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Production of Bio-Diesel from Dairy Waste SCUMA Thesis

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ABSTRACT: Dairy factory waste scums are increasingly being considered a valuable resource. However, these wastes may also contain contaminants, natural or artificial, that may adversely affect the land or water to which they are discharged. The study investigates the potential of using dairy waste scum as a feed stock for bio-diesel production. Present study optimized the parameters involved in the alkali catalysed Trans esterification process of dairy waste scum oil. The effects of methanol to oil ratio, temperature and amount of KOH were investigated. A study was conducted to evaluate the capability of production of biodiesel from consortium of native microalgae culture in dairy farm treated wastewater. Native algal strains were isolated from dairy farm wastewaters collection tank (untreated wastewater) as well as from holding tank (treated wastewater). The consortium members were selected on the basis of fluorescence response after treating with Nile blue reagent. Preliminary studies of two commercial and consortium of native strains showed good growth in waste waters. A consortium of native strains was found capable to remove more than 98% nutrients from treated wastewater. The biomass production and lipid content of consortium cultivated in treated waste water were $153.54 \text{ tha}^{-1} \text{ year}^{-1}$ and 16.89%, respectively. 72.70% of algal lipid obtained from consortium could be converted into biodiesel. The present study found that bio-diesel from dairy waste scum is quite suitable as an alternative to petroleum diesel with recommended fuel properties as per ASTM standards. By using dairy waste scum as a feed stock for bio-diesel and the environmental impact related to the disposal of dairy scum.

I. INTRODUCTION

GENERAL

Bio-fuel is one of the most promising renewable fuels as it is biodegradable, less toxic than fossil fuel and has low emission profile. However, now-a-days the competitive potential of bio-diesel is limited due to high cost of common lipid feedstock such as soybean, canola, rapeseed, sunflower, palm and coconut oils which constitutes 70-85% of the overall bio-diesel production cost, strongly influencing the final price of the biofuel. Thus, there is a need to find an alternative source for the production of biofuel which is cheaper and readily available in large quantities.

In contrast, dairy waste activated sludge has been used for the production of biofuel. The production of bio-diesel from sludge poses great challenges for fast commercialization.

ADVANTAGE

1. provide an economically feasible and viable technology to produce biodiesel at low cost using waste materials as feedstock and catalyst.
2. Since these scum materials contain a large amount of triglycerides and is therefore selected as a feedstock in the present study.

APPLICATION

1. The dairy waste scum was heated to $110 \text{ }^\circ\text{C}$ until it becomes anhydrous.
2. It is then filtered through a stainless steel mesh to remove any suspended impurities.



II. OBJECTIVES OF THE STUDY

The objectives of the study is,

- i. To analyse the initial characteristics of the dairy waste activated sludge.
- ii. To optimize the time and power of ultra-sonication for effective flock disintegration.
- iii. To optimize the time and temperature of thermal pretreatment for effective solubilization of sludge.
- iv. To optimize the time and dosage of ozonation for the disintegration of sludge.

III. MATERIALS AND METHODS

GENERAL

The lab study has been carried out to analyze the effect of disintegration and the effect of homogenization pretreatment of dairy waste activated sludge and biofuel production was analyzed. The optimum conditions for sludge disintegration have been studied before going to extraction process.

COLLECTION OF SLUDGE

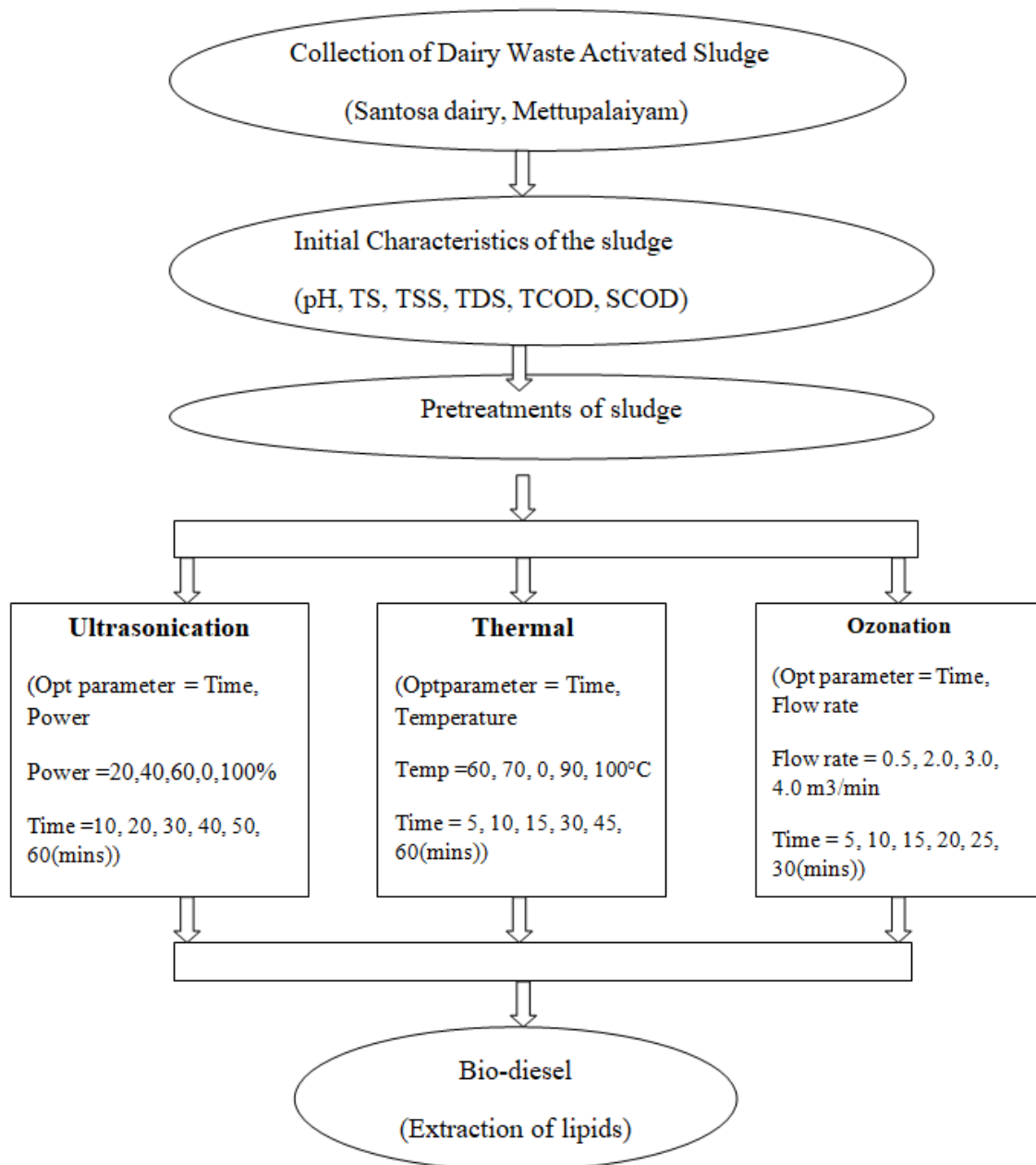
The secondary sludge, produced by an activated sludge process was collected after thickening by floatation in Santosa Dairy industry, Mettupalaiyam. The sample was immediately stored in the laboratory prior to the analysis.

CLEANING OF GLASSWARE

Always wash glass lab ware immediately after use. If a thorough cleaning is not immediately possible, always allow the glassware to soak. If not cleaned immediately some residues may be impossible to remove. Most new glass is slightly alkaline and should be washed and soaked in a 1% HCL or HNO₃ solution before wash and rinsed. Never soak for long periods in strong alkaline solutions as it will damage the glass wares. Do not use wire brushes or brushes with a wire core as it can abrade the glass.

IV. METHODOLOGY

The schematic representation of methodology of the work is shown in Figure in



Total Solids

Take a clean china dish, wash it and dry it in the oven at 105°C for one hour. Measure the dry weight of china dish and note it as W₁. Now take 10ml of dairy sludge in the china dish. Place the china dish containing dairy sludge in the oven at 105°C for one to two hours. Now take out the china dish from oven and cool it in the desiccator. Measure the weight of the china dish with residue as W₂.

$$\text{Total Solids} = \frac{(W_2 - W_1)}{v} \text{----- (3.1)}$$

Where,

W₁ = Initial dry weight of china dish

W₂ = Weight of china dish + residue

V = volume of the sample (ml)



Fig:1 Identification of Total Solids (TS)

Total Suspended Solids

Take a clean china dish, wash it and dry it in the oven at 105°C for one hour. Measure the dry weight of china dish with filter paper(0.45µm) and note it as W₁. Now take 10ml of dairy sludge and filter using filter paper. Note it as W₂ and place the china dish containing filtered dairy sludge in the oven at 105°C for one to two hours. Now take out the china dish from oven and cool it in the desiccator. Measure the weight of the china dish with filter paper as W₃.

$$\text{Total Suspended Solids (\%)} = \frac{(W_3 - W_2)}{v} \text{----- (3.2)}$$

Where,

W₁ = Initial dry weight of china dish + filter paper

W₂ = Weight of china dish + residue along with filter paper before drying

W₃ = Weight of china dish + residue along with filter paper after drying

V = volume of the sample(ml)

Total Dissolved Solids



Take a clean china dish, wash it and dry it in the oven at 105°C for one hour. Measure the dry weight of the china dish and note it as W₁. Filter 10ml of dairy sludge through a clean dry filter paper. Now pour 10ml of filtered sample in to the china dish. Place the china dish containing dairy sludge in the water bath for evaporation. Measure the weight of china dish with residue as W₂.

$$\text{Total Dissolved Solids} = \frac{(W_2 - W_1)}{V}$$

Where,

W₁ = Initial dry weight of filter paper

W₂ = Weight of filter paper + residue

V = volume of the sample (ml)

Total Chemical Oxygen Demand (TCOD)

10 ml of sample has been taken in a 250 ml reflux flask along with a pinch of mercuric sulphate. 15 ml of sulphuric acid is to be added slowly, followed by 7 ml of 0.25N potassium dichromate solution. The mixture has been refluxed for 2 hours. After cooling, the mixture is diluted twice its volume with distilled water and titrated against 0.25N ferrous ammonium sulphate using ferroin indicator. The endpoint is the appearance of reddish brown color. Calculation were done as follows,

$$\text{Total Chemical Oxygen Demand (mg/L)} = \frac{(A - B) \times N \times 8000}{V} \dots\dots\dots (3.3)$$

Where,

A = Volume of ferrous ammonium sulphate used up for blank solution

B = Volume of ferrous ammonium sulphate used up for sample titration

N = Normality of ferrous ammonium sulphate

COD Solubilization

COD solubilization will be calculated using the following formula.

$$\text{COD Solubilization (\%)} = \frac{\text{SCOD}}{\text{TCOD}} \times 100 \dots\dots\dots (3.5)$$

pH

Initially the electrode is washed with distilled water and wiped off using soft tissue. Now take some amount of buffer solution of pH 9 in a beaker. Immerse the electrode without touching the sides and bottom of the beaker. Ensure whether it shows the pH9 or not. Again wash the electrode using sludge and wiped off.

V. RESULTS AND DISCUSSION

INITIAL CHARACTERISTICS OF SLUDGE

The initial characteristics of waste activated sludge from Dairy industry were determined using standard methods (APHA 2005) and the results are as shown in the Table .



Table Initial Characterization of Raw Dairy Sludge

S.NO	PARAMETERS	UNIT	VALUE
1	Total solids	(mg/L)	16,000
2	Total Suspended solids	(mg/L)	10600
3	Dissolved solids	(mg/L)	5400
4	TCOD	(mg/L)	13200
5	SCOD	(mg/L)	200
6	Ph	-	7.84

EXTRACTION OF LIPIDS

The lipid from the sludge was extracted by Folch method of extraction of lipids in laboratory. The optimized sludge was added with chloroform-ethanol (2:1) and is filtered by funnel in the apparatus. The biodiesel was extracted by phase separation process in the bottom phase as shown in figure 2.



Figure 2. Biodiesel Extractions (Lower Portion)

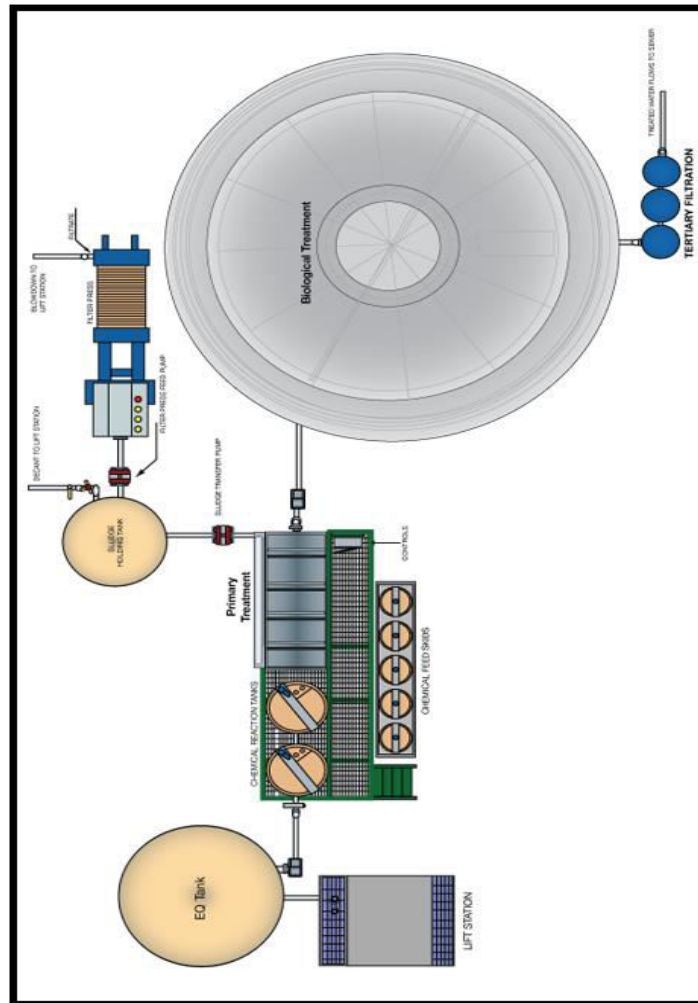


Fig: 3.Schematic Flow Diagram for Treatment of Dairy waste Scum

VI. CONCLUSION

There are currently considerable concerns in developing efficient and environmental friendly ways to convert waste activated sludge to bio-diesel, as clean, renewable fuel for multiple utilizations. The initial characteristic of the dairy waste activated sludge has been found out (pH, TS, TSS, TDS, TCOD, and SCOD). The pretreatment of the sludge such as ultra-sonication, thermal and ozonation and combination of pretreatments has been carried out for effective disintegration of flock. The pretreatments from the sludge showed some improving extraction efficiency in the sludge. The optimized values of time, power, temperature, flow rate were found out graphically. After optimizing those



parameters, the lipids from the sludge were extracted by using Folch method successfully. The production of biodiesel by this method is comparatively efficient for the use of fuels in vehicles.

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