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# Purification of Dairy Wastewater Using Low Cost Adsorbents & Study on Compressive Strength of Concrete by Purified Wastewater

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A B S T R A C T

The dairy industry involves processing raw milk into products including milk, butter, cheese, yogurt using processes such as chilling, pasteurization, and homogenization. An experimental investigation was carried out for the treatment of dairy wastewater using low cost adsorbents such as laterite soil, orange peel, rice husk and groundnut shells. Generally dairy waste water contains lactose, fat, casein, inorganic salts, detergents, sanitizers etc. These all contribute largely towards their high biological oxygen demand (BOD), chemical oxygen demand (COD) and oil and grease much higher than the permissible limits, which affect and disturb the environment. In this paper the wastewater from dairy industry is passing through the vertical stand which are filled with low cost adsorbents. The use of low cost adsorbents minimizes the hazardous effect which is harmful to the environment to considerable extent. After conducting the experiments, we found that the COD, BOD, Turbidity and pH of the dairy waste water is reduced and effective use treated dairy wastewater in the making the concrete cubes.

Keywords: Adsorbents, Dairy Wastewater, Concrete, Purification, Compressive strength, BOD, COD.

## 1. Introduction

Industrialization has a big role for development of a country which causes serious pollution problems throughout the earth. With increase in demand for milk and milk products, dairy industries have shown enormous growth in number and size in many countries all around the world. Dairy industry is the one of the best example of this sector. Per year milk producing industry generates about 3.739 to 11.217 million cubic meters of waste. Some of the techniques used in waste water or water treatment plants to remove oil and grease, COD, BOD and colour are skimming tanks, oil and grease traps, sedimentation and flocculation etc. But these are not efficient and cost effective, they need frequent maintenance. With these points in view, an efficient alternate method is developed to remove oil and grease, COD, BOD and colour from wastewater using adsorption technique with easily and cheaply available laterite soil, groundnut shells, orange peels and rice husk as adsorbent material (K.S. Jayantha, et al. 2007).

Dairy wastewater needs complex treatment prior to discharge in order to prevent environmental damage. This is due to the high concentration of organic materials including protein, carbohydrates, fats, grease and minerals that elevate BOD. To reduce the environmental problems proper treatment of dairy waste water is very necessary. Adsorption technique emerges as promising technique in the removal efficiency. Some of the techniques used in waste water or water treatment plants to remove oil and grease, COD, BOD and colour are skimming tanks, oil and grease traps, sedimentation and flocculation etc. But these are not efficient and cost effective, they need frequent maintenance. With these points in view, an efficient alternate method is developed to remove oil and grease, COD, BOD and colour from wastewater using adsorption technique with easily and cheaply available laterite soil, groundnut shells, orange peels and rice husk as adsorbent material (Akshatha B.A et al. 2018). The objectives of treating dairy wastes are, to investigate the organic waste pollution from the dairy industry that may pollute fresh water and influence aquatic environment, Reduce the organic content of the waste water, Removing of organic matter by adsorption techniques. (Sheetal S Karale & Mayur M Suryavanshi 2014).

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The construction industry appears to be responsible for the consumption of huge amount of fresh water. The concrete industry has serious impact on the environment with regard to consumption of water. Therefore, need to find the alternative source of fresh water in concrete industry. The ultimate and last option will be treating the waste water and this treated waste water is not used for drinking purpose. So use of this treated waste water in the construction industry and save the freshwater.

## 2. Need For The Study

Water is a valuable natural resource for the existence of all living organisms. Indian rivers are polluted due to the discharge of untreated sewage and industrial effluents. Management of the quality of this valuable resource is, therefore, of special importance(Uttarini Pathak et al. 2016). Disposing different kinds of wastewater such as domestic, industrial and agricultural effluent into environment, especially to surface water, can cause heavy pollution of this body sources. With regard to increasing wastewater disposed standards to the environment, high considerations should be made when selecting proper treatment processes. Any of chemical, biological and physical treatment processes have its own advantages and disadvantages. It should be kept in mind that economical aspects are important, too. In addition, employing environment friendly methods for treatment is emphasized much more these days(Thuraiya Mahir Al Khusaibi et al. 2015). In this study, dairy effluent is collected and analysed for different parameters such as pH, Turbidity, BOD and COD. After checking such parameters natural adsorbents are used to absorb the impurities.

## 3. Objectives Of Study

- To check the feasibility of use of low-cost adsorbents for dairy wastewater.
- To determine various parameter of treated & untreated dairy wastewater such as pH, DO, BOD, COD etc.
- Removing of organic matter by adsorption techniques & reduction of BOD, COD.
- To achieve the sustainable development of environment by avoiding pollution of streams.
- To reuse the wastewater for various purpose like Gardening, flushing sewer, cleaning, farming.
- To study the effect of treated water on compressive strength of concrete.

## 4. Materials And Methodology

**MATERIALS:** Dairy Waste Water, Laterite Soil, Orange Peels, Rice Husk, Groundnut Shells

**METHODOLOGY:**The study was carried out in an experimental setup of filtration media in a vertical stand with 4 bottle compartments. Each bottle compartment consists of filtration materials depending upon larger to smaller voids(R.A. More & S.K. Dubey 2014).At top most layer laterite soil grains of about sieve size passing from 4.75mm and retaining in 1.18mm is filled in bottle compartment. In second most layer rice husk is placed for better adsorption of dairy wastewater. In next layer powdered orange peel and groundnut shell is placed as it is finer media it efficiently adsorbs the wastewater. Between each layer filter paper is provided likewise 4 compartments are prepared and fitted in vertical stand. In bottom water can is provided to collect the waste water passing from filtration media which is considered to be treated waste water from low cost adsorbents. Collected water is tested and replaced in preparation of concrete moulds using M20 mix design.

Figure 1: Experimental model

## 5. Results And Discussion

An experimental study is conducted on the treatment of dairy waste water using low cost natural adsorbents and during treatment we have found that before adding the adsorbents the values of COD, BOD, Turbidity, pH and total solids are very high indicating that it cannot be used for any domestic purposes. After the addition of adsorbents, the values have reduced indicating that it can be used for domestic purposes such as cleaning, flushing. Gardening, washing etc(Prabha R.T &Dr. Udayashankara T.H 2014). Based on the results obtained in the different stages of this experiment, it is quite evident that laterite soil, rice husk, orange peel and groundnut shells are powerful adsorbing mediums. For vertical stand and slower flow rates, the contact period with adsorbent increased and thus efficiency increased. In addition, as the compartments of vertical stand increased efficiency also increased.(Mr. Ayoup Met al. 2016).

**Table 1: Characteristics of Dairy Wastewater Beforeand filter Filtration**

| Name of Experiments | Dairy Wastewater | |
|---|---|---|
| | Before Filtration | Filtration After |
| pH | 9.8 | 7.94 |
| Chloride(mg/L) | 151.23 | 87.32 |
| BOD(mg/L) | 578.42 | 28.93 |
| COD(mg/L) | 1456.8 | 87.41 |
| Hardness(mg/L) | 457.25 | 128.03 |
| Total Suspended Solids(mg/L) | 287.45 | 114.98 |
| Total Dissolved Solids(mg/L) | 1335.8 | 534.12 |
| Oil And Grease(mg/L) | 2.91 | 0.06 |

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**After filtration it has been observed that**

1. The pH value of dairy wastewater is reduced by 19%
2. The Total Solids value of dairy wastewater is reduced by 60%
3. The BOD value of dairy wastewater is reduced by 95%
4. The COD value of dairy wastewater is reduced by 94%
5. The Oil and Grease concentration is reduced up to 98%

**Table 2: Result of Compressive Strength of Concrete**:

| Specimen | Average Compressive Strength Of Concrete ($N/mm^2$) | | |
|---|---|---|---|
| | **7 Days** | **14 Days** | **28 Days** |
| Concrete Prepared With Treated Waste Water | 40.5 | 42.3 | 52.6 |
| Concrete Prepared With Portable Water | 34.5 | 43.7 | 52.3 |

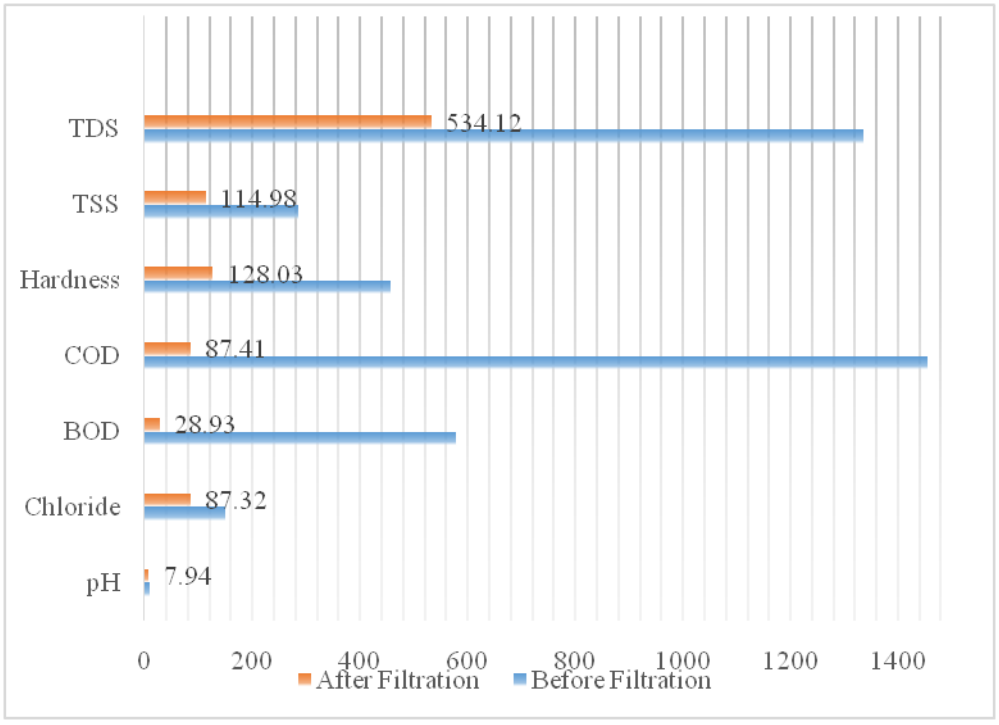


Figure 2: Graph Showing Differences between Before and After Filtration

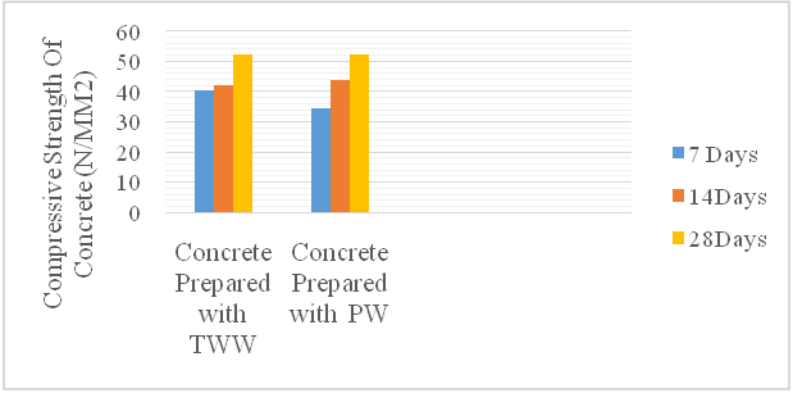


Figure 3: Bar graph showing Compressive Strength Test results at 7, 14 and Day

## 6. Conclusion

The optimum results may be obtained for using low cost adsorbents as filtration materials. Since laterite soil, rice husk, orange peel and groundnut shells are cheaply and easily available, expenses and maintenance incurred are very low as compared to other system.(M S Shetty 2012). Hence this method can be conveniently employed in the construction industry for the construction purpose replacing wastewater into treated wastewater. However further investigations may be necessary on performance of adsorbent for continuous wastewater flow and its reuse potentials. Based on the test results obtained and observations made, it is evident that further study is necessary for better evaluation of low cost adsorption materials. The study has evaluated the use of treated dairy wastewater for concrete cubes production. The water quality analysis showed that treated waste water is suitable for concrete production according to permissible limits of mixing water for concrete(IbrahimAl-Ghusain & Mohammed J Terro 2013).

The compressive strength of the concrete is increased by mixing treated waste water at the end of 7 days. The preliminary research findings suggested that significant differences do not exist between concrete cubes made of both treated waste water & portable water. Treated waste water can be

used in the preparation of concrete for both casting & curing purposes without affecting the target mean strength of the concrete at the age of 28 days curing for M-20 grade concrete. Workability of concrete is good(Kulkarni, 2014). With the comparison of concrete prepared with treated waste water and portable water gives similar results. Now a day there is so much scarcity of water i.e. there is a need to arrange other sources of water for concrete or construction of building units. Low cost and environmental friendly concrete can be produced by using treated waste water in concrete. Concrete cost can be reduced by using treated waste water in concrete (Lishan lal jain,et al. 2014).

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