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Aerobic treatment of blackwater and organic waste

***Figure 1**: Liquid Composting Plant (Alva Naval) in Norway (Photo: P. Jenssen)*

Currently, in Norway a system exists where a local farmer collects black-water and organic household waste by truck from the surrounding community in return for payment corresponding to the municipal sewage fee (Skjelhaugen, 1999). The farmer then takes responsibility for treating the waste in an aerobic bioreactor and applies the finished product to his own land. During collection, samples are taken and sent for chemical analysis to reveal the presence of any contaminants. In cases where contamination is detected which exceeds accepted limit values, it is possible to trace the source of contamination and additional fees charged to the households responsible.

The figure below depicts the main features of the farmer operated bioreactor. The wastes are handled as liquids (dry matter content between 2 and 10 %) and stabilised in the reactor at thermophilic temperatures between 55 and 60 °C with a hydraulic retention time of 7 days (Skjelhaugen, 1999). This temperature range is effective at destroying pathogens in the waste and meets the hygienic standards set by the Norwegian Ministry of Environment (1996). The process is run semi-continuously and is characterised by high oxygen utilisation, low ammonia loss and no odour release (Skjelhaugen, 1999). Since considerable amounts of heat

are generated during the aerobic bacteria which breakdown the organic matter, no additional heat input is required to achieve thermophilic temperatures.

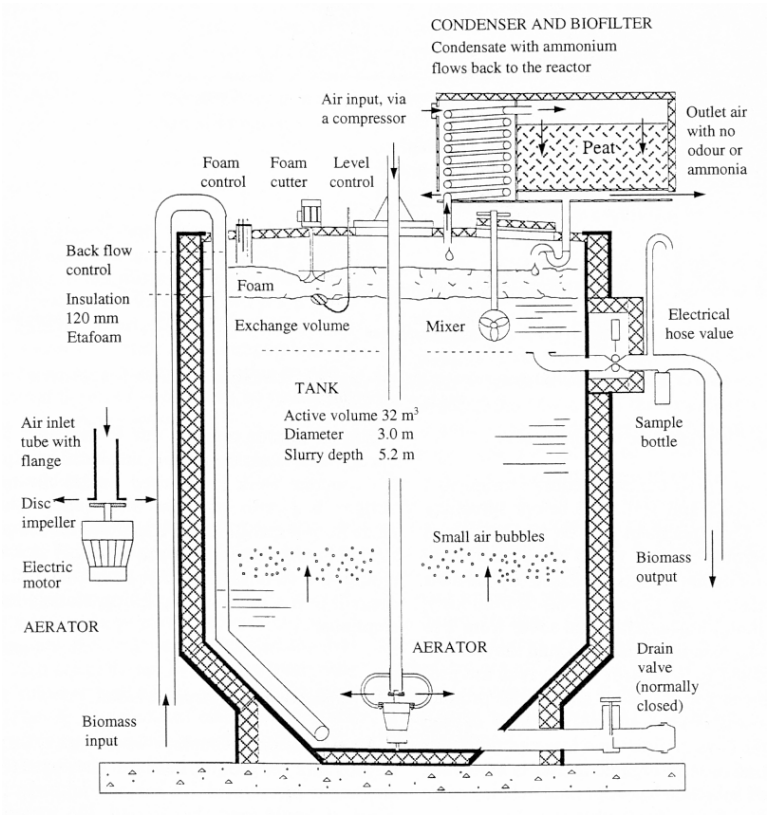

***Figure 2**: Thermophilic aerobic reactor for processing organic liquid wastes, or a mixture of liquid and solid wastes (Skjelhaugen, 1999)*

In processing trials with cattle slurry, the stability of the product proved to be sufficient to give odour free storage for a period of 10 months (Skjelhaugen, 1999).

The reactor is capable of treating blackwater and organic household waste from about 700 homes. The amount of finished product produced which can be spread onto the farmer's own land will be determined by national regulations. The Norwegian Ministry of Environment (1996) will permit up to 4 tonnes of dry matter per hectare, provided the product is hygienic and heavy metal concentrations are very low and in accordance with prescribed limit values. Under Norwegian conditions the amount of product which can typically be spread to agricultural land will require an area of 18 to 23 hectares per 1000 people (Skjelhaugen, 1999). This assumes that the land does not already receive applications of other organic wastes or manure.

Skjelhaugen (1999) has undertaken an economic analysis of the farmer operated system. In Norway, the profit for the farmer for operating a processing plant serving 1700 people, and spreading the finished product on his own land, is around NOK 200 000 (EURO 25 000) per year. In addition, a small financial return can be generated from transporting sludge and organic household waste from homes to the processing plant.

From the customer's perspective, the cost of participating in the farmer operated system is around NOK 840 (EURO 105) per year (Skjelhaugen, 1999). This is based on the assumptions set out in Table 8.

Table 1: Costs to be charged to householders for handling blackwater and Organic Household Waste (OHW) in a farmer operated recycling system (Skjelhaugen, 1999).

Operation	Waste type	Gate fee, NOK/t	Amount, t/home/yr	Cost, NOK/home/yr
Transport	Blackwater and OHW			400
Processing and spreading	Blackwater	200	1.8	360
Processing and spreading	OHW	400	0.2	80
Total cost				840

In 1996, the average cost for centralised treatment of domestic wastewater in Norway was NOK 2813 (EURO 352) per home (Refsgaard and Etnier, 1998). This rises to NOK 3152 (EURO 394) per home if the cost of handling organic household waste is included.

It should be remembered that the farmer operated system does not include treatment of greywater. According to Refsgaard et al. (1998) the cost for onsite treatment of greywater from 40 homes connected to a single facility is around NOK 583 (EURO 73) per home. Participation in the farmer operated system, together with onsite greywater treatment, therefore gives a theoretical saving to the householder of 1729 NOK (EURO 216) per year.

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