



Co-digestion of Manure with Industrial and Household Waste

Summary

The Kristianstad biogas plant is the first in Sweden to co-digest municipal solid waste with manure and other organic biomass for the production of useful energy and fertiliser. The project offers a feasible and environmentally sustainable solution to waste problems encountered in many countries.

Normally, the use of household waste in biogas plants requires a

special pre-treatment plant to remove plastics. At Kristianstad, organic household waste is collected in paper bags to avoid these problems. A special reception and pre-treatment technology has also been developed for this source-separated waste. An expensive mechanical pre-sorting step has been avoided and all organic matter, including the bags, contribute to the production of biogas and organic fertiliser.

Highlights

- ▼ Sustainable system of organic waste management
- ▼ Generation of biogas equivalent to 20,000 MWh/year
- ▼ Recycling of digested manure and organic waste as fertiliser
- ▼ Low amount of reject material

The Kristianstad biogas plant.



Photograph: Kristianstads Renhållnings AB

Project Background

In autumn 1995, Kristianstad City Council decided to introduce a waste recycling system involving source-separation of household waste. The project began in December 1996 when the Kristianstad biogas plant was inaugurated. The plant is a result of co-operation between the municipality, farmers, industry and consumers; the aim is to treat industrial, agricultural and all local organic household waste in an environmentally responsible way. The plant is owned and operated by a local municipal waste company, Kristianstads Renhållnings AB.

The biogas plant is built at the premises of a closed-down sugar beet factory. Tanks from the former sugar wastewater treatment plant

are used as digestion and storage tanks. This re-use of former industrial buildings was convenient because it offered a suitable location; moreover, it is appropriate for a recycling plant to re-use existing structures. The Danish company Krüger A/S has been responsible for process design, engineering and machinery supply.

The Project

The citizens of Kristianstad separate their organic household waste into paper bags, which are collected every second week. The city has about 100,000 inhabitants and currently about 50% of them participate in the project. By the end of the year 2000, this figure is expected to be 100%. The inhabitants have a positive attitude towards the project and the quality

of the separated waste is very satisfactory.

The industrial organic waste used by the biogas plant consists of gastrointestinal waste delivered from two abattoirs and bio-sludge from a distillery, as well as liquorice, potato and carrot waste. The industrial companies which provide it are charged SEK 350/tonne (where SEK is the Swedish krona) for this means of waste disposal; this is about SEK 100/tonne less than the gate fee at a landfill site.

The paper bags containing the household waste are transported in compactor vehicles and dumped into a 100 m³ reception silo close to the entrance of the biogas plant. Some solid organic industrial waste is also unloaded here. The waste

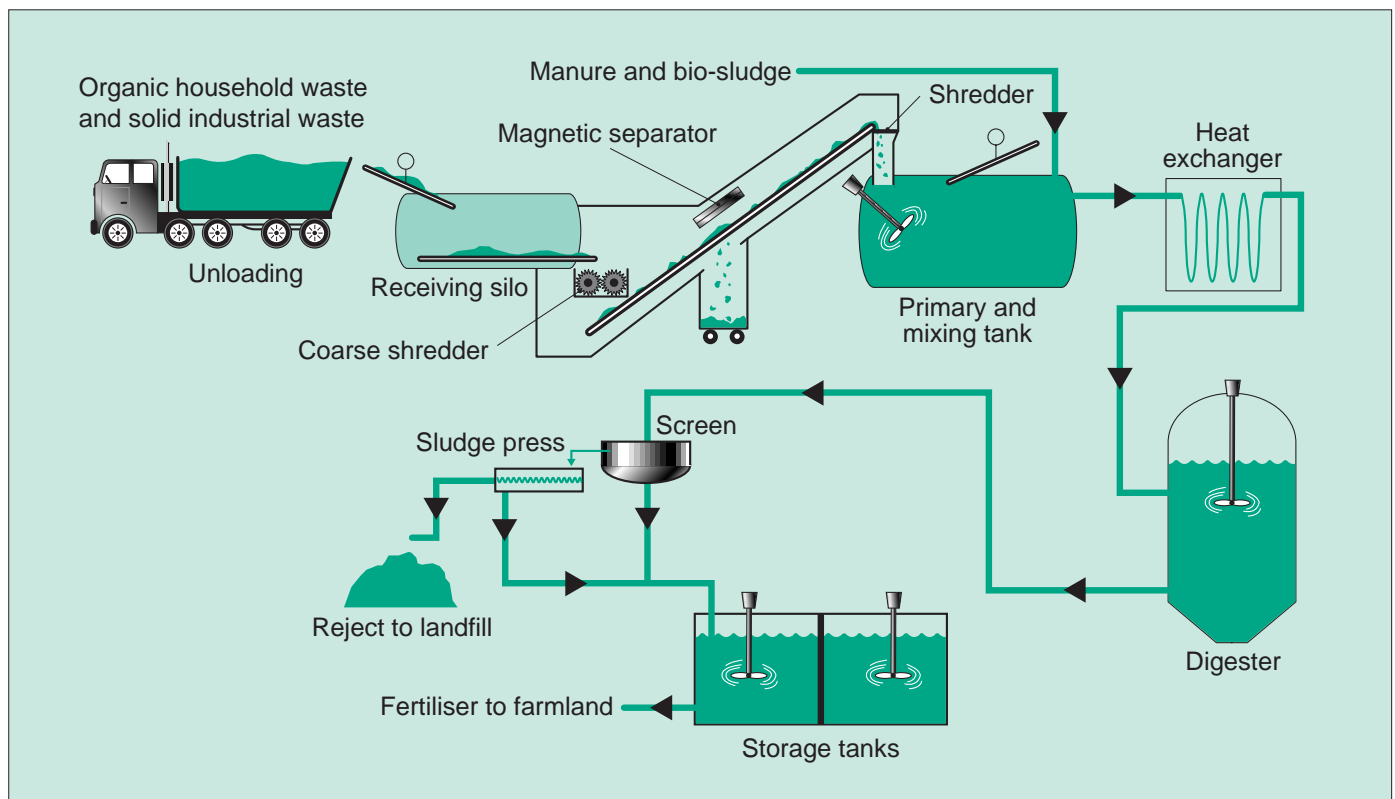


Diagram of the process at the Kristianstad biogas plant.

mixture is automatically fed into a coarse shredder and cut into pieces about 8 cm long. It then continues along an air- and odour-tight conveyor belt where a magnetic separator removes metals. A fine shredder cuts the waste into 10–11 mm pieces before it is mixed with manure and bio-sludge in a 1,000 m³ primary mixing tank.

Manure and liquid industrial organic waste are transported to the biogas plant in tankers, which are unloaded directly into the primary tank. Homogenising of the manure, industrial and household waste is carried out by top-mounted propeller agitators. The plant treats manure from 22 farms. Farmers deliver it on a contract basis without expenses, in return for receiving free fertiliser. They are sympathetic to using the digested biomass as a fertiliser and several are queuing to join the project. Surplus fertiliser is sold to farmers not supplying manure at SEK 18/m³, which covers transportation costs.

From the primary tank, the biomass is pumped into two pasteurisation tanks – each with a capacity of 30 m³. The biomass is treated there by heat produced at the biogas plant for at least one hour at 70°C to destroy weed seeds and pathogens. Samples of the digested biomass are analysed once a week to ensure that a clean fertiliser product is returned to the farmers.

The biomass is then pumped through a heat exchanger for digestion in a 4,500 m³ digester tank. The plant is mesophilic in operation, with the biomass digested

at 38°C for 20–24 days. The temperature of the biomass is reduced to the process temperature by the heat exchanger. About 200 tonnes of biomass are digested daily, producing 8–9,000 Nm³/day of biogas; this corresponds to about 20,000 MWh/year. The recovered volumes of biogas have met expectations. Most of the gas is piped about 4 km to the Allöverket district heating plant, which supplies district heating for parts of Kristianstad. About 10% of the biogas is used for process heating at the biogas plant itself.

The digested biomass is pumped from the digester to one of two screw separators, which remove undesirable material such as plastics and non-decomposed materials. This is disposed of at a nearby landfill site. The liquid matter is sent to one of two storage tanks, each with a capacity of 1,250 m³, before transportation as fertiliser to the farmers. The same tankers transport both the manure and the fertiliser. So, once the tankers have taken the manure to the biogas plant, they are reloaded with fertiliser; this is delivered to the farmers' own storage facilities and spread on the fields in the spring.

Kristianstad biogas plant is designed for fully automatic operation, monitoring and data collection. A full-time manager and an assistant oversee the operation.

Performance

Table 1 shows inputs to and outputs from the biogas plant in 1998.

Table 1: Kristianstad biogas plant – inputs and outputs (1998)

Input	Tonnes
Pig manure	20,800
Cattle manure	20,000
Poultry manure	400
Household waste	3,100
Abattoir waste	24,600
Distillery waste	900
Vegetable waste	1,400
Total input	71,200
Output	
Digested, liquid biofertiliser	67,150
Recovered biogas	4,000
Reject fractions	50
Total output	71,200

The rejected material amounted to about 50 tonnes/year of miscellaneous material. This can be attributed to the high quality of the source-separated household waste and to its collection in paper bags.

In 1998, biogas production was equivalent to 20,000 MWh; the overall energy statistics for that year are shown in Table 2.

Table 2: Kristianstad biogas plant – energy statistics (1998)

	MWh
Gross biogas recovery	20,000
Biogas used for process heating at the biogas plant	2,100
Biogas sales to district heating plant	17,900
Electricity purchased to operate the biogas plant	540

Economics

The total investment cost was SEK 43 million (in 1997 prices). SEK 4 million was provided by the Swedish state through the Commission on Ecological Sustainable Development. The plant has proved to be an economically sound way of treating household waste. In 1998, the cost of treating household waste there was SEK 350/tonne – very competitive with other forms of household waste treatment in Sweden. To date, the

plant's performance in both production and economic terms has fulfilled Kristianstads Renhållnings AB's expectations.

Environment

The Kristianstad biogas plant represents an environmentally friendly method of waste treatment, disposing of significant amounts of a variety of wastes (see Table 1) and producing useful by-products in doing so.



Photograph: Kristianstads Renhållnings AB

Host Organisation

Kristianstads Renhållnings AB,
Biogasanläggningen
Wrangels Allé 4
S-291 75 Färlöv, Sweden
Contact: Mr Christer Johansson
Tel: +46 44 718 01
Fax: +46 44 718 02
E-mail: krab.biogas@spray.se

Equipment Manufacturer

Krüger AS
Gladsaxevej 363
DK-2860 Søborg, Denmark
Contact: Mr Preben Carøe
Tel: +45 39 690 222
Fax: +45 39 690 806
E-mail: hpc@kruger.dk

Information Organisation

CADDET Denmark
NOVA PRO
Sofievej 1, PO Box 80
DK-4340 Tølløse, Denmark
Contact: Mrs Gudrun Lund
Tel: +45 59 186 999
Fax: +45 59 186 573
E-mail: novapro@novapro.dk

Please write to the address below if you require more information.



CADDET Centre for Renewable Energy
ETSU, 168 Harwell, Didcot
Oxfordshire OX11 0RA
United Kingdom
Tel: +44 1235 432719
Fax: +44 1235 433595
E-mail: caddet.renew@eat.co.uk

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