

A PILOT PLANT STUDY OF THE ANAEROBIC DIGESTION OF A MIXTURE OF MUNICIPAL SEWAGE AND INDUSTRIAL SLUDGES

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ABSTRACT

With up to 100 tonnes/day of municipal sewage sludge, the municipality of Cork County Council had a problem of disposal. Spreading on agricultural land was the most common method of disposal until the 1986 EC Directive 86/278/EEC imposed severe restrictions on such a method. For industry in the county, the method of disposal was sometimes landfilling, but more often disposal at sea. The Helsinki Agreement terminates sea disposal. An evaluation of treatment and disposal means identified anaerobic digestion as an alternative to land and sea disposal. After anaerobic digestion, the sludge is sufficiently stabilised to spread on land. A pilot project using a 20m³ reactor was studied for one year, using a mixture of municipal sewage sludge, yeast from a citric acid industry and abattoir waste (including blood, paunch contents and sheep's offal). The results were impressive; input sludge of 10% dry matter was reduced to 2%; the COD reduction approached 90%; in the mesophylic temperature range, the sludge was stabilised after an HRT of 29 days. The sludge after anaerobic digestion satisfies the EC limits for landspreading.

KEYWORDS

Abattoir waste; anaerobic digestion; % dry matter; EC Directives; industrial yeast; mesophylic; municipal sewage sludge; pilot study; stabilisation.

PILOT PLANT DESIGN

The pilot plant, which began operation in January 1990, is sited in the grounds of an existing municipal wastewater treatment plant, using both percolating filters and extended aeration as secondary treatment. The pilot plant consists of a 2.0m³ tank for holding the mixture of sewage sludge and yeast waste. There is also a 3.5m³ chilled tank for holding the abattoir wastes. Both tanks were connected to the 20m³ cylindrical digester tank (2.5 m diameter by 4 m height) using 75mm I.D pipework. The two tanks were connected independently to the digester, with each having its own pump. The plant layout is shown in Figure 1. The operation temperature was in the mesophylic range.

COMPOSITION OF SLUDGES BEFORE ANAEROBIC DIGESTION

The municipal sewage sludge had a BOD of approximately 400 mg/l, a COD of approximately 800 mg/l and 4% solids. This was made up of sludges from both the primary treatment and secondary treatment processes of the adjacent wastewater treatment plant. In both, the percentage solids was approximately 1%. Primary sludge accounted for approximately 15% of the mixed

sewage sludge. Both sludges were then mixed in a picket fence thickener from which the output was a sludge of 4% solids.

The abattoir waste is seasonal in its output, varying from 100 m³/day in the off-peak June and July months to the peak of 200 m³/day in the peak months of October and November. The composition was paunch contents, soft offal (sheep) and blood. This was macerated on site and had an 8%–10% solids content. It had a COD of 200,000 to 250,000 mg/l.

The industrial yeast from a citric acid plant was a waste product of approximately 15% solids. The sludge was homogeneous. The COD of this was 10,000–20,000 mg/l. Currently this waste is disposed of at sea.

OBJECTIVES AND SCHEDULE OF TESTS

The aims of the project are

- (i) to reduce the % dry matter of influent mix,
- (ii) to reduce the COD of influent
- (iii) to optimise the feed rate to maximise (i) and (ii) and the rate of biogas production, while still remaining stable.

RESULTS AND CONCLUSIONS

Figure 2 shows the variation in COD loading over the twelve month test period.

Figures 3 to 7 show the response of the system to the loadings in terms of biogas production, pH trends, Volatile Fatty Acids (VFA) and NH₃ concentrations.

The pilot test results indicated that anaerobic digestion of these mixed sludges is technically viable. Consequently, a feasibility study for a full scale plant was undertaken and recommendation was made for the establishment of a plant to treat all sewage sludge generated in the municipality.

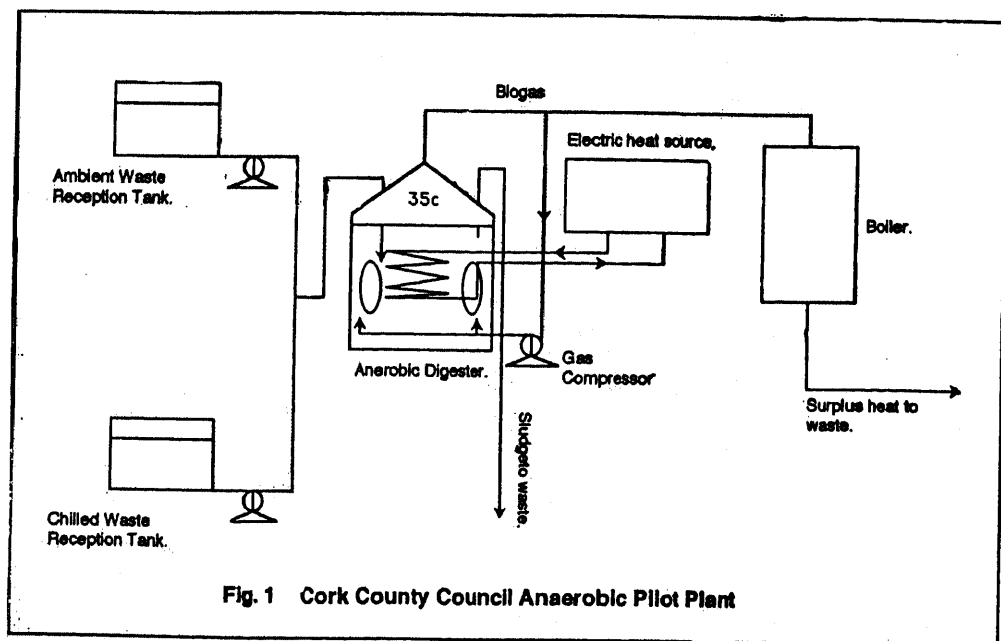


Fig. 1 Cork County Council Anaerobic Pilot Plant

FIGURE 2. PILOT STUDY - C O D Loading.

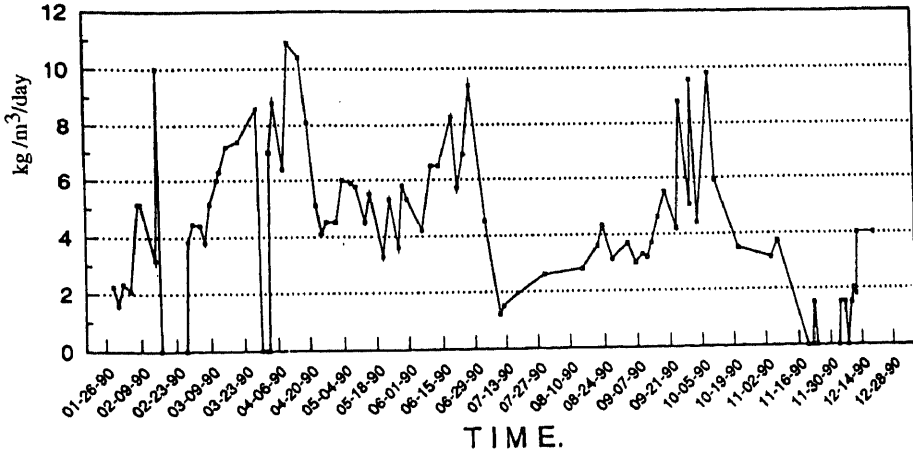


FIGURE 3. PILOT STUDY - BIOGAS PRODUCTION.

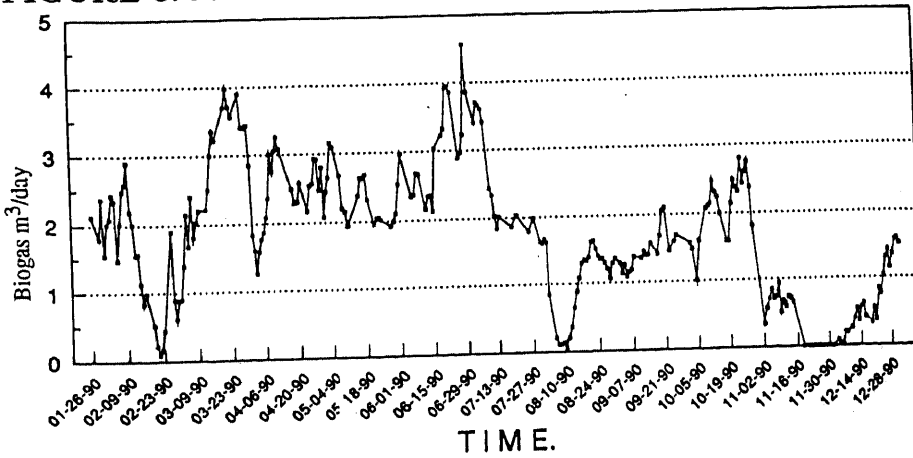


FIGURE 4. PILOT STUDY - BIOGAS & COD. LOAD.

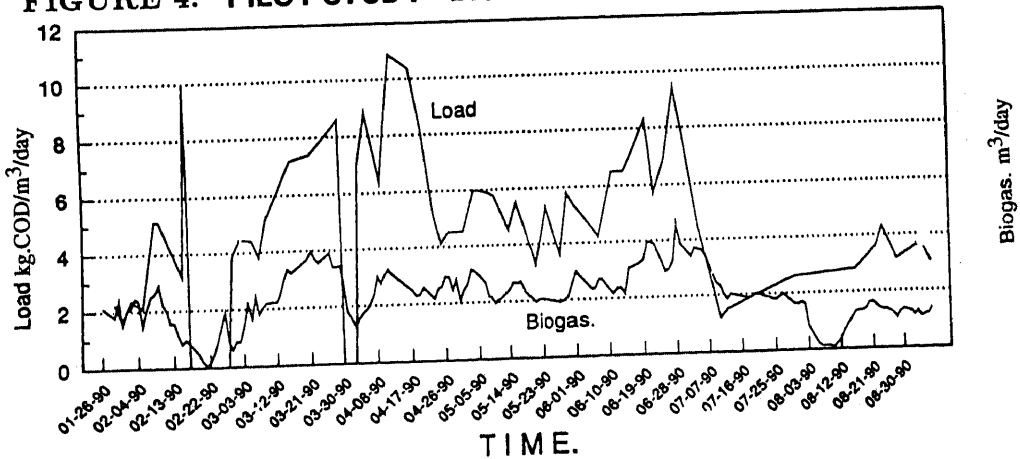


FIGURE 5. PILOT STUDY - pH.

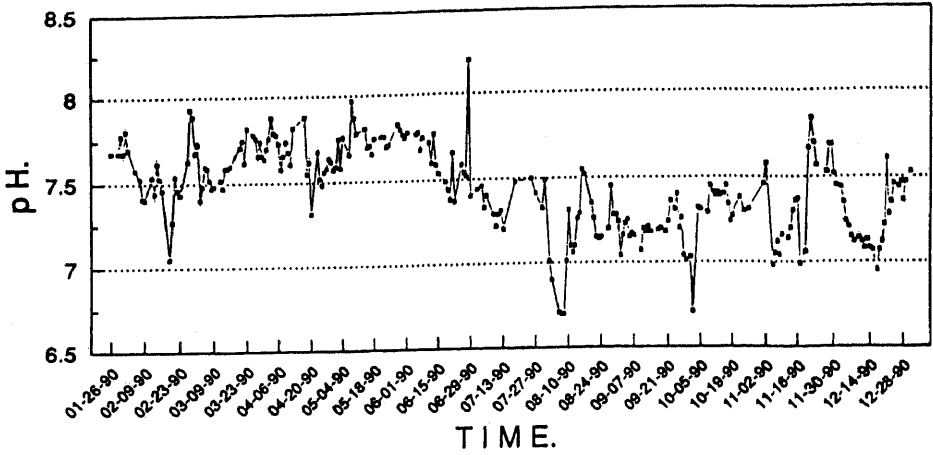


FIGURE 6. PILOT STUDY - V F A.

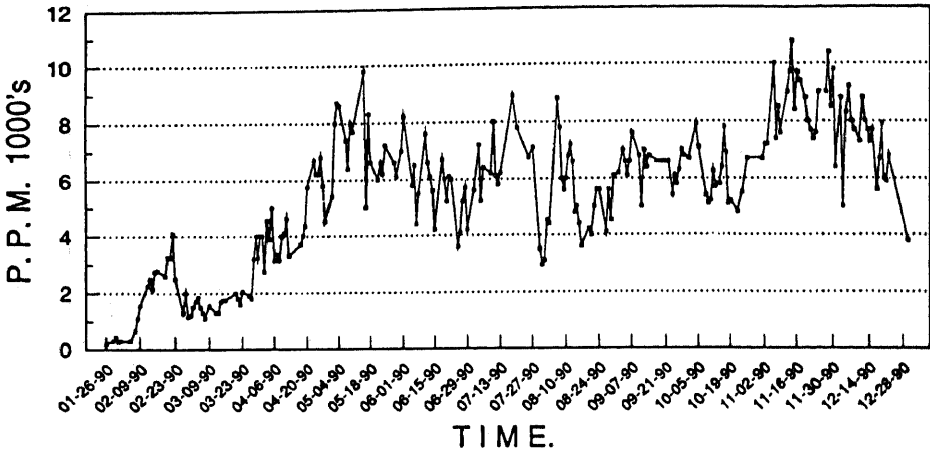


FIGURE 7. PILOT STUDY - NH₃.

