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TREATMENT OF DAIRY INDUSTRY WASTEWATER BY HYBRID UPFLOW ANAEROBIC SLUDGE BLANKET REACTOR

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Abstract - *In recent years we have been moving towards more and more industrial development. As a result we are facing many environmental pollution problems. The wastewater emanating from high processed industries processes which are putrescible(hazardous) in nature. Hence treatment of such wastewater is essential before disposal of river, stream etc.*

The quality of wastewater decides the line of treatment. The study undertaken involved the characterization of wastewater and dairy waste is selected for this purpose. The model study gives the approximate idea about the usability and function of the treatment of the wastewater of industry by Upflow anaerobic sludge blanket reactor method.

Wastewater coming from dairy industry produces high organic matter such as Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), pH and many others. Hence treatment of such organic matter can be done by UASB reactor.

Keywords: *BOD (Biochemical Oxygen Demand), COD (Chemical Oxygen Demand), TS (Total Solids), HRT (Hydraulic Retention Time).*

Introduction

This course is about the study wastewater of milk and milk-derived food products from a food science perspective. It focuses on the biological, chemical, physical, and microbiological aspects of milk itself, and on the technological (processing) aspects of the transformation of milk into its various consumer products, including beverages, fermented products, concentrated and dried products, butter and ice cream.

In manufacturing of milk products large amount of water is used. But during this process the water gets contaminated. Dairy waste has maximum amount of BOD, COD, Turbidity, PH, and many other lipid materials. This implies the need for waste water treatment before discharge.

The anaerobic treatment is considered one of the most efficient methods for treating several types of effluents. This is due to its scope for treating high rate of simply biodegradable matters and wastewater. The up flow anaerobic sludge blanket (UASB) technology is considered as the most popular method in which the highest rate of organic materials can be removed.

Anaerobic treatment is often reported to be an effective method for treating dairy effluents.

The main characteristics of industrial dairy waste streams are identified and the anaerobic degradation mechanisms of the primary constituents in dairy wastewaters, namely carbohydrates (mainly lactose), proteins and lipids are described. Combined (anaerobic–aerobic) treatment methods are also discussed. Finally, areas where further research and attention are required are identified.

Table: Characteristics of Dairy Wastewater

Sl.No	Parameters	Standard Effluent
1	BOD	1240mg/L
2	COD	1120mg/L
3	pH	7.2
4	TDS	1060mg/L

India has 75 million dairy farms, more than anywhere else in the world.

Uttar Pradesh is the highest milk producing state of India. It holds about a share of 17.22% in the total milk production of the country. It has the second largest population of cattle and buffaloes are the primary source of milk in Uttar Pradesh. It produces 23.33million tones of milk each year. The milk producing districts of Uttar Pradesh are Meerut, Agra, Muzaffarnagar, Bijnor, Aligarh and Mathur.

Biological Wastewater Treatment Method.

It is a process that seems simple on the surface since it uses natural processes to help with the decomposition of organic substances, but in fact, it's a complex, not

completely understood process at the intersection of biology and biochemistry.

Biological treatments rely on bacteria, nematodes, or other small organisms to break down organic wastes using normal cellular processes. Wastewater typically contains a buffet of organic matter, such as garbage, wastes, and partially digested foods. It may also contain pathogenic organisms, heavy metals, and toxins.

The goal of biological wastewater treatment is to create a system in which the results of decomposition are easily collected for proper disposal.

Aerobic and Anaerobic

In biological treatment processes, it is important to briefly discuss the terms aerobic and anaerobic. Aerobic, as the title suggests, means in the presence of air (oxygen); while anaerobic means in the absence of air (oxygen). These two terms are directly related to the type of bacteria or microorganisms that are involved in the degradation of organic impurities in a given wastewater and the operating conditions of the bioreactor. Therefore, aerobic treatment processes take place in the presence of air and utilize those microorganisms (also called aerobes), which use molecular/free oxygen to assimilate organic impurities i.e. convert them in to carbon dioxide, water and biomass. The anaerobic treatment processes, on other hand take place in the absence of air (and thus molecular/free oxygen) by those microorganisms (also called anaerobes) which do not require air (molecular/free oxygen) to assimilate organic impurities. The final products of organic assimilation in anaerobic treatment are methane and carbon dioxide gas and biomass. **Hybrid Upflow Anaerobic Sludge Blanket(UASB) reactor**

An anaerobic digester that combines a UASB reactor with an anaerobic filters. This combination is an advanced form enabling improved solid retention time in the treatment of wastewater. This wastewater can be built up in the secondary chamber and must be removed daily or an explosion is imminent to occur.

Upflow Anaerobic Sludge Blanket Reactor Wastewater Treatment is a wastewater treatment system using biology that without using of air or oxygen. It aimed to remove organic pollution in wastewater, slurries and sludge. Anaerobic microorganisms convert organic pollutants into a "biogas" which contains methane and carbon dioxide.

Statement of Problem

Consequently, there is a significant need to improve the management and treatment of dairy effluents in order to reduce environmental problems and to ensure the economic viability of this essential agricultural industry. Several research groups have studied the biological treatment of dairy wastewater, either under aerobic condition or anaerobic conditions with the simultaneous production of hydrogen and methane.

The residues from dairy are part of natural products. These create environment hazards if permitted to be discharged without proper treatment and subsequent careful disposal. A large volume waste of organic nature is produced during the process of dairies and normally they are discharged on to land or nearby water sources, usually small streams, practically without pre-treatment. Condition becomes worse as the stream flow reaches a very low level and even though dilution water is not available. Effluent discharge from dairy constitutes a number of chemical pollutants, such as oil, grease, carbonate, bicarbonate, nitrate, phosphate, starch, iron in addition to total suspended solids, dissolved solids, volatile solids and scope of other unwanted fats and lipids. Aquatic life gets destructed and the dilution of water gets reduced and causes soil pollution when disposed on land.

Therefore, according to the standards of Central Pollution Control Board (CPCB) BOD of the treated water should be less than 100mg/L to 350mg/L, total solids not more than 150mg/L to 1060, COD of the treated water should be less than 3300 to 3500mg/L and pH should be 6.5to 8.5 Considering all the problems above the low-cost efficient treatment is essential for dairy industries.

Objectives:

Treatment of Dairy wastewater by Upflow Anaerobic Sludge Blanket Reactor.

- To obtain the variation of BOD content with respect to the HRT.
- To obtain the variation of COD with respect to HRT.
- To obtain the variation of pH with respect to HRT.
- To obtain the variation of Total Solids with respect to HRT.
- To obtain the optimum Hydraulic Retention time (HRT).

Fabrication of Materials

A laboratory scale Upflow Anaerobic sludge blanket reactor was fabricated. The overall height of the reactor is 1220mm. The effective volume of the reactor is 18.2 liters and the effective height is 1145mm.

A 10% of fresh cow dung slurry is seeded to the reactor to generate bacteria in it. Sampling ports were given to the reactors as shown in the figure. The sampling ports were fixed at various levels 25 %, 50 % and 75 % of overall

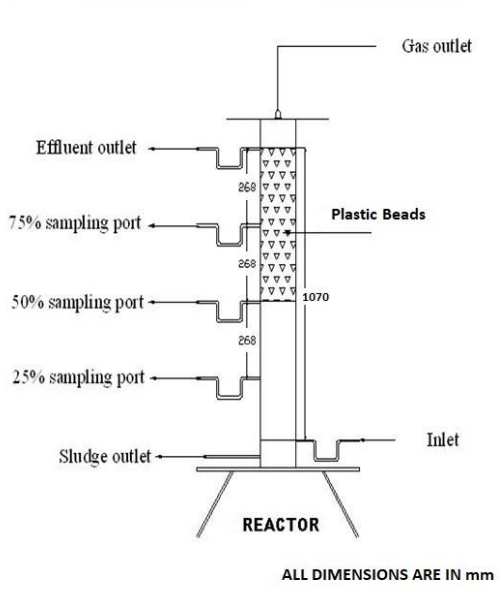
height of the reactor and they are placed at 75mm from top as well as 75mm distance from bottom to arrest the packing material and reduce the choking problems at inlet as well as outlet.

Packing material

According to previous studies and literature review use of plastic materials are having more advantages in removal efficiencies when compared to others materials. Hence we have selected packing material for the present study. It is Plastic Beads.

Details of the reactor

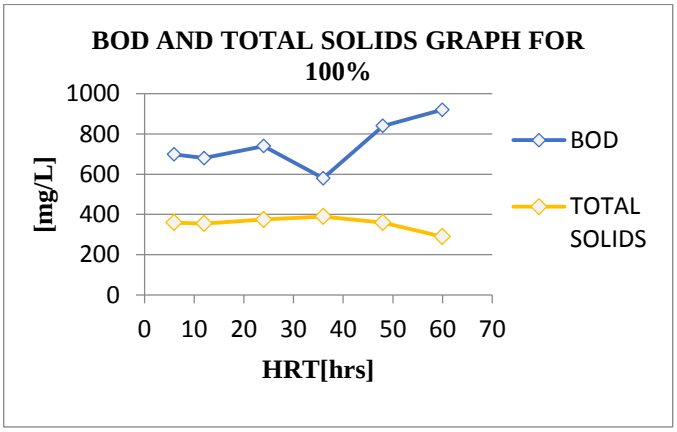
Total height	1220mm
Effective height	1145mm
Inner diameter	142.4mm
Outer diameter	150.4mm
Thickness	4mm
Diameter of Plastic Beads	5mm
Thickness of Plastic Beads	2mm

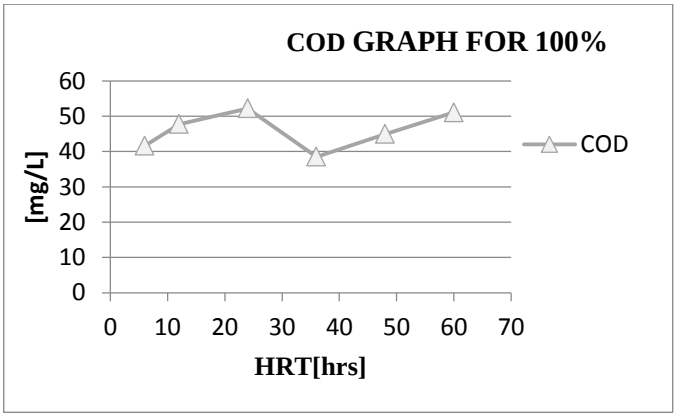


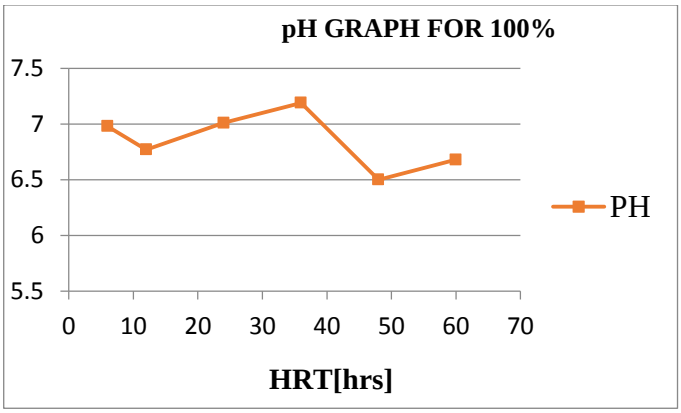
Results:

1) Parameters at 100% level of reactor

HRT in Hours	pH	TS in mg/l	COD in mg/l	BOD in mg/l
60	6.68	290	51.08	920
48	6.5	360	44.97	840
36	7.19	410	38.50	580
24	7.01	375	52.20	740
12	6.77	355	47.76	680
6	6.98	360	41.60	698

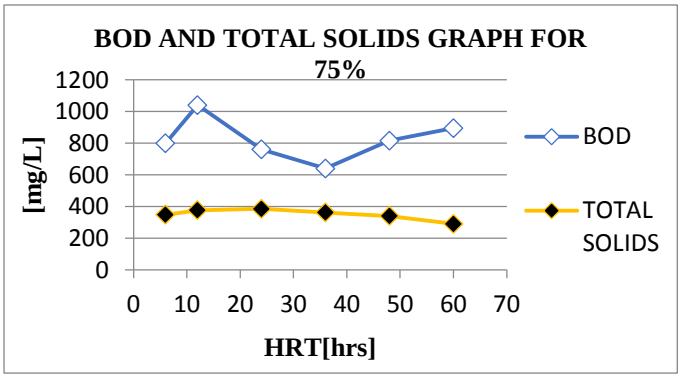


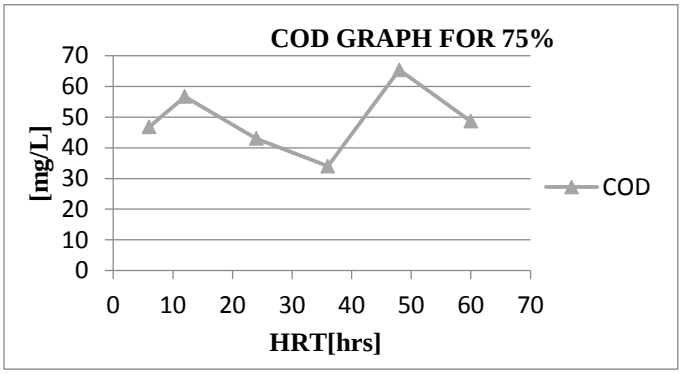


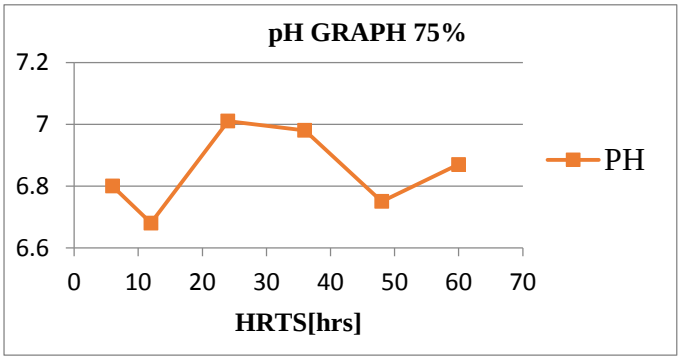


2) Parameters at 75% level of reactor

HRT in Hours	pH	TS in mg/l	COD in mg/l	BOD in mg/l
60	6.87	290	48.68	895
48	6.75	340	65.38	816
36	6.98	362	34.00	640
24	7.01	385	43.00	760
12	7.68	376	56.67	1040
6	6.8	348	46.80	800

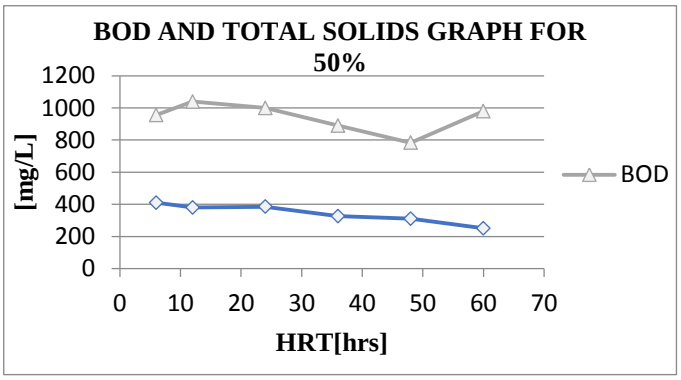


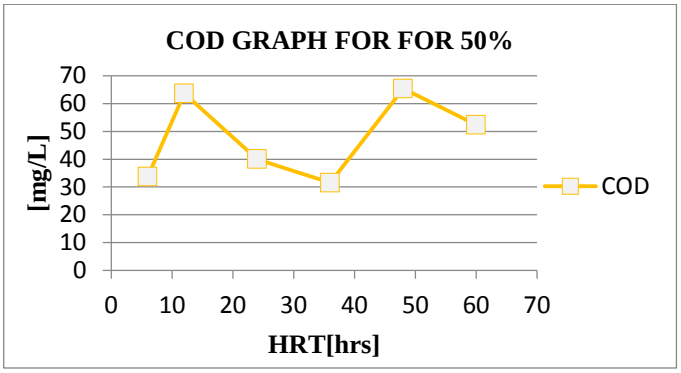


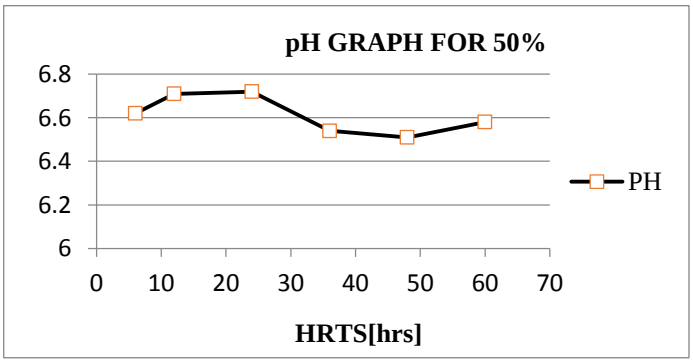


3) Parameters at 50% level of reactor

HRT in Hours	Ph	TS in mg/l	COD in mg/l	BOD in mg/l
60	6.58	250	52.38	980
48	6.51	310	65.38	784
36	6.54	326	31.50	890
24	6.72	385	40.00	1000
12	6.71	380	63.67	1040
6	6.52	410	33.70	956

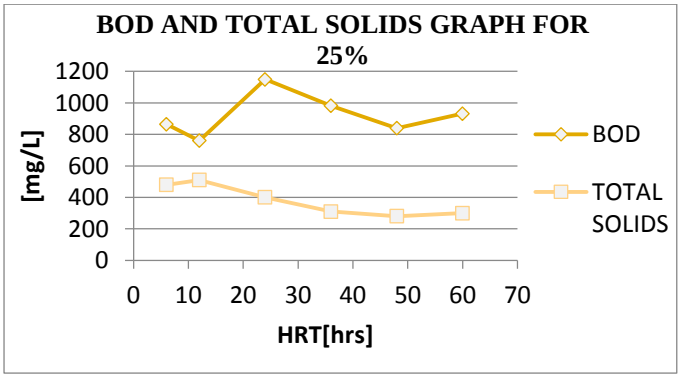


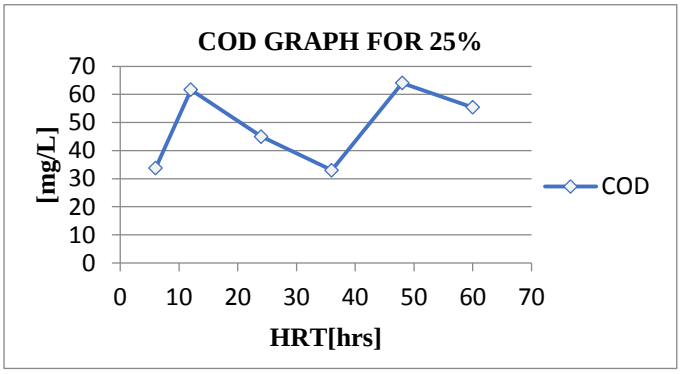


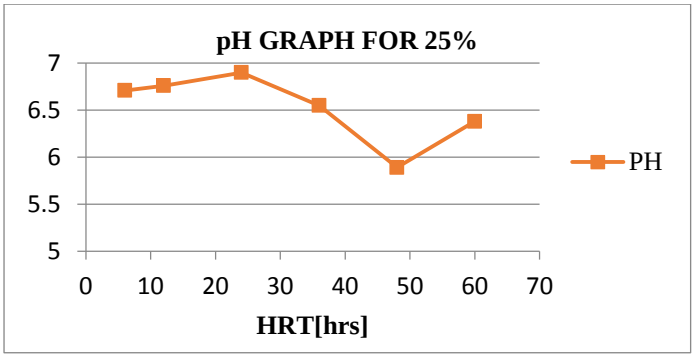


4) Parameters at 25% level of reactor

HRT in Hours	pH	TS in mg/l	COD in mg/l	BOD in mg/l
60	6.38	300	55.38	932
48	5.89	280	64.09	840
36	6.55	310	33.00	982
24	6.9	400	45.00	1150
12	6.76	510	61.67	760
6	6.71	480	33.80	865







Conclusions

The dairy industrial wastewater was treated in the UASB hybrid reactor which involves simple biological process. The UASB reactor has reduced the amount of BOD, COD and increased the level of pH and total solids. The proposed biological treatment process appears to be promising wastewater treatment method for industrial wastewater treatment with reduction of BOD, COD and increment of pH and Total solids. Handling of the excess sludge is not a problem because the amount of sludge produced is less.

- From our result we observe that the amount of BOD is reduced from 1100 mg/L to 580mg/L at 36hrs of HRT.
- The amount of COD is reduced from 1622.22mg/L to 38.5mg/L at 36hrs of HRT.
- The level of pH is decreased from 11 to 7.19.
- The amount of Total solids has increased from 400 mg/L to 410mg/L.
- The efficiency of the UASB hybrid reactor is about 52%
- Hence the Dairy industry wastewater can be effectively treated by Upflow Anaerobic Sludge Blanket reactor.

Scope for future study

In future this reactor can be studied be

- By changing the filter media.
- By varying the HRT.
- By varying the dimensions of the reactor.
- By varying the parameters of the reactor.
- By varying the concentration of the reactor.

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