

FUEL CELL POWER PLANT (FCPP) FOR ANAEROBIC DIGESTER GAS (ADG)

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In North America, 35% of municipal biosolids treatment is undertaken with anaerobic digesters. This represents over one million cubic meters per day in biogas of which 60 to 70 percent is methane and 30 to 40 percent is carbon dioxide. Small amounts of hydrogen sulphide and hydrogen are also present. The anaerobic digester gas (ADG) is often burned to provide heat for the temperature maintenance of the digesters and may also be burned in gas fired internal combustion engines or turbines to directly run rotating equipment or to generate power. Excess gas is fired in flame towers. Through combustion of the biogas, nitrogen oxides (NO_x) and volatile organic compounds (VOC) become emission pollutants. Because of the carbon dioxide, the calorific content is lower than natural gas but is capable of delivering 0.55 to 0.65 kW-hr of energy per cubic meter of biogas. For a population of 1 million people with primary treatment, the available power is about 550 to 650 kW. The additions of secondary treatment will almost double the available power.

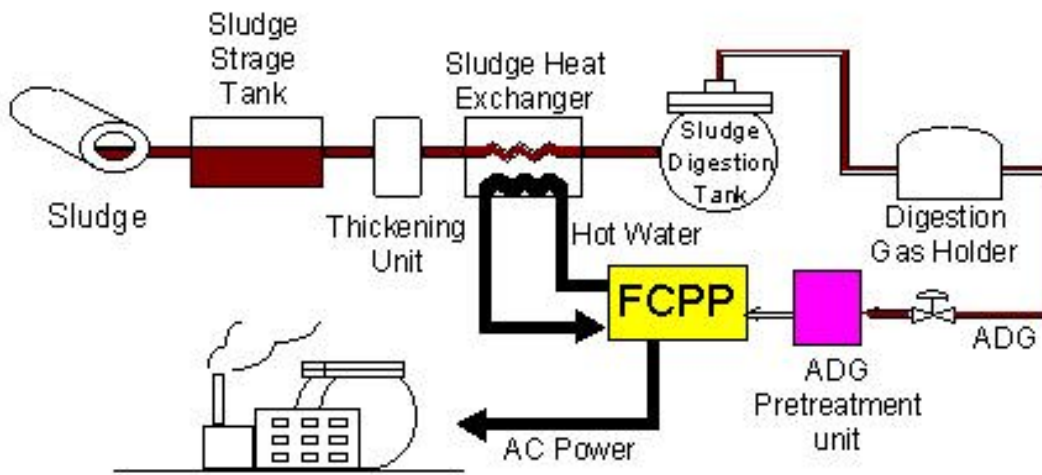
The present handling of ADG is energy inefficient. For a 0.1 to 1 MW facility, efficiency for the FCPP is about 50% compared to the efficiency of diesel that is about 35% or a gas turbine that is about 30%. The present energy recovery systems also add to the green house gas emissions. The use of fuel cells (FCs) has the potential to provide effective solutions to these problems by efficiently generating premium quality electricity and much needed heat while consuming ADG and emitting orders of magnitude of smaller amounts of nitrogen oxides (NO_x) and volatile organic compounds (VOC). Flared quantities of surplus methane would be eliminated. In addition, use of FCs with inexpensive ADG would be a major step in reducing FCPP electricity cost and initiating the use of FC technology at wastewater treatment plants.

Potential benefits extend far beyond the wastewater treatment plants. FCs offer high efficiency, very low emissions, available thermal energy, fuel flexibility, potential mobility and premium quality electricity in distributed generation applications. The need to gain hands on experience in assessing the role and markets for FCs in ADG applications is essential to maintain global

competitiveness, application know-how and an improved future in a constantly changing environment that is now just realizing the importance of energy resources.

The City of Prince George wastewater treatment facility generates and uses ADG for conventional heat energy recovery systems. The facilities serve approximately 50,000 people and are suitable for the addition of a co-generation facility. As a first phase of work, an audit of the existing recovery systems, determination of the energy balance and an assessment of the ADG use and emissions were undertaken in conjunction with a study of a FCPP. Investigation for ADG pretreatment to remove water, sulphur compounds and halogens was undertaken to determine ancillary treatment needs. Estimation of the value of the facility for reducing greenhouse gas emissions was also undertaken. The second phase of this work would be the addition of a small fuel cell demonstration project.

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ADG Energy Recovery with FCPP (from FuelCell Energy, Inc.)