficiency, technological innovation and agricultural re-conversion criteria. During the first year, in certain cases it may reach 0.18 € / kWh. This incentive, combined with the power of German industry, makes Germany the most advanced country world-wide in biogas based energy production systems.

Biogas cogeneration unit produced by SEVA ENERGIE AG.

This unit comprises, from left to right: gas treatment, motor and generator, control station and lubricant storage compartment.

CIAT is delivering here a heat exchanger and an associated refrigeration unit to dehumidify the biogas before combustion.

There are several different types of biogas production systems. Biogas production always means production of electricity using a gas engine and an alternator. Process heat can also be recovered. This is called cogeneration. Biogas is a gas produced by the fermentation of animal or vegetable organic matter without oxygen. Fermentation is also called methanization and occurs naturally (in swamps) or spontaneously in waste dumps containing organic waste. Also, it can be artificially produced in digesters (when treating purification sludge, industrial organic waste or selected agricultural crops, etc...). Biogas can also be recovered by sucking mine gas. In all cases, the biogas must be dehumidified and purified before combustion; otherwise it can damage the gas engine.

Biogas is a mixture essentially comprising methane (30 to 70%) and carbon dioxide, with varying quantities of water and hydrogen sulfide (H_2S). Other compounds can also be found from contamination, especially in waste dump biogas: ammonia, hydrogen, nitrogen and carbon monoxide. Biogas energy is only produced from methane and is in fact a renewable form of fossil energy, which is natural gas. Furthermore, biogas systems are highly respectful of the environment. In fact, the contribution of a methane molecule (CH_4) to the greenhouse effect is 21 times greater than that of a carbon dioxide molecule. Therefore burning methane, even though producing CO_2, reduces its impact on the environment.

SEVA ENERGIE Systems Already Profitable!

SEVA has developed forefront know-how for small-sized systems. Out of the 820 installed in Germany in 2006, this company, with a payroll of 150, produced 170 biogas combustion units, with a total cumulative 54 MW power. The philosophy at SEVA ENERGIE is to make biogas profitable by offering high production rate systems, operating continuously with limited human intervention and very high reliability.

CIAT has become a recognized standard for the up-line treatment part of gas. As previously mentioned, the humidity is removed from the gas. Steam is condensed by cooling the gas to temperatures between 15 and 5°C. The advantage of this process is to eliminate part of the impurities in gas by trapping them in the condensates, which are evacuated. This treatment protects the motor, reducing the maintenance frequency and prolonging its service life. This operation is carried out by an optimized CIAT refrigeration unit and heat exchanger set, delivering precisely the cooling power needed...

Michael SIEMER from SEVA, working on the biogas system control station

"What we like at CIAT is that it is always capable of reactively responding with the precise technical solution", explains Klaus VIETH, project leader at SEVA. Reliability is also a strong point: "We tried several competitors' systems previously, but we found too many failures, especially in the refrigeration unit, which is located outside".

"For each new development project, we forward our specifications to CIAT, who help us size the components to integrate in the best possible manner. They respond quickly, the prices are competitive and there is always a CIAT product corresponding to our need", adds Michael SIEMER, Sales Manager at SEVA.

The Mönninghausen GmbH Biogas system located at Geseke (Germany) illustrates effectively the capacity of SEVA to provide profitable solutions. The gas here is produced by the fermentation of organic waste, delivered by truck weekly. The installed electrical power is 537 kW for a 230 Nm3/h approx. biogas flow rate. The system duty factor is 97%, being 8500 hours per year. This system only requires the presence of a technician for two hours per day. The control system designed by SEVA displays the instantaneous operating parameters from the SEVA office in EMSTEK and sends telephone alerts or SMSs in case of an operating incident. Shutdowns are thus minimized. The cost per kWh produced is 0.08 €. Today, the energy is sold at 0.16€. "As a general rule, our customers obtain an investment return in 2 to 4 years", concluded Michael SIEMER.

Furthermore, this system consumes 70% of the produced heat (sterilization of organic waste before methanization, maintaining methanizers at operating temperature, heating of neighbouring buildings and neighbouring chicken farms) which participates in the investment profitability. 15% of the biogas energy yield was obtained by heat recovery in Germany in 2006 (equivalent to 1324 KTEP/year). SEVA is present internationally: Europe, United States, Thailand, and Japan.

SILOXA, the Cutting Edge Gas Treatment Specialist

SILOXA is specialized in Biogas treatment (industrial or agricultural biogas, waste gas, STEP or mines). SILOXA, founded in 1998, differentiates itself from other companies by a very wide range of biogas impurity treatment solutions. Biogas saturated in steam contains impurities such as organic silica compounds (siloxanes) and hydrogen sulfide. The presence of these compounds is highly detrimental to gas engine reliability. Other than the corrosion generated by hydrogen sulfide, irreversible damage may be caused by siloxane, which is deposited in combustion chambers and can cause total shutdown of the engine. Steam creates condensation in the pipeline system. The consequences are corrosion, alteration to valve and measurement instrument calibration and pressure variations.

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Automated control interface: the system operates continuously and needs human presence two hours per day

The system installed by SILOXA at Recklinghausen (4/5 König Ludwig mine shaft) differentiating characteristic is its high capacity: 2 400 Nm³/h for an annual electricity production of 20 GWh, being the equivalent of 6 large-sized wind turbines. The centre container, fitted with two compressors, sucks up the underground gas at a 400 meter depth through an appropriate shaft. The gas is dehumidified though an exchanger powered by a rooftop refrigeration unit and distributed to the 4 motors in the adjacent cogeneration containers.

Once again, profitability and reliability are key elements. Continuous process, maximum availability, minimum human intervention (1 hour/day) have been key factors since commissioning. The modules are fully transportable. Thus, when the mine no longer produces sufficient methane, the entire energy production system can be moved to another mine.

Jochen Beese, member of the Board of SILOXA AG, explains why CIAT was chosen: "Our systems range from 100m³/h to 4000m³/h. CIAT provides us with extensive experience in choosing solutions and sizing systems. Furthermore, the characteristics of the CIAT equipment are exceptional in terms of energy yield".

SILOXA, employing 22 persons, also offers a range of solutions for gas extraction and transport over long distances. Its international activity is increasing considerably with installations in Russia, Spain and France.

CIAT, the Fluid Cooling and Heating Specialist for Biogas Cogeneration Systems

"Our leading position in Germany enabled us to work alongside the players in this sector. CIAT's equipment offers several sought-after features. Our experience in the sector and our equipment range allows us to propose a system solution sized ideally over the entire power range. Furthermore, with our mastery in 3 technologies, we can propose the 5 main heat exchangers of a cogeneration system", explains Marc Schaller, Marketing Manager for the INDUSTRIAL segment at CIAT.

Containerized gas engine

"We have specifically adapted some items in our proposal to correspond to the exchangers that have been simplified to provide just what is necessary", adds Marc Schaller. CIAT tubular exchangers also benefit from structural exchange surfaces to maximize heat transfer.

"Biogas is considered as one of the cleanest green energies and its use will naturally progress across the world. Based on our experience, acquired over several years in partnership with our German customers, we want to share our expertise in other markets. We already have numerous projects or installations completed in Russia, Thailand, England, France, Spain and Turkey, and this is just the beginning. Numerous countries are copying the German model, offering financial incentives that are sometimes greater", concluded Marc Schaller.

CIAT is present on the entire world-wide environment and energy market. Target applications are those participating in production, distribution or transformation of energy, air or water.

The company provides equipment plus unique expertise, based on the 3 main skills of thermal exchange, air conditioning and hot or cold production from thermodynamic cycles.

CIAT tubular heat exchanger system at the entry to the gas preparation container (installation with Bypass and condensate separator).

CIAT global proposal for a biogas based cogeneration system

AQUACIAT 2 installed on the SILOXA gas treatment container