

## Dairy Effluent Scum :A Resourceful Material For Biogas

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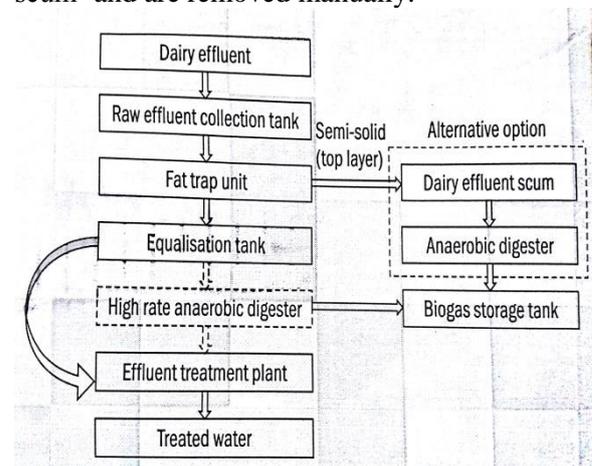
### ABSTRACT

A steady rise in the world demand for milk and milk products has led to tremendous growth of dairy industries. Around 500 modern dairy plants, spread throughout the country, process around 300 lakh litres of milk every day and produce packed liquid milk of different grades and a wide variety of dairy products. It has been estimated that 300–600 lakh litres of effluent is also produced in the milk processing plants every day. The effluent is first stored in a raw effluent collection tank and subsequently treated for safe disposal. Low density solid particles (fats, lipids, proteins, etc.) float on the exposed surface in the tank and are called 'dairy effluent scum'. It has been estimated that 50–100 kg of scum is produced for every lakh litres of milk processing capacity depending upon the final product. The scum is manually removed and land filled, used either for soap manufacturing or spread in drying beds for subsequent use after vermin composting/composting. The organic fraction of the solid waste has been recognized as a valuable resource that can be converted into useful products using microbes. Anaerobic digestion is a well established technology for treatment of organic wastes. Bio-degradation of the organic wastes in the absence of oxygen produces biogas, which is a mixture of methane and carbon dioxide as major components and traces of hydrogen, ammonia, hydrogen sulphide, etc. Biogas can be used for thermal applications, such as water heating, drying, boiler fuel, etc. or for electricity generation. The digested material available after the anaerobic treatment may be used as a soil conditioner after composting/vermin-composting. Dual benefits reaped using anaerobic digestion processes for organic solid waste are simultaneous removal of organic pollutants and waste stabilization as well as production of renewable energy in the form of biogas. Bio-methanation of the dairy effluent scum is an attractive alternative method for the milk processing industries in terms of energy generation for captive use, besides, significant reduction of the organic pollutant load.

**Keywords:** Renewable Energy, Bio-degradation, Dairy Effluent Scum etc.

### I. INTRODUCTION

**Source of Dairy Effluent Scum** → In dairy effluent treatment plants, effluents generated from various sections of the production facilities are first received in a collection tank. Before mixing in an equalization tank, the effluents are passed through a fat trap unit. The low density semi-solids, which float in the tank and contain fats, proteins, packing materials, etc., are known as 'dairy effluent scum' and are removed manually.



**Figure 1: Schematic Diagram of the Dairy Effluent Treatment System**

After removing the dairy effluent scum (top layer), the effluents are further treated in aerobic or anaerobic conditions. The characteristics of dairy effluent scum vary with the products being produced in the plant and their relative proportion and the methods of the operation used. The schematic diagram of the source of dairy effluent scum generation in

a dairy effluent treatment system has been shown in Figure1.

## II.COMPOSITION OF DAIRY EFFLUENT SCUM

Dairy effluent scum was collected from a dairy industry at 'Anand' (Gujarat) processing liquid milk, ice-cream, ghee, and cheese. The physico-chemical characteristics of fresh dairy effluent scum have been given in Table 1. All the parameters were estimated according to the procedures recommended in the standard methods for examination of water and waste water. Rich organic content of the scum indicates its suitability as a feedstock for Bio-methanation.

Parameter	Average Value
pH	6.5±0.3
Total solids, % wb	10.4±3.2
Volatile solids, %db	76.8±4.6
Organic carbon, %db	47.2±1.2
Total nitrogen, %db	1.8±0.2
Total phosphorus,%db	1.0±0.2
Crude protein, %db	11.2±1.2
Crude fat, %db	7.5±1.5

**Table 1: Physico-Chemical Characteristics of Dairy Effluent Scum**

## III.BIO-METHANATION OF DAIRY EFFLUENT SCUM

The laboratory scale followed by pilot scale studies for bio-methanation have been carried out at 'SPRERI' using the dairy effluent scum as the substrate in daily fed reactors for 10 percent total solids concentration and 40 days hydraulic retention time. The pictorial view of a 900 L capacity biogas plant used for bio-methanation studies of the dairy effluent scum is shown in Picture1.Performance of the plant has been given in Table 2.

The salient findings of the study are as follows:

→A very high biogas yield of 45–50L/kg of fresh dairy effluent scum and 462 L/kg of total solids was obtained.

→ The methane content of the biogas was found to be 70–72 percent as compared to 50–60 percent for the cattle dung.

→ The methane production potential of the dairy scum was found to be 3.8 times that of the cattle dung.

→The hydrogen sulphide content of the biogas was very low (around 10–30 p.p.m.). As such

the biogas can directly be used for thermal applications as well as power generation.

Parameter	values
HRT (d)	40
Effective volume of the reactor (L)	900
Dairy scum fed	
→ wet mass (kg/d)	22.5
→ dry mass (kg/d)	2.25
TS fed (%)	10
TS removal efficiency (%)	40.2
Avg. Biogas production (L/d)	1040
Biogas yield (L/kg TS fed)	462
Methane (%)	71
Carbon dioxide (%)	28.9
Hydrogen sulphide (p.p.m.)	30

**Table 2: Performance of the Biomethanation Plant**

## IV.DAIRY EFFLUENT SCUM-BASED DEMONSTRATION

Based on the studies carried out at 'SPRERI', a demonstration plant for Bio-methanation of 500 kg/d dairy effluent scum has been set up at M/s Vidya Dairy,Anand (Picture 2). The floating drum-type biogas plant having effective volume of 20 m<sup>3</sup> consisting of inlet chamber,digester, gas holder, and outlet was designed and constructed. For commissioning of the plant, the digester was charged with digested cattle slurry taken from a large cattle dung-based biogas plant in normal operation.



**Picture 1: Pictorial View of a 900 L Capacity Biogas Plant**



**Picture 2: Dairy Effluent Scum-Based Biogas Plant at M/S Vidya Dairy, Anand**

After acclimatization of digested cattle slurry with the dairy effluent scum, an average biogas production of around 12–15 m<sup>3</sup> per day with a methane content of 71 percent was obtained. The biogas produced is being used for in-house thermal applications.

#### V.FINANCIALS

Methane (natural gas) production potential of the scum available in India processing three hundred lakh litres of milk per day has been estimated as 534–1,068 m<sup>3</sup> per day, enough to generate 668–1,335 units of electricity per day or 3.66 lakh units annually (@ 5.00 per unit). This works out to be 18.3 lakh for the electricity produced annually.

#### VI.CONCLUSION

Technology for bio-methanation of dairy effluent scum has been developed and demonstrated in a dairy plant. Besides providing suitable solutions to the waste management problems, the methane generated improved the overall economy of the milk processing industries.

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