

This is one of 12 case studies presented in the report "Biogas from manure, and waste products – Swedish case studies"
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Norrmejerier's biogas plant in Umeå

Facts/unique: Producing biogas from whey from cheese-making. Biotrans-technology optimises both purification and energy extraction

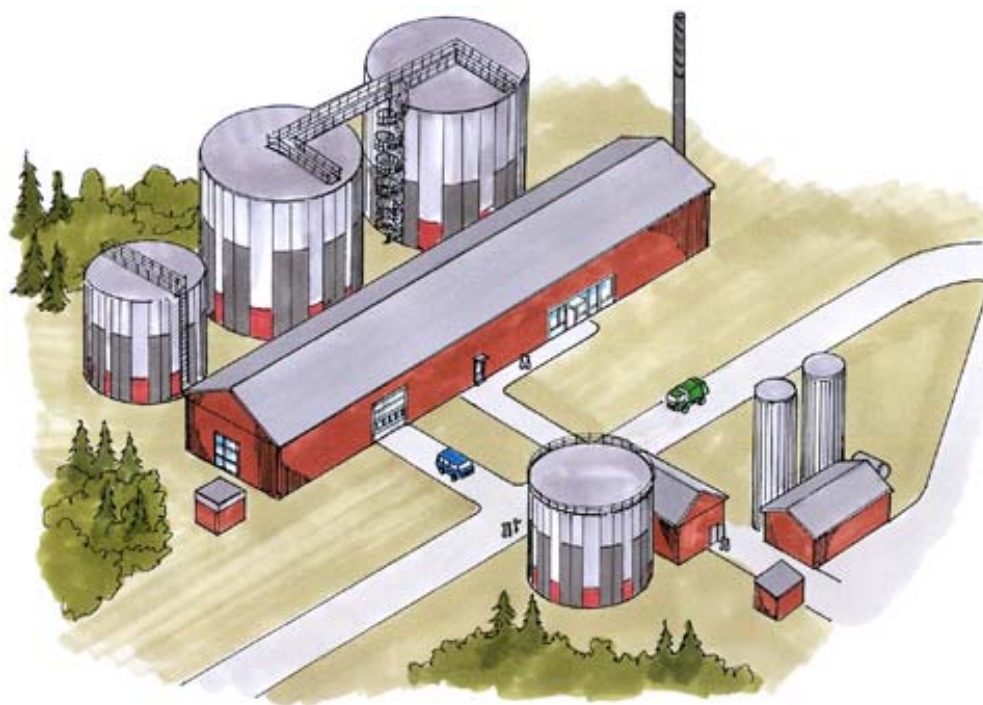


Figure 1 The biogas plant in Umeå

Whey and other waste products from cheese-making are used as substrates to produce biogas at Norrmejerier's dairy near Umeå. In making cheese, roughly 90% of the milk becomes whey. Dealing with such large quantities of whey can be problematic. Traditionally, this waste product is fed to animals. After studying new technologies at dairies in Germany, Switzerland and Belgium, the management at Norrmejerier decided instead to further refine the whey using ultra-filtration. With this method, most of the proteins in the whey are removed by filtration. These proteins are valuable as a raw material in producing new food products. Together

with wastewater and other waste products, the remaining whey is anaerobically digested to produce biogas. This system optimizes the purification of the various waste products and also the extraction of energy from them. The biogas plant started operations in the spring of 2005, as a result of a collaboration between Norrmejerier, SIK, CIT Industrial Analysis and the Centre for Membrane Technology at Lund Technical University.

The 'Biotrans'-plant at Norrmejerier is the first in Sweden, and one of only a few in Europe, that makes effective use of whey by extracting the valuable proteins and using the by-product to produce energy from biogas. The investment in this technology benefits the environment, and is also financially advantageous for the dairy, because it has saved money on oil and has also been able to increase production capacity.



Figure 2 Turning the cheese at the dairy in Burträsk

The biogas plant and substrate

The substrate consists of whey from the dairy in Burträsk, 100 km north of Umeå, and whey and other waste products from the dairy in Umeå. The substrate is first passed through a hydrolysis chamber (800 m³) before it is pumped into the biogas reactor. The fat is then removed by flotation separation. This fat is digested separately in two mesophilic reactors (35°C), each 100 m³ in size, with a retention time of 22 days. The remaining material is digested in a 'contact process' in two reactors with a total volume of 5000 m³. 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.

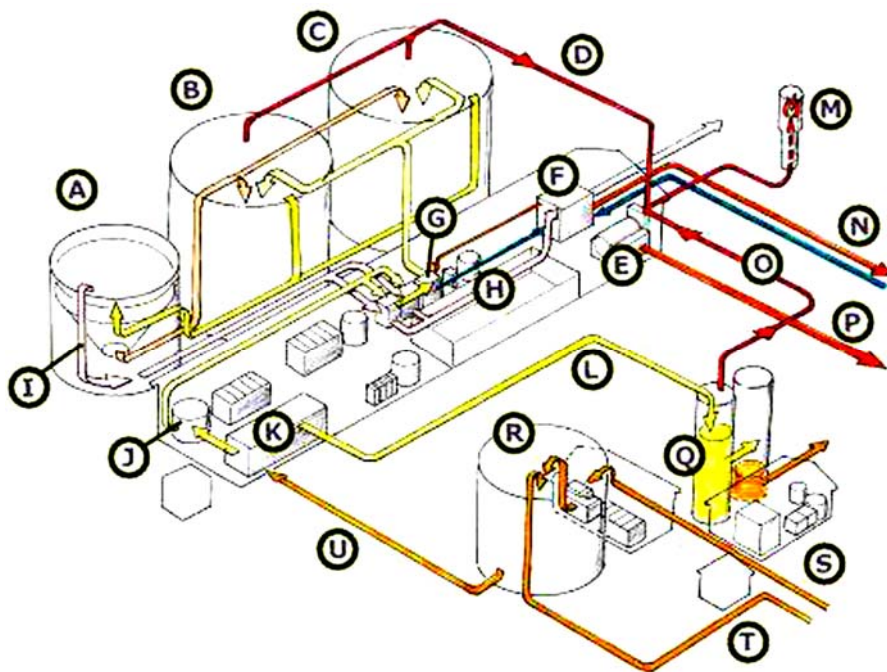


Figure 3 Process diagram of the biogas plant in Umeå

Use and distribution of the biogas

The biogas replaces oil, and is used to produce steam in a boiler. About 10,000 MWh of biogas is produced annually. A further 7,000 MWh is obtained in the form of heat from the effluent using a heat pump.

Digestion residue

The sludge that goes into the clarifier after digestion is cooled in a heat pump to 15°C and then stored. The store is emptied at night, and the sludge transported to the sewage treatment plant in Umeå. In total, c. 400 tons of sludge (dry weight) is produced annually. In turn, the digestion residues from Umeå sewage treatment plant are used to manufacture a filler material ('sludge pellets') that is used in construction (e.g. roads).

Financing

The total investment cost for the biogas plant including the filtration facility was 90 million SEK. Of this, Norrmejerier paid 80 million, the county council of Västerbotten paid 8 million and the EU paid 2 million. The investment is expected to be repaid within 6 years, thanks to the energy savings and an improved use of raw materials.

Lessons learned

The plant is working according to expectations. The entrepreneur underestimated the amount of biogas that could be produced from whey, which means that the investment will be re-paid earlier than expected (6 years). Management consider the project a success and would recommend this technology to other businesses with similar problems. However, the circumstances in each particular case should be analysed very carefully and the advantages and disadvantages of the various technical solutions examined. A few teething problems occurred in coordinating the steam boiler, the heat pump and the process. The plant has attracted much attention, and has received many visitors both from Sweden and abroad.

Norrmejerier are also planning to build another plant to treat the digestion residue aerobically in a final purification step, including sludge thickening. Norrmejerier would then have a complete purification plant and would not have to rely on the municipal treatment plant. As the substrate is clean, the final product would be a bio-manure of high quality, which could be used to produce topsoil, for example. This plant will be built in the autumn of 2008.

Benefits for the environment and society

Norrmejerier are replacing oil with biogas, saving c. 2,500 m³ oil each year. This is partly due to the energy in the form of steam extracted from the biogas and partly because the whey is treated more efficiently in the 'Biotrans' process. The process also extracts valuable proteins from the large quantities of whey produced by cheese-making. Similar plants in other countries have mostly focused on wastewater purification, but the Norrmejerier dairy has optimized both purification and energy production. In addition, less sludge is sent to the municipal sewage treatment plant, which helps both the environment and the local authority.

Facts 1. Basic data on the biogas plant

| | |
|---------------------------------|---|
| Start year (biogas production): | 2005 |
| Digester volume: | 2 x 2 500 m ³ , 2 x 100 m ³ |
| Process temperature: | 35 °C |
| Total investment costs: | 90 million SEK |

Facts 2. Yearly inputs and outputs

| | |
|-----------------------------------|---|
| Substrate: | |
| Whey | 2450 tons dry weight (35,000 tons wet weight) |
| Milk waste products/process water | 2700 tons dry weight |
| Biogas: | |
| From the biogas plant | 10 000 MWh |

| | |
|---|---------------------|
| From the heat pump | 7 000 MWh |
| Digestion residue: | |
| Sludge pellets from the treatment plant | 400 tons dry weight |

Contacts

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Suppliers

| | |
|---------------|--|
| Biogas plant: | <p>Enviro-Chemie www.envirochemie.com</p> <p>Peab www.peab.se</p> <p>YIT www.yit.se</p> <p>Bravida www.bravida.se</p> |
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