Biocycle South Shropshire Ltd

Technology: Anaerobic Digestion

The following technical summary has been written by Defra's Project Managers on the New Technologies Demonstrator Programme (NTDP), SKM Enviros. The content of this summary is derived from the activities undertaken, results obtained and information produced by the individual Demonstrator's final report.

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Introduction

Biocycle South Shropshire Ltd (Biocycle) was set up as a partnership between Greenfinch Ltd and South Shropshire District Council (SSDC). The main objective was to demonstrate the treatment of biodegradable municipal waste (BMW) by anaerobic digestion (AD) at Ludlow Business Park, Shropshire, in order to produce biogas to generate heat and power, with excess power exported to the National Grid. The by-products of the process (pasteurised digestate) were to be used for application to agricultural land.

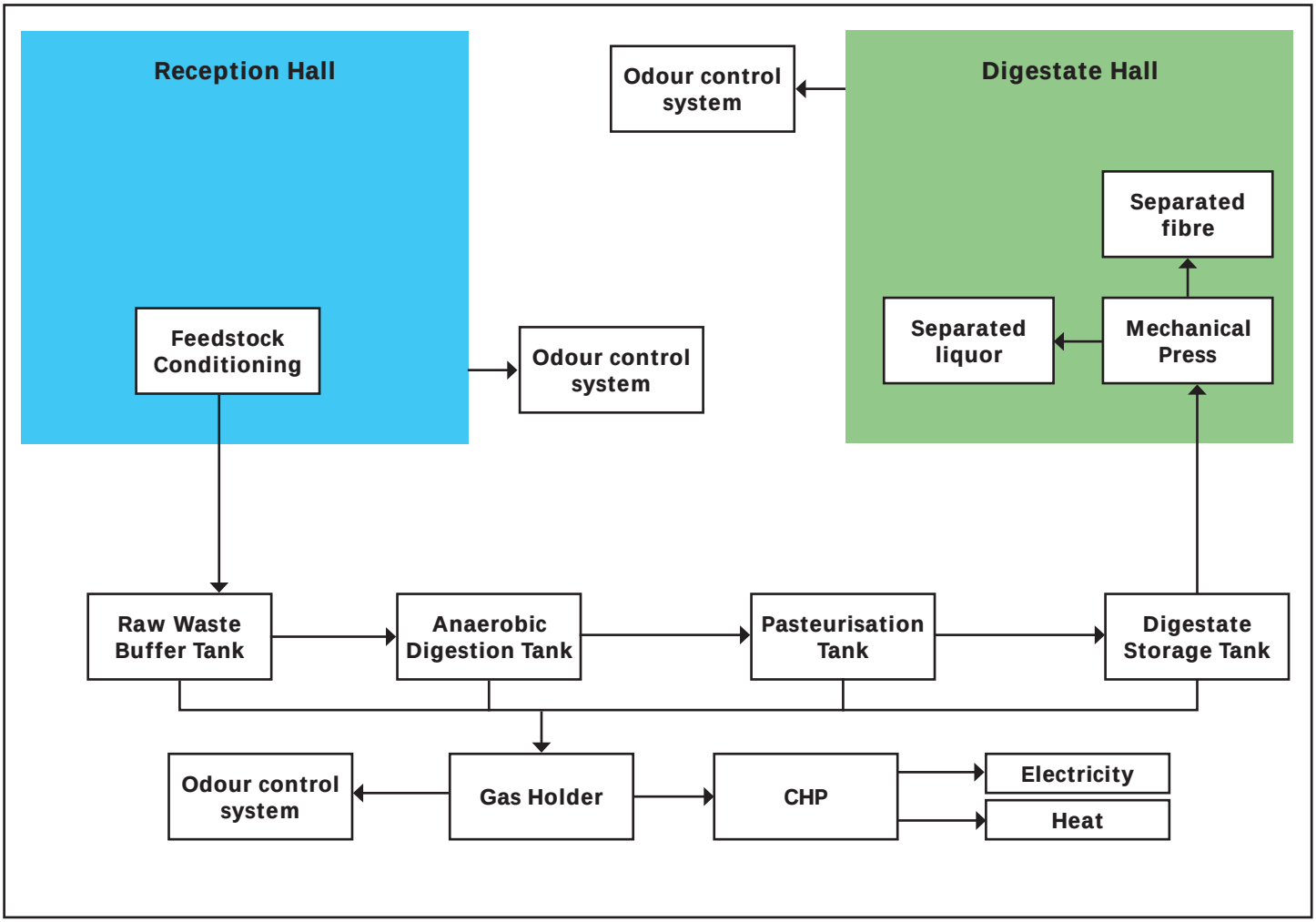
Technology Process

The 5,000 tonnes per year Biocycle demonstrator project uses a mesophilic[1] Anaerobic Digestion process which transforms biodegradable materials in the absence of air into biogas and biofertiliser[2].

BMW is delivered into a reception hall and conditioned for processing. Material is then stored in a vessel which in turn feeds the 900m^3 anaerobic digester. In the digester material is heated to 37-42°C using hot water (from the plant's combined heat and power (CHP) unit) while being mixed by circulating biogas throughout the tank. Material is then transferred from the digester to the pasteurisation tank where it is heated at 70°C for a minimum of 1 hour. Pasteurised digestate is then transferred to a storage tank and kept until exported for use on local agricultural land. The digestate was either used whole or separated by a mechanical press to separate its liquor part from its fibre part.

Biogas collection is undertaken on all the tanks, but the bulk of the gas originates from the digester tank. The biogas is stored in a gas holder with a capacity of 150m^3 and then used in a CHP unit to generate heat and electricity. The plant is designed to use the electricity generated on site while the excess load is exported to the National Grid. The hot water from the CHP unit is used in the process for the digester and pasteurisation stages.

Figure 1: Process flow diagram



[1] Organisms for which optimum growth temperatures are within the range 30°C to 45°C.

[2] The term biofertiliser refers to fertilisers that are produced as a result of the degradation of organic matter.

Development Timeline

The following provides the details on the key stages of project development to operational phase:

Milestones	Approx Date
Selection by Defra of Project as preferred bidder	September 2004
Process design	September 2004 - December 2004
Planning application	December 2004 - March 2005
Mechanical and electrical design	January 2005 - July 2005
Construction design and contract negotiation	February 2005 - June 2005
Waste management license application	July 2005 - March 2006
Ground works and concrete bases	June 2005 - September 2005
Steel tank construction	August 2005 - November 2005
Building construction	August 2005 - January 2006
Mechanical installation	October 2005 - January 2006
Electrical installation	December 2005 - February 2006
Commissioning	March 2006 - April 2006
Biowaste processing	March 2006 - On going
Process monitoring	March 2006 - July 2008

Planning Issues and Application

The planning process for the project was characterised by an early engagement with the Planning Authority and the public. Emphasis was put on informing and consulting with the public through different media (radio, local newspaper and public meetings). Initially concerns were expressed by the public as to the site location, potential issues related to noise, odour, visual impact and generated traffic. The issues raised were addressed within the planning application and an Environmental Report was compiled to consider these issues further and mitigation measures proposed. The planning application for Biocycle was consented with relative ease and was completed within three months.

Authorisations

- Waste Management Licence (WML) and Approval from the State Vetinary Service

Due to the size of the plant (<3MW) a WML was required for the site rather than a PPC licence and an application was submitted to the Environment Agency (EA). A Hazard Analysis and Critical Control Point (HACCP) was carried out as part of the approval under the Animal By-Product Regulations (ABPR) 2005. In both authorisations a number of visits were undertaken and good dialogue maintained, with only minor delays incurred due to the lack of experience and knowledge of the new technology processing food wastes.

- Environmental Permitting Exemption (digestate)

At project commencement digestate output from the plant was classified as a waste. Consequently in order to apply the digestate to land as a biofertiliser an exemption had to be applied for so as not to require an Environmental Permit. The exemption was permitted following a number of months, which was a result of learning from the authorities and a reduction in levels of plastic contamination to that which was deemed acceptable by the EA.

It was observed that the plastic contamination had come from residents using biodegradable carrier bags provided by supermarkets and these had not biodegraded quickly enough through the anaerobic digestion process. As a consequence this material had to be sent for reprocessing to remove the plastic.

Work was carried out to reduce the plastic contamination going through the plant by temporarily introducing hand sorting at the reception, and by a high profile public education strategy. The first export of digestate from the site occurred in March 2007 when 830m^3 of liquid digestate was successfully applied to arable land within 2 miles of the digester. Following the introduction of the source separated food waste collection scheme the level of contamination in the feedstock (and therefore the digestate) reduced significantly.

The data from the project aided WRAP to develop the PAS110 a standard, which can remove the need for a waste exemption.

Construction Process

No specific issues arose during the construction process on the project. However, there were slight delays with the connection to utility services (electricity and water) and temporary supplies had to be installed.

Financial Process and Close

The site was provided by SSDC, together with support towards collection costs. In total £3.55 million was invested in the project through financial support from Defra and Advantage West Midland, furthermore SSDC successfully applied for additional funding from WRAP who provided £160k in 2006 and £24k in 2008 to finance the required food waste collection.

Feedstock and Outputs

Anaerobic digestion transforms the feedstock into biogas (60% methane and 40% carbon dioxide) and digestate which can confer beneficial fertiliser and soil conditioning properties. The quality and economic value of the outputs (both biogas and digestate) is determined by the type and quality of the feedstock materials.

At the beginning of the project in 2006 households were issued with two 240 litre bins; one for residual waste and one for biodegradable waste (garden, cardboard and food wastes), which were emptied on alternate weeks to each other. Whilst a communications campaign was undertaken on the new collection the actual composition of the feedstock collected did not match the anticipated composition and was found to be contaminated. The main contamination was soil, stones, bricks, rubble & garden refuse not suitable for AD (e.g. thick tree trunks etc) together with a small amount of plastic bags, which was believed to be due to residents wrapping the food waste up due to health and odour concerns with a large fortnightly collection service.

The collection system was amended in 2007 to allow a greater proportion of food waste, which included additional wastes from Somerset County Council and Cwm Harry Land Trust (Newtown), food waste from commercial premises in South Shropshire collected by SSDC and a new weekly source separated food waste collection scheme in three market towns in the Ludlow area. The new Ludlow food collection included a 5 litre kitchen caddy, compostable starch liners and a 25 litre bin that was collected from the kerbside once per week by a dedicated collection vehicle (powered using electricity from the anaerobic digester).

Whilst the change in feedstock composition had a positive impact on the efficiencies of the plant it had a detrimental impact on the levels of odour generated. The odour abatement system was updated in July 2008 with uprated air extraction and an activated carbon filter, which vastly improved odour control.

With the amended collection the feedstock was more predominantly food waste.

Table 1: Feedstock composition during operating period 1 June 2007 – 31 July 2008

Sources	Kitchen	Green	Commercial	Total
Wet weight tonnes	3,759	64	114	3,937
% of total	95.5%	1.6%	2.9%	100.0%

Energy

In the first year of operation the plant used a parasitic load of approximately 30% of both its gross electrical and heat output. Excess electricity was exported to the local electricity network at low voltage through an import / export meter. The sale of electricity produced was made more financially attractive by the existence of the Renewables Obligation Certificates (ROCs).

The aim of the project was to use CHP heat not used parasitically for a district heating scheme, unfortunately this was not installed during the project but continues to be explored.

Digestate

Digestate resulting from the process has a beneficial nutrient value and can be used as an alternative to synthetically produced fertilisers. Under the EA exemption digestate was applied on agricultural land within a 6 mile radius of the plant.

Table 2: Summary of inputs, outputs and project performance

Operating period 1 June 2007 – 31 July 2008		
Total waste processed (wet weight tonnes)	3,936	
Gross energy output	2,781,481 kWh Electricity 1,891,407 kWh Heat	
Outputs	Biogas (m3)	615,472
	Digestate (t)	3,969
	Fibre (t)	39
	Rejects (t)	35
Utilities consumed	270,422 kWh Electricity 446,334 kWh Heat	
Operating costs	£158,821	

The monitoring of the digester for the NTDP was undertaken by the University of Southampton.

Conclusions

Key lessons learnt

- Be aware of potential uncertainties in the feedstock composition and design plant to provide flexibility to allow for variation in waste streams
- Mixed garden waste and food waste collection proved inappropriate for successful operation of this technology
- Odour control is an issue which needs particular attention and is dependent on feedstock used, and control systems need updating in line with evolutions in the feedstock and delivery methods used
- With the technology being relatively new in the UK, permitting was challenging; but the project has paved the way for an easier process for subsequent plants.

Added value of project

The project provided valuable information in the application of anaerobic digestion for the treatment of household waste in the UK. The project paved the way for easier planning and permitting processes, making the relevant authorities more familiar with the process. The project also aided the development of PAS110 which will have positive impacts for any future anaerobic digestion plants.