SETatWork Good Practice
Biotrans

Setting	
Country	Sweden
Location	Umeå
Project start date	March 2002
Project end date	
Technology keywords	Industrial technologies
Host sector	Dairy plant

Technical summary of the project

Objective of the project

Norrmejerier's management unit Ersboda dairy plant produces milk, sour milk, yoghurt, cream, butter, cheese and milk powder. Norrmejerier wanted to increase its production of cheese which also would increase emissions in the wastewater. Since the municipal wastewater treatment plant did not allow increased emissions Norrmejerier was forced to seek alternative sewage cleaning. It was found that the Biotrans project would solve the problems with the wastewater and also reduce the energy need.

The Biotrans project includes:

- A biogas plant (anaerobic) to convert the wastewater into an energy source
- A heat pump to recuperate heat in the wastewater after the biogas plant
- An ultra-filtration plant for extraction of high-grade whey protein

Changes in production, mainly increased cheese production.

Project description

The goal of the Biotrans project was to reduce both emissions and energy consumption. Before the project whey was converted to powder through evaporation and drying - a very energy intensive process due to the amount of steam needed. An alternative is to concentrate the whey protein through ultra filtration and evaporation to the product WPC80 (Whey Protein Concentrate 80%) which is a less energy intensive process. In the filtration process most of the proteins in the whey are removed. These proteins (in the form of WPC80) are valuable as a raw material when producing new food products. The residual product from the filtration (whey permeate) has a high energy value and is the substrate in the biogas reactor together with other waste products from the dairy plant.

The most important changes in production are:

- The evaporation of skim milk and buttermilk is heavily reduced
- Ceased evaporation of whey
- Whey protein concentrate from the ultra-filtration is dried to the product WPC 80
- Increased cheese production and slightly reduced butter production
- The greater part of the equipment is disinfected with hydrogen peroxide instead of hot water

The whey permeate (remaining whey from ultra-filtration) together with wastewater and other waste products is anaerobically digested to produce biogas. The substrate is first passed through a hydrolysis chamber (800 m^3) before it is pumped into the biogas reactor. The hydrolysis chamber evens-out the load and the decomposition of the organic material is started. The fat is then removed by flotation separation. This fat is digested separately in two mesophilic reactors (35°C), each 100 m^3 in size, with a retention time of 22 days. The fat free substrate is heat exchanged with the effluent from the reactors. It is then digested in a "contact process" in two reactors with a total volume of 5000 m^3. This means that the effluent is returned to the process via sedimentation in a so-called "clarifier". This maintains the density of bacteria in the reactor, which means that the retention time for the liquid can be kept short (3.6 days) with no risk of loss of bacterial culture. The process temperature in these reactors is also 35°C. The effluent is heat exchanged with the incoming flow to the digesters and is further cooled in a heat pump. The effluent is finally sent to the municipal sewage treatment works.

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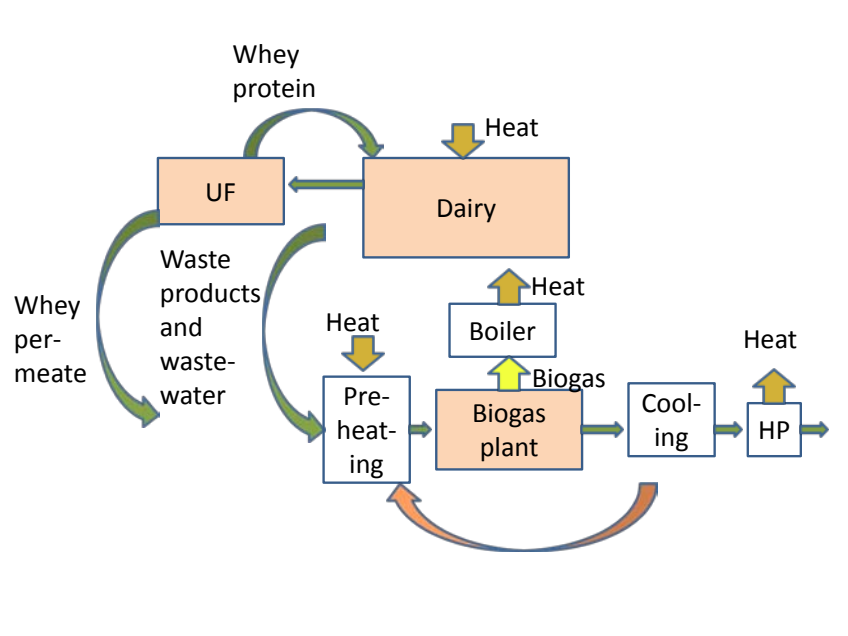

The biogas from the digesters is combusted in a boiler and produces steam at 27 bars. The biogas surplus is flared. The heat pump delivers hot water that is used in the dairy and for top heating of the flow to the digesters.

The biogas production in the digesters has exceeded the expectations. The production of biogas is 9000 m^3/day in the production week and about half on Sundays. This corresponds to 8400 m^3/day as an average, significantly more than the expected 5700 m^3/day. The methane concentration in the biogas has also been higher than expected (70% compared to 64%). The energy content is 21000 MWh/year. The boiler has a limited capacity which is why biogas must be flared most part of the week.

The Biotrans project has reduced energy consumption in the dairy due to:

- Steam production based on biogas
- Reduced steam consumption in the evaporator
- Heat production in the heat pump
- Reduced hot water demand

The BOD and COD concentrations in the wastewater have been reduced by 90% and 80%, respectively.

Environmental and social benefits	
(Estimate of) Greenhouse Gases abated (in metric tons of CO_2-equivalent)	
Number of reduction units (EAU, CER, ERU, AAU)	
Socio-economic aspects What social and economic effects can be attributed to the project and which would not have occurred in a comparable situation without that project?	

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Methodology used (if applicable: approved baseline methodology or study done – refer to this; and monitoring organisation)	

Economic data	
Capital costs	The cost of the biogas plant and the ultra-filtration was 5.5 and 3.5 m Euros, respectively.
Financing scheme	The investment was expected to be repaid within 6 years, thanks to the energy savings and an improved use of raw materials. However, the entrepreneur underestimated the amount of biogas that could be produced from the whey, which means that the investment will be re-paid earlier.
Financing organisation (if third party)	Financiers of the preplanning were The Swedish Energy Agency and Norrmejerier. Financiers of the biogas plant and the ultrafiltration were Norrmejerier (8 m Euros), the county council of Västerbotten (0.8 m Euros) and the EU (0.2 m Euros).

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