



Combined treatment of alkaline and disperser for improving solubilization and anaerobic biodegradability of dairy waste activated sludge

R. Uma Rani^a, S. Kaliappan^b, S. Adish Kumar^a, J. Rajesh Banu^{a,*}

^a Dept. of Civil Engineering, Regional Centre Tirunelveli, Anna University, Chennai, Tirunelveli Region, India

^b Dept. of Civil Engineering, Anna University, Chennai 600025, India

HIGHLIGHTS

- Chemo-mechanical pretreatment synergistically enhances sludge solubilization.
- No study carried out on this pretreatment method.
- The optimal study conditions were, SE of 4544 kJ kg⁻¹ TS for NaOH – pH 10.
- COD solubilization and SS reduction was 24% and 23.3% higher than control.
- Biogas production was 76% higher than control, at optimized conditions.

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ABSTRACT

An investigation into the influence of combined alkaline and disperser pretreatment on sludge disintegration was studied. The effects of four variables, alkalines (NaOH, KOH, Ca(OH)₂), treatment time (15–180 min), pH (8–11) and rpm (4000–24,000) were investigated. The effect of sludge pretreatment was evaluated by COD solubilization, suspended solids reduction and biogas production. The best performances, in terms of COD solubilization, SS reduction and biogas production, were the ones that occurred for specific energy input of 4544 kJ kg⁻¹ TS for NaOH at pH10, were found to be 24%, 23.3% and 76%, higher than the control, respectively. Not only the increase in biogas production was investigated, excluding protein hydrolysis was also performed successfully by this combined pretreatment even at low specific energy input. Thus, this chemo-mechanical is an effective method for enhancement of biodegradability and it laid the basis to produce higher biogas quantities, to improve clean energy generation from WAS.

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1. Introduction

Dairy industry is one of the prime sectors of an Indian industrial realm. Water management in the dairy industry is well documented, however effluent production and disposal remain a problematical issue for the dairy industry. The expected increase is itself a challenge for waste management and the choices of treatment and disposal methods will have large economic and environmental implications. Sludge management places a high economic burden as it occupies approximately 60% of the plant's operating charges. Because of the high cost of these treatments, interest for solutions allowing sludge volume and mass reduction is escalating. Anaerobic digestion is considered as the sustainable option in treatment of solid wastes, can be explained considering mainly three factors (1) the need to apply a process to dispose of organic

solid wastes more environmental friendly than landfills as requested by the latest rules concerning the environmental protection in many countries in the world; (2) the opportunity to obtain from this process a renewable fuel called biogas, an alternative to fossil fuels; (3) the advantage of relatively low costs in starting up and managing this process (Esposito et al., 2012). Historically, the anaerobic digestion process applied to sludge treatment is critically considered in favor of the sludge stabilization to reduce odors and pathogens. Currently, emphasis is captured on exploiting and utilizing its actual and potential ability for energy conservation and recovery. Anaerobic degradation can be achieved through several stages: hydrolysis, acidogenesis, acetogenesis and methanogenesis. The efficiency of digestion has often been limited by hydrolysis, which is widely regarded as the rate limiting step due to the complex structure of Waste Activated Sludge (WAS). Consequently, longer sludge retention times (SRTs) are required for digestion of WAS. In order to improve the rate of hydrolysis and the anaerobic digestion performance, sludge

* Corresponding author. Tel.: +91 9444215544.

E-mail address: rajeshces@gmail.com (J. Rajesh Banu).