

Ensuring reliable heat and power generation

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Mitsubishi Electric's automation technology delivers highly accurate control solution for anaerobic digestion plant.

Mitsubishi Electric Automation Partner, Ashdale Engineering, located in Northern Ireland, has designed a highly accurate control system for an anaerobic digestion (AD) plant. The precision process control is achieved using Mitsubishi Electric automation components and is vital to ensuring continued operation of the live AD process, enabling the generation of heat and electricity that the plant operator now plans to sell to the grid.

The anaerobic digester at a large farm near Armagh drives a combined heating and power (CHP) plant that heats the farm's buildings while also producing electricity. Animal slurry, silage and additives are mixed together and the resulting biomass then is heated to produce biogas, used to power the CHP. Based in Belfast, Ashdale Engineering became involved with the project because of its specialist expertise, having worked on AD projects for over 10 years in Northern Ireland together with Mitsubishi Electric.

One of the crucial aspects of anaerobic digestion is temperature control, as the microorganisms that break down the biomass require temperature stability. Fluctuations above one degree centigrade per day can kill them, stopping the process and with it, the generation of heat and power. In the event that this occurs, it takes considerable time to remove and replenish the biomass to restart the AD

process. In addition to offering stability, the control system also needs to be responsive, easy to use and reliable.

Accurate control with Mitsubishi Electric PLC

By utilising the advanced programming features of the Mitsubishi Electric MELSEC-Q Series PLC, Ashdale Engineering was able to develop an accurate and reliable control solution. Analogue flow and temperature signals transmitted from the pump house and digesters, which could be up to 30 metres away, are communicated over CC-Link via remote I/O. Interaction with the PLC takes place via a HMI communicating over Ethernet and a variety of Mitsubishi Electric variable speed drives control the system's pumps. The solution ensures reliable heating and power generation and is now providing the opportunity for profitable export to the grid.

"The AD plant has capacity for around 40,000 m³ of biomass fuel and small changes to any of the variables can impact the temperature of the biomass," says Adrian Whitten, Systems Manager at Ashdale Engineering.

"Floating point number calculations, made possible by Mitsubishi Electric's MELSEC-Q Series PLC, were vital to achieve the precise control required to ensure long-term stability of the process. Combined with high resolution analogue inputs, the accuracy of calculations gives greater control, meaning continued assurance for heat and power generation."

High resolution and accuracy are also critical for recipe control. The ratio of ingredients can change dependent on seasonality as well as adjustments for desired outcomes.

“Some farmers may overfeed the AD system, or feed a recipe that is too rich,” explains Adrian. “Again, this can kill the microbes and stop the process. Any changes in the feed have to be made very gradually and with precise control. That’s what the MELSEC-Q PLC enables us to do.”

Simple AD system management

Ashdale also accounted for the AD plant’s wish to expand in the future. The MELSEC-Q Series PLC offers the needed flexibility in terms of expansion on I/O, for example to control additional drives as well as pumps, enabling the scale up of their operation and energy export to the grid. To enhance operator control, the system enables easy selection of recipes from the Mitsubishi Electric HMI and different recipe settings can be stored for changing feed parameters.

“The HMI’s recipe system allows farmers to retrieve feed ratio data from previous months and years, identifying how the ratio changed according to the season. This way, planning and monitoring recipes is a simple process for the farmer to manage for optimum generation and efficiency,” adds Adrian.

Monitoring data and alarms can be easily viewed from any internet-connected device and the system can be controlled remotely too. Ashdale Engineering’s system design integrates gas monitoring into a single measurement sensor, removing the need for multiple analogue devices that measure each gas separately.

High reliability Mitsubishi Electric drives

The slurry pump is responsible for filling the digester, so reliability is essential, and the torque requirement is dependent on the consistency of the slurry. This is achieved with the FR-800 series variable speed drive. With flux vector control and

providing high torque at low and zero speed, the drive features torque monitoring for quick detection of blockages. Gas feed pressure is very important for the efficient operation of the gas engine and this is achieved by the FR-D700 drives that are highly reliable and simple to set up.

“Choosing the correct variable speed drive for the application and the careful consideration of the fieldbus network that links all plant components is critical,” says Simon Murray, Variable Speed Drives Product Manager, Mitsubishi Electric. “With the assured reliability of the FR-800 series drive range from Mitsubishi Electric, combined with Ashdale’s extensive skills and experience, delivery of this AD plant control system was seamless, from design to final commissioning.”

An effective partnership for automation control systems

“We have a close and successful partnership with Ashdale Engineering and have been delivering solutions for a wide range of applications for over 35 years,” says Ciaran Moody, General Manager, Mitsubishi Electric Ireland. “This project is one example of many where we have worked together to exceed the customer’s expectations with the final result.”

The next stage for the AD plant operator is to expand the process and export biomethane as well as electricity to the grid. This requires an increase in the methane content of the produced biogas from 70% to 90%, the level needed for export to the grid, which will be achieved by the partnership between Ashdale Engineering and Mitsubishi Electric.

“This project is a good example of what can be achieved in the development of an AD plant and biomass upgrade. Together with Mitsubishi Electric’s automation

technologies and technical support, we have designed, installed and can support the whole system,” concludes Adrian.

Image captions:

Image 1: The precision process control solution provided is vital to ensuring continued operation of the live AD process, enabling the generation of heat and electricity that the plant operator now plans to sell to the grid.



Image 2: By utilising the advanced programming features of the Mitsubishi Electric MELSEC-Q Series PLC, Ashdale Engineering was able to develop an accurate and reliable control solution.

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*At an exchange rate of 106 yen to the US dollar, the rate given by the Tokyo Foreign Exchange Market on March 31, 2018

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