BIOGAS IN SOCIETY
A Case Story

MONO-DIGESTION OF CHICKEN LITTER

TULLY BIOGAS PLANT, BALLYMENA, NORTHERN IRELAND

IEA Bioenergy Task 37

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MISSION AND VISION

The Tully Biogas Plant (figure 1), located near Ballymena in Northern Ireland, is one of the first facilities in the world that generates renewable energy from chicken litter as the sole feedstock using an innovative combination of anaerobic digestion and nitrogen stripping technology. With a construction cost of £23 million this plant represents a major investment for Northern Ireland and delivers several benefits to the community, in the form of local jobs, renewable energy and recycling of nutrients. The biogas plant processes up to 40,000 tonnes of locally sourced chicken litter each year and generates 3 MW of renewable electricity which is enough to power 4,000 homes. The plant was developed by Stream BioEnergy and was co-financed by funds managed by the UK's Foresight Group and Invest Northern Ireland. Xergi, a Danish specialist supplier of large scale biogas plants, was responsible for the design and delivery of the plant and is also a shareholder in the project. Xergi is also responsible for the operation of the plant.

BENEFITS OF THE FACILITY

Employment and Services: The plant employs 12 full time members of staff for operations and many off-site jobs have been created through a range of professional services that the plant requires. Local companies in Northern Ireland were appointed to deliver engineering and construction services and, during peak construction, up to 50 people were working on site.

Poultry Sector Benefits: Where excessive nutrients from chicken litter are spread on land they can cause pollution of watercourses and have a negative impact on the environment. Action to address nutrient enrichment of watercourses is required by both the EU Nitrates Directive and the EU Water Framework Directive meaning a more sustainable way of managing chicken litter is urgently needed. The Tully Biogas Plant is helping to achieve that at a local level through this innovative combination of technologies. The plant is fed with poultry litter from over 100 farms around the Ballymena region thus providing local farmers with a safe outlet for the disposal of the litter. In this way the innovative Tully Biogas Plant provides the Northern Ireland poultry industry with a solid foundation to support its continued economic growth, which in turn creates more employment and increases the gross output of the agricultural sector.

Renewable Energy Generation: Biogas is a valuable product of AD which will play an important role in helping to achieve Northern Ireland's EU Renewable Energy Targets for 2020 and beyond. The biogas generated at the Tully facility is converted to electricity (3 MW) which is exported to the national grid. The plant provides a constant stable supply of renewable electricity to the grid delivering energy security of supply benefits. It also further diversifies the national fuel mix and reduces the country's reliance on fossil fuels.

Climate Change Benefits: The Tully Plant plays an important role in the fight against climate change as it reduces Greenhouse Gas Emissions (GHG). Landspreading of litter generates uncontrolled emissions of GHGs to the atmosphere as the waste degrades. By diverting this litter to AD the organic materials are processed in an enclosed system which prevents the uncontrolled release of methane. Replacing fossil fuels with renewable energy generated in this manner also reduces GHG emissions.

Production of Biofertiliser: AD not only recovers energy from organic waste, but it also produces a nutrient rich digestate that can be used as an organic biofertiliser. The nutrients contained in digestate are more amenable to plant uptake than other organic fertilisers and thus its use has water quality, environmental and health benefits as it decreases organic pollution potential as well as reducing risk of spreading microbial contamination.

Figure 1: Tully Biogas Plant

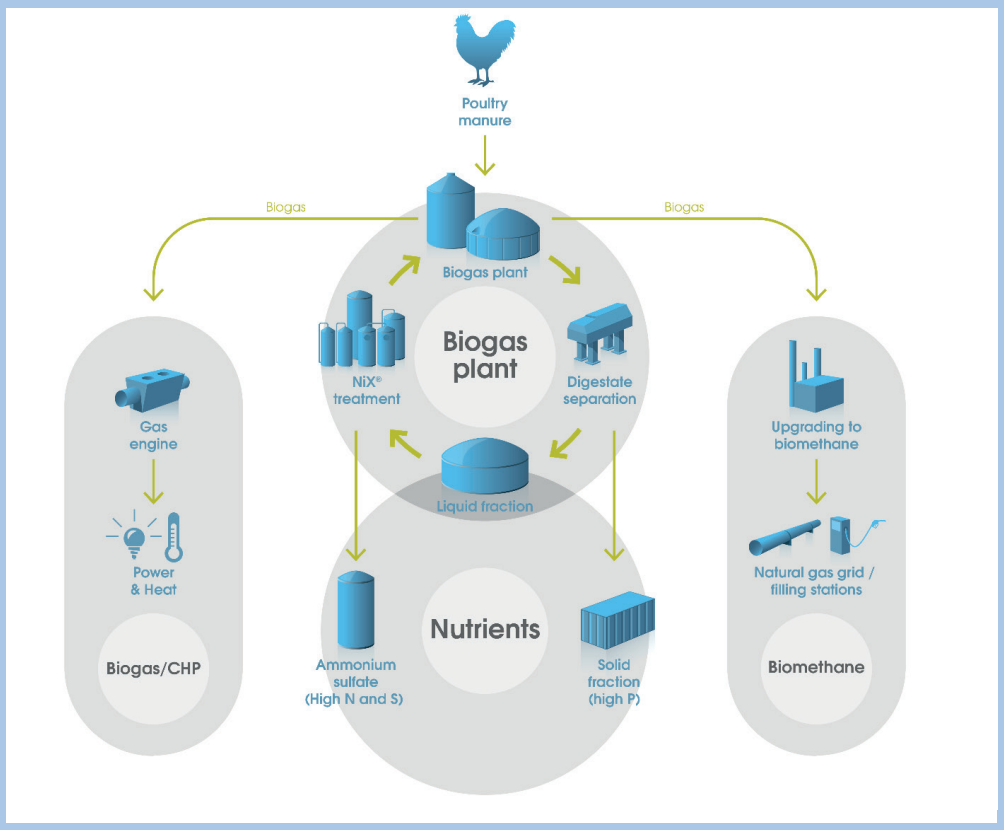

Figure 2: Principle Process Flow For AD Plant with NiX®

TECHNICAL DATA

The processing of chicken litter through conventional AD systems has been historically challenging due to the elevated nitrogen present in the litter which inhibits the digestion process. To prevent this, chicken litter is normally digested together with other feedstocks which have lower nitrogen content. Typically, chicken litter can only form a maximum of between 15–20 % of the total feedstock to a digester. The Tully Biogas Plant combines conventional and well-established AD technology with a patented nitrogen removal system, NiX® which reduces the nitrogen concentrations in the chicken litter to levels that allow it to be processed as a single feedstock. A high-level description of the process is outlined below and illustrated in Figure 2.

Feedstock Reception and Pre-treatment: All handling of chicken litter and pre-processing activities are carried out indoors. Fast acting doors are used at the reception hall entrance to maintain a closed environment. When offloaded inside the building chicken litter is fed into mixing tanks for blending with fresh water and recirculated digestate liquid.

AD Process: Feedstock in the mixing tank is pumped to primary digestion tanks. Digestion takes place in a two-stage process. The digesters are operated at mesophilic temperatures of 37°C and the total digestion time is 35 days. Following digestion, digestate is pasteurised at 70°C for one hour to satisfy Animal By-Product Regulations. The digestate produced is PAS110 certified.

Biogas Treatment and CHP: Biogas generated in the digestion tanks is stored in the tank roof spaces and in two gas holder domes. Biogas is cooled to remove any condensate before use in gas engines to generate electricity and heat. Gas blowers boost gas pressure for input to the engines. Two 1.5 MW rated Jenbacher gas engines are installed in acoustically self-contained rooms within the main building. The electricity generated is exported to the grid, and heat recovered from the engines is re-circulated for use in the digestion and pasteurisation processes.

Digestate Management: Following pasteurisation, the whole digestate is pumped to the separation plant where it is partitioned into solid and liquid fractions using decanter centrifuges. The solid fraction is transferred from the site to horticultural markets with a demand for this nutrient rich product. Most of the liquid fraction is treated in Xergi's patented nitrogen stripping process, NiX®, that denitrifies the liquid so that it can be used to dilute the incoming chicken litter. The NiX® nitrogen stripper utilises sulphuric acid which results in the creation of an ammonia sulphate solution that is pumped to a storage tank before being exported off site for use as a concentrated ammonium fertiliser that can replace artificial nitrogen fertiliser.

PLANT DESIGN AND ABATEMENT SYSTEM

Several abatement systems are incorporated into the plant design to minimise the potential for adverse impacts on the environment and human health. These include indoor delivery and handling of feedstock and its processing in an enclosed and sealed system, a multi-stage odour treatment process, and acoustic containment of engines and other noise generating equipment. Operational areas of the site benefit from an engineered containment system comprising an impermeable surface. Bunds are provided for all tanks containing liquids. All process effluent associated with incoming litter together with any floor wash down in the building is contained and recycled to the process. This containment prevents the release of potentially polluting liquids to surface water and groundwater.

Sustainable drainage system (SuDS) measures are also included that are designed to manage and control surface water runoff from the site. Rainwater harvesting is a key measure included in the management of surface water. Excess runoff is discharged from the site to existing surface water drainage via an attenuation storage system. An oil water separator and silt trap contains any potential contaminants on site.

LESSONS LEARNED

Mono-digestion of chicken litter is technically viable at a commercial scale as demonstrated at the Tully Biogas Plant. This solution allows for sustainable management of nutrients in an intensive agricultural area in a way that safeguards the environment and animal health.

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