

# Biological Treatment of Dairy Wastewater using Bio Enzyme from Citrus Fruit Peels

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**Abstract:** Wastewater is directly discharged into the ground or other water sources; it causes soil pollution and it affects the nature of the soil. Hence it is necessary to treat the wastewater before discharging. The objective is to treat the dairy wastewater using Bio Enzyme. Bio Enzyme is produced by the fermentation process of citric fruit peels, water, and jaggery. To reduce the time of the fermentation process, yeast is added into the Bio Enzyme. Then the parameters like Biological Oxygen Demand(BOD), Chemical Oxygen Demand(COD), Total Solids(TS), Total Dissolved Solids(TDS), Total Suspended Solids(TSS), pH, Alkalinity, Chlorides and Oil & Grease present in Dairy wastewater after the treatment using Bio Enzyme in different percentages (2%,4%&6%) were found. Then from the results the efficient percentage of Bio Enzyme for treating the Dairy Wastewater was found.

**Keywords:** Dairy wastewater, Bio Enzyme, Fermentation, Citrus fruit peels

## I. INTRODUCTION

India is a developing country where there is an increase in population and rapid industrialization. Among other industries, the dairy industry is also growing day by day due to increase in milk demand. These industries discharge large amounts of wastewater every day. So it is necessary to treat the wastewater generated from the dairy industry before it is discharged directly into the ground or any other water source. The wastewater in the dairy industry originates from milk receiving stations, bottling plants, butter plants, cheese factories and also from cleaning and washing operation done in the milk processing plant.

The wastewater produced from the dairy industry is organic and it has very high alkalinity. When this is directly discharged into the river or any other sources of water, there will be the rapid depletion in the dissolved oxygen level and this may lead to the bacterial and fungal formation in the river. This will lead to much environmental as well as public impact.

On the other hand, waste that is generated from fruits and vegetables when directly disposed into the land and water contributes to a major sharing of soil and water pollution. Fruit and vegetable waste also causes greenhouse gas

emission which is a serious and environmental concern, so these waste fruits and vegetables can be effectively used.

In this study, citrus fruits are chosen to prepare a Bio Enzyme. These Bio Enzymes are proved as a multipurpose solution for various problems. These enzymes have been used to treat natural water bodies and also domestic wastewaters. The Bio Enzyme produced is acidic and it contains organic materials. The present study focuses to treat dairy wastewater using the Bio Enzyme. Compared to other methods this can be an easy and cost-effective method and reduces the use of other synthetic chemicals that are toxic to human health and the environment.

## II. MATERIALS AND METHOD

The materials that have to be used for the preparation of Bio Enzyme are jaggery, citrus fruits peels, and water.

**Citrus fruit peels-** Citrus fruit peels contain carbohydrates in the form of sugars, sucrose, glucose, fructose, etc., Organic acid is also present in citrus fruit peels, such as citric acid, malic acid, oxalic acid, succinic acid. The organic acids help to convert carbohydrates to alcohol[1].

**Jaggery-** Jaggery is loaded with antioxidants and minerals like zinc and selenium. Among those zinc helps in killing bacteria and also has antibacterial properties.

**Yeast-**Yeast produces carbon-dioxide, alcohol and other compounds. Yeast is used to converting sugar, starch, glucose into alcohol(Ethanol) and produce carbon dioxide gas[3].

The proportion used to prepare the Bio Enzyme with the ratio of 1:3:10. Thus one part of jaggery, three parts of citrus fruit peels and ten-part of water were mixed in an airtight plastic container. The container must be in such a way that it can accommodate the Bio enzyme, still have 10-20% space left empty. The principle behind the enzyme preparation is the simple fermentation process.

An airtight container is used to promote fermentation by minimizing oxygen. Usually, it takes three months for the Bio Enzyme to be ready. But when yeast is added to the enzyme while preparation, the time is reduced to 25 days. When the process of fermentation starts there will be some release of gases that will be built up in the space of the container. The bubble formation during the fermentation process due to the release of gases is shown in (Fig 1). So we must release the gases by opening the lid once in a day and the container must be again closed tightly. This must be repeated for one week and from the second week it can be opened in alternative days as the formation of gases will be reduced. The enzyme prepared must be stored in a cool place at room temperature and should not be stored under direct sunlight. Settling of the citrus fruit peels in the bottom of the container and less bubble

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formation indicates the completion of fermentation process. This is shown in (Fig 2). After the preparation of Bio Enzyme, the dairy wastewater was collected from the Aavin Dairy Plant, Coimbatore and the basic tests were done to find the characteristics of dairy wastewater. Then Bio Enzyme was added to the dairy wastewater in different dosage (2%, 4%, and 6%) and different parameters like pH, Alkalinity, Chlorides, BOD, COD was found at the first day. Again, the same parameters were tested on the fifth day.



Fig:1: Bubble Formation during Fermentation Process



Fig:2: Settling of The Citrus Fruit Peels

### III. METHODOLOGY

The primary aim of our project is to treat the Dairy wastewater using the Bio Enzyme prepared from the citrus fruit peels. The treatment is done using different percentages (2%, 4% & 6%) of Bio Enzyme. The flowchart (Fig :3) below represents the methodology of our project.

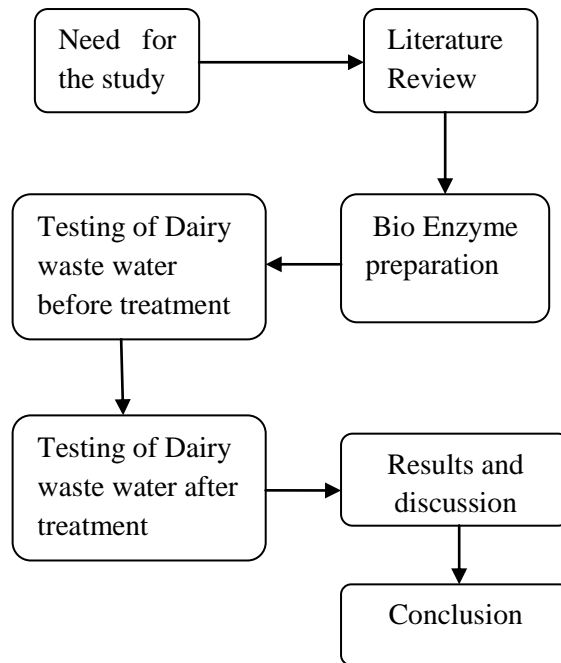


Fig: 3: Flowchart representation for the methodology

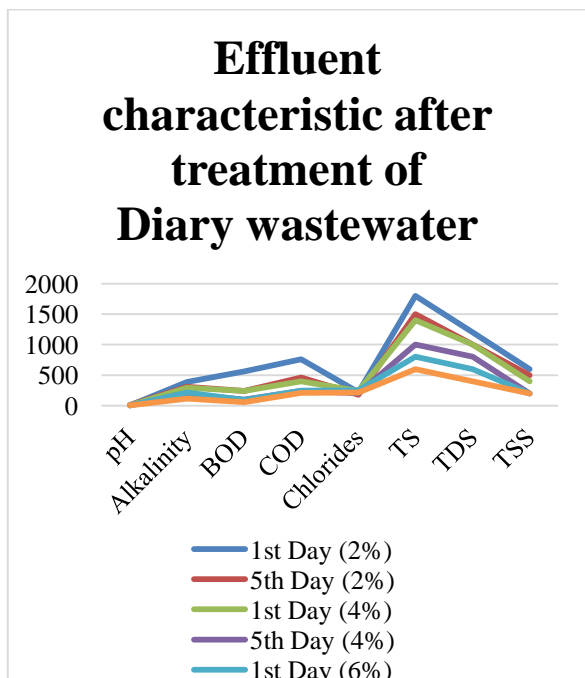
### IV. TESTS CONDUCTED

The tests that have been conducted for the Dairy waste water and the effluent after treatment are

- **pH**-(power of hydrogen)It specifies how acidic or basic a liquid solution is.
- **Alkalinity**-This test is done to measure how much acid can be neutralized by the liquid sample.
- **Biological Oxygen Demand (BOD)**-It gives the amount of oxygen consumed by microorganisms and bacteria[5].
- **Chemical Oxygen Demand (COD)**-It is a measure of oxygen needed for oxidizing soluble organic matter in water[6].
- **Chlorides**-It is done to represent the chloride ion concentration in the water sample.
- **Total Solids (TS)**-It gives the measure of total dissolved, colloidal and suspended solids in the water sample[7].
- **Total Dissolved Solids (TDS)**-It gives the concentration of dissolved substances in the water sample[8].
- **Total Suspended Solids (TSS)**-It gives the concentration of suspended particles that are not dissolved in the water sample[9].
- **Oil & Grease**-It gives the amount of oil and grease present in the sample.

### V.RESULTS AND DISCUSSION

The characteristics of raw Dairy wastewater were tested immediately after the collection of samples. Figure :4 shows the graphical representation of various parameters of the effluent from the results obtained during the treatment of Dairy waste water with different percentages (2%, 4% & 6%) of Bio Enzyme on first and fifth day as digestion period.



**Fig:4: Graphical representation of various parameters of the treated effluent.**

The table below gives the characteristics of Dairy wastewater.

**Table-1: Characteristics of raw Dairy wastewater**

Parameters	Units	Value
Ph	mg/l	9.2
Alkalinity	mg/l	400
BOD	mg/l	1290
COD	mg/l	1630
Chlorides	mg/l	176
TS	mg/l	2200
TDS	mg/l	1600
TSS	mg/l	600
Oil & Grease	mg/l	3.66

**Table-2:Effluent characteristic after treatment of Dairy wastewater using 2% Bio Enzyme.**

Parameters	1 <sup>st</sup> Day	5 <sup>th</sup> Day	Irrigation standards
pH	7.11	7.8	5.5 to9.0
Alkalinity	387	307	-
BOD	559.5	239.5	100
COD	760	459	-
Chlorides	220	179	-
TS	1800	1500	-
TDS	1200	1000	-
TSS	600	500	-
Oil & Grease	0.33	BDL	10

**Table-3:Effluent characteristic after treatment of Dairy wastewater using 4% Bio Enzyme.**

Parameters	1 <sup>st</sup> Day	5 <sup>th</sup> Day	Irrigation standards
Ph	6.32	7.2	5.5 to9.0
Alkalinity	295	190	-
BOD	240	97.5	100

COD	400	239	-
Chlorides	239	205	-
TS	1400	1000	-
TDS	1000	800	-
TSS	400	200	-
Oil & Grease	BDL	BDL	10

**Table-4:Effluent characteristic after treatment of Dairy wastewater using 6% Bio Enzyme.**

Parameters	1 <sup>st</sup> Day	5 <sup>th</sup> Day	Irrigation standards
Ph	5.84	6.8	5.5 to9.0
Alkalinity	216	114	-
BOD	92	59.5	100
COD	247	210	-
Chlorides	254	213	-
TS	800	600	-
TDS	600	400	-
TSS	200	200	-
Oil & Grease	BDL	BDL	10

## VI.CONCLUSION

The Bio Enzyme was found to be acidic in nature and it contains large amount of organic materials. The results indicate that 2% and 4% can effectively reduce the parameters like Alkalinity, pH ,COD, TDS, TS, TSS, Oil &Grease were reduced and satisfied the irrigation standards.BOD was also reduced but was not under permissible limit on the first day. It was observed that 4% of Bio Enzyme satisfied all the parameters and it was under permissible limit after 5 days of digestion period. When the Dairy waste water was treated with 6% of Bio Enzyme all the parameters were under permissible limit on the 1<sup>st</sup> day itself. So thereby we conclude that 6% of bio enzyme solution can effectively treat Dairy waste water. And the treated water can be used for irrigation purpose. This is a cheap and effective method for treating Dairy Waste water. As an extension of the project further study can be carried out to make the Bio Enzyme a concentric solution and also studies can be carried out to apply this method practically in the industries.

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