Effect of ZNO, P25 degussa, anatase and mixture of ZNO + P25 degussa on essential parameters of dairy wastewater.

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Abstract - *The main objective of the study was to analyse the effect of ZnO, P25 Degussa, Anatase and mixture of ZnO + P25 Degussa on essential parameters of dairy wastewater. Dairy wastewater contains highly putrescible organic matter which requires various biological treatment including aerobic and anaerobic process for effective solutions for dairy effluent treatment.*

The treatment includes only preliminary treatment for oil and grease removal followed by constructing a reactor with synthetic hydrogels or additives to fix reagents, reducing retention time. The study involves mixing varying concentration of reagents, which ranges from 0.05gm, 0.1gm, 0.2gm, 0.3 gm, 0.4gm and 0.5gm per 500ml of dairy wastewater and thoroughly mixed in separate beakers to ensure uniform distribution. The optimum dose of reagent when exposed under UV light for 48 hours is determined.

Key Words: Dairy wastewater, P25Degussa and UV light

1. INTRODUCTION

The dairy industry, being one of the largest food processing sectors in many countries, faces significant challenges in managing its water usage and wastewater generation. With the growing demand for milk in India, the industry is poised for rapid expansion, leading to increased waste generation and environmental concern. Inadequately treated wastewater, stemming from poor design or operation of treatment systems, poses major environmental risks when discharged into land or water bodies. This industry's diverse operations generate various waste types, including organic materials, suspended solids, high levels of biochemical and chemical oxygen demand, nitrogen, oil, and grease, as well as pH fluctuations, requiring specialized treatment to prevent environmental harm. Dairy wastewater treatment is complicated by fluctuating flow rates due to production cycles. Existing treatment methods, like conventional approaches and sequencing batch reactors, often require extensive land and incur high costs, posing challenges for future sustainability.. Various techniques, including established methods, recovery processes, and emerging technologies, can be employed to enhance wastewater treatment efficiency.

The study mainly focuses to analyse the parameters of dairy wastewater and obtain cost effective nanoparticle for treatment of wastewater. Also, its emphasis on to find optimum dose with minimal cost for effective treatment.

1.1 Overall Process Description

In the Raw Milk Revolution Department (RMRD), incoming milk from dairies arrives either in cans or large truck containers. Cans are unloaded at the dock and subjected to smell testing before acceptance. Accepted cans are emptied into collecting vessels, with each institute's milk given a separate sample number. Samples are taken automatically, homogenized, and tested for fat and water percentage before being sent to the lab. The milk's rate is determined based on its quantity, fat, water percentage, and market rate. After testing, sample bottles are washed and reused. Emptied cans are inverted and sterilized with hot water before being erected and dispatched. Lids are manually washed, assembled, and loaded onto trucks. Milk from truck containers undergoes manual stirring, sampling, and testing before being transferred to silos for mixing. The truck is then sterilized, and wastewater is discharged to the Effluent Treatment Plant (ETP). Refrigeration is used to chill milk and store milk products at 4°C to inhibit bacterial growth. Pasteurization heats milk to 75°C, reducing viable pathogens and extending milk's shelf life to about two days. This process, named after Louis Pasteur, allows milk to be stored longer, enhancing its usability.

1.2 Characteristics of Wastewater

Temperature: Temperature affects chemical and biological reactions in water, varying with season and sampling time.

pH: pH serves as a pollution index, influenced by factors like photosynthesis, industrial water disposal, and sewage. It ranges from 0 to 14, with values below 7 being acidic, 7 neutral, and above 7 basic or alkaline.

Turbidity: Turbidity indicates suspended solids concentration, increasing with stronger waste.

Total Dissolved Solids (TDS): TDS comprise colloidal and dissolved solids that pass through a filter and evaporate at a specified temperature.

Dissolved Oxygen (DO): DO levels are crucial for biological wastewater treatment. Decreased DO leads to septic conditions due to higher organic matter and chemical oxygen demand.

Biochemical Oxygen Demand (BOD): BOD indicates wastewater's organic strength, measuring oxygen required for microorganisms to stabilize organic matter under aerobic conditions.

Chemical Oxygen Demand (COD): COD measures pollution in domestic and industrial waste, showing the oxidizable organic matter and the oxygen used for oxidation.

Mixed Liquor Suspended Solids (MLSS): MLSS denotes suspended solids concentration in an aeration tank during wastewater treatment, mainly comprising microorganisms and non-biodegradable matter.

Mixed Liquor Volatile Suspended Solids (MLVSS): MLVSS determines the concentration of volatile suspended solids in the aeration phase, crucial for assessing the operational behaviour and biological inventory of the treatment process.

2. MATERIALS AND METHODS

2.1 Methodology

Reagents used for experimentation were made of varying concentrations, which ranges from 0.05gm, 0.1gm, 0.2gm, 0.3 gm, 0.4gm and 0.5gm per 500ml of dairy wastewater. These solutions were prepared and thoroughly mixed in separate beakers to ensure uniform distribution. Then the prepared solutions were exposed to UV light for 24 and 48 hours to initiate, the supernatant of treated wastewater is collected for COD testing.

Figure 1: Samples kept under the box for UV light exposure

2.2 Analytical Analysis

The Chemical Oxygen Demand (COD) of the supernant was found out according to the procedure explained in IS 3025. The COD removal efficiency was calculated according to the formula enlisted below;

$$\text{Efficiency} = \frac{InitialCOD - TreatedFinalCOD}{InitialCOD}\ \%$$

3. RESULTS

The initial parameters of the dairy wastewater before treatment are illustrated in table 1:

Table -1: Results for initial parameters of dairy wastewater before treatment

P25 Degussa Dosage per 500ml, (gm)	COD (mg/l)	Efficiency (%)	BOD(mg/l)	Efficiency (%)	TS (mg/l)	Efficiency (%)
0.05	400	55.35	276	52.82	2000	16.67
0.1	288	67.85	270	53.85	1800	25.00
0.2	264	70.53	252	56.92	1600	33.33
0.3	216	75.89	234	60.00	1400	41.67
0.4	160	82.14	222	62.05	1200	50.00
0.5	120	86.16	210	64.10	1200	50.00

After carrying out several lab trials by subjecting the wastewater involving various reagents at different concentrations under the UV box for 24 and 48-hour processes are as follows:

3.1 Results for P25Degussa reagent after 24 hours of UV exposure

After treating dairy wastewater with P25Degussa at various dosage concentration ranging from 0.05 gm/500 ml to 0.5 gm/500 ml under UV exposure for 24 hours is outlined below:

Table 2 Results of P25Degussa exposed for 24 hours under UV light

P25 Degussa Dosage per 500ml, (gm)	COD (mg/l)	Efficiency (%)	BOD(mg/l)	Efficiency (%)	TS (mg/l)	Efficiency (%)
0.05	400	55.35	276	52.82	2000	16.67
0.1	288	67.85	270	53.85	1800	25.00
0.2	264	70.53	252	56.92	1600	33.33
0.3	216	75.89	234	60.00	1400	41.67
0.4	160	82.14	222	62.05	1200	50.00
0.5	120	86.16	210	64.10	1200	50.00

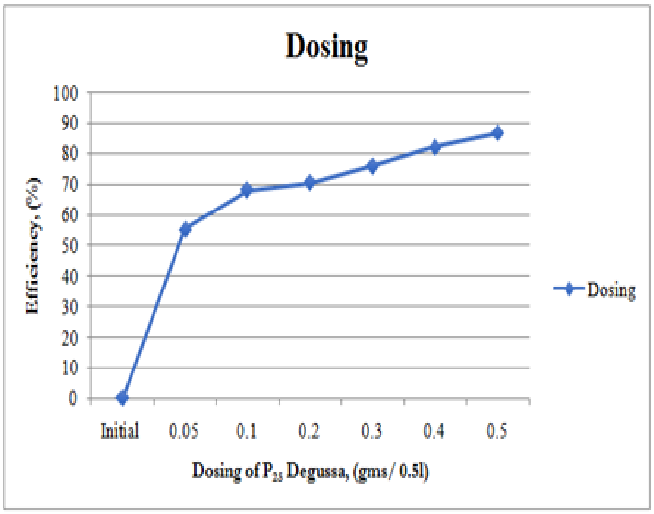

Fig. 2 Graph for dosing of P_{25}Degussa vs. efficiency exposed for 24 hours

Figure 2 shows that as the P25 Degussa dosage concentration increase there is also an increase in COD removal efficiency. All relevant parameters are monitored as the dosage concentration rises.

3.2 Results for P25degussa reagent after 48 hours of UV exposure

When subjecting dairy wastewater to various dosages of P25Degussa ranging from 0.05gm, 0.1gm, 0.2gm, 0.3 gm, 0.4gm and 0.5gm per 500mlunder a UV Box for 48 hours, the resulting effectiveness is as follows:

Table 3 Results of P25degussa exposed for 48 hours under UV light

P25 Degussa Dosage per 500ml, (gm)	COD (mg/l)	Efficiency (%)	BOD (mg/l)	Efficiency (%)	TS (mg/l)	Efficiency (%)
0.05	360	59.82	282	51.79	2200	8.33
0.1	296	66.96	264	54.87	2000	16.67
0.2	248	72.32	258	55.90	1800	25.00
0.3	280	68.75	252	56.92	1600	33.33
0.4	264	70.53	246	57.95	1400	41.67
0.5	248	72.32	240	58.97	1400	41.67

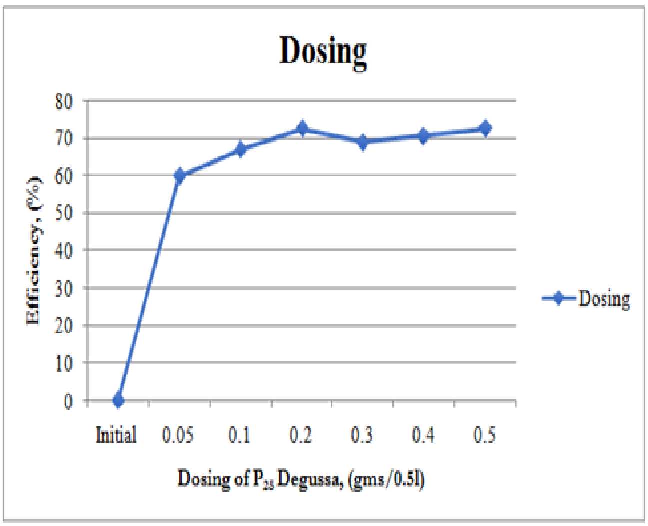

Fig. 3 Graph for dosing of P_{25}degussa vs. efficiency exposed for 48 hours

The results reveals that after 48 hours, an increment in efficiency is observed with increasing dosage of P25Degussa until the dosing rate reaches 0.2gm/500 ml, beyond which a reduction in efficiency is observed, indicating its saturation limit, with a COD, with a COD reduction efficiency of 72.32%.

4. CONCLUSIONS

From the result of analysis, it is seen that there is consistent increment in efficiency with increasing dosage for P25 Degussa exposed in UV light for 24 hours.

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