

# Dairy Waste Water Treatment by using Natural Coagulants - A Review

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**Abstract**—Dairy industry is one of the top most industries among the entire industries food arena. So a large quantity of water is needed for the process of products. Also water is needed for other processes like cleaning, cooling of milk products, sanitary and the washing of processing equipments. By using large amount of water for the process high quantity of waste water is produced. This waste water contains high amount of chemical oxygen demand, inorganic and organic particles, biological oxygen demand and nutrients hence it is turbid. It is not properly treated this waste water will pollute water bodies and affect our biodiversity. The present review study aims to assess the application of natural coagulants for treating dairy waste water.

**Keywords**—Waste water, Natural coagulants, Turbidity, Jar Test.

## 1. INTRODUCTION

The dairy industry has been one of the leading enterprises of economic importance in the agricultural sector; the increased demand for milk and dairy products has led to the expansion of the dairy industry in the world [1, 2]. Wastewater from dairy industry represent a serious environmental problem because they contain compounds, such as wasted milk, lactose, fats, washing detergents, nutrients, and sanitizing agents [3,4,5,6]. The risk of environmental pollution must be reduced by treating dairy wastewater before discharging it into coastal waters, rivers, and lakes [3].

The dairy industry involves processing raw milk into products such as consumer milk, butter, cheese, yogurt, condensed milk, dried milk (milk powder), and ice cream, using processes such as chilling, pasteurization, and

homogenization. Typical by-products include buttermilk, whey, and their derivatives. Unit operations that generate wastewater are 'washing' and 'disinfection' of equipment (tanks, centrifuges, pasteurizers, homogenizers, pipes, pails, etc.), loss of packages containing milk, and loss during internal transportation [7]. In dairy industries, water is a key processing medium. Water is used throughout all processing steps of the dairy industry, including cleaning, sanitization, heating, cooling and cleaning of external areas -as a result, the water requirement is huge. Moreover, the liquid effluents generated through dairy product production exhibit high concentrations of organic matter, fats, suspended solids and nutrients. These are considered to be the main sources of pollution in this industry.

Conventional treatment of these effluents normally includes a primary treatment to remove the suspended solids and fats and a secondary biological treatment; however, many problems have been reported during these processes. They are often related to the high production of foam, the low settle ability of the sludge, the low resistance to shock loads, the difficulty in removing nutrients, and the problems associated with the degradation of fats, oils, and other specific types of pollutants. [8].

Coagulant has a significant role in contaminant removal during coagulation process [9]. Conventional CEPT (Chemically Enhanced Primary Treatment) uses metallic coagulants (e.g. polyaluminium chloride, ferric chloride, and ferrous sulphate) for the removal of pollutants. However, there are many disadvantages associated with their use such as alteration of pH, alkalinity consumption,



and higher dosage; also, chemical coagulants produce large quantities of toxic sludge [9, 10, 11,12]. Therefore, it is necessary that natural, biodegradable, and environmentally friendly coagulants must be used. The present review is a detailed study of the pros and cons of different natural coagulants used to treat dairy waste water.

## II. METHODOLOGY

Coagulation/flocculation is used to remove suspended particles, turbidity colour, bacteria, and odour-causing compounds from a solution. Chemicals are used to destabilise suspended particles, colloidal materials, and macromolecules during coagulation. The coagulation of dairy waste water using natural coagulants like powder form of *Moringa Oleifera*, Neem leaves, banana leaves and orange peel and banana peel and Orange peel and Channa Nanocomposites has been studied in present review.

## III. NATURAL CAGLANTS FOR DAIRY WASTE WATER TREATMENT

### A. Moringa Oleifera seed powder

*Moringa oleifera* (Drumsticks seed) as herbal coagulant is reported to be quite effective and have many advantages over chemical coagulant like Alum. Recent studies have pointed out several serious drawbacks of using aluminium salts, such as Alzheimer's disease and similar health related problems associated with residual aluminium in treated waters [13, 14]. besides production of large sludge volumes. High cost of imported chemicals like alum for water and wastewater treatment is not affordable for many developing countries. [15].

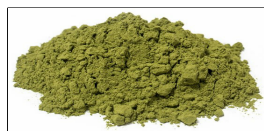


Fig. 1 Moringa Oleifera seeds (powder form).

*Moringa Oleifera* has been reported to be free of constraints like pH and alkalinity. Sludge produced with *Moringa Oleifera* is reported to be four to five times compact than that produced with alum [16].

In a case study, powdered *Moringa Oleifera* was sieved and selected particle size (425,150 and 212 $\mu$ m)has been

used . The optimum dosage for 425, 150 and 212 $\mu$ m was found to be 300and 500mgL<sup>-1</sup>respectively. 212 $\mu$ m particle size was most effective among other two in the reduction of COD. COD was reduced from 2240mgL<sup>-1</sup> to 800,960 and 1120mgL<sup>-1</sup> by 212, 425 and 150 $\mu$ m particle size of *Moringa Oleifera* respectively. Turbidity has been reduced from 230NTU to 32, 26 and 42NTU by 212, 425 and 150 $\mu$ m particle size *Moringa Oleifera* respectively [17].

### B. Neem leaves and Banana leaves powder



Fig. 2 Neem (*Azadirachta indica*).



Fig. 3 Banana leaf (*Musa acuminata*).

An experimental study has revealed that a dosage of 0.4 g/L of neem leaf and banana leaf powder was sufficient to maintain a pH of 7.8 and turbidity of 34 nephelometric turbidity unit (NTU). It delivers that the pH (8 to 7.84) and the turbidity values decreased and then increased as the coagulant's dosage was increased from 0 to 1 g/L. Therefore, the optimum dosage of the bio-coagulant was considered to be 0.4 g/L. The turbidity levels were reduced by a rate of 55 and 65% using neem and banana bio-coagulants, respectively. The study also revealed that the more dispersion and suspension rates in the treatment of dairy wastewater by banana and neem leaf bio coagulants, the better. Neem and banana powder were found to be non-toxic and ecofriendly ways for the

treatment of wastewater and can be used as an alternative coagulant in water treatment plants [18].

### C. Orange peel powder

Orange peel is another fruit waste that have been investigated for its potential use as coagulant. A case study has compared treatment of dairy wastewater by using orange peel and comparing it to alum. Dairy wastewater used was stated to have an initial turbidity of 260 NTU but then reduced to 8 NTU by using orange peel



powder as coagulant [19].

Fig.4 Orange peel powder

### D. Orange peel and Channa Nanocomposites

Another study has demonstrated that, the dosing of Orange peel and channa powder as an adsorbent and nanocomposite at various concentrations obtained the reduction of turbidity. The orange peel has the ability to remove turbidity levels up to 76% and Channa has the ability to remove turbidity levels up to 82%. Orange peel Nanocomposite has a turbidity content of up to 83% and Channa Nanocomposite has the ability to remove turbidity levels up to 92% [20].

world. But the effluent content leads to the some problems such as turbidity, oil and grease, organic content etc. If treating this effluent with some chemical coagulant leads some health problems. So these can be overcome by using some natural materials. In this review the effectiveness of Moringa Oleifera seed powder, Neem leaves, Banana leaves powder, and combination of Orange peel and banana peel powder has been studied. It was observed that of Moringa Oleifera seed powder was effective with turbidity removal up to 88.6%. The turbidity levels were reduced by a rate of 55 and 65% using neem and banana bio-coagulants, respectively. Orange peel powder as natural coagulant has found to reduce the turbidity of dairy waste water by 97%. Orange peel Nanocomposite has a turbidity removal up to 83% and Channa Nanocomposite has the ability to remove turbidity levels up to 92%. The above studies revealed that Orange peel, Channa and Moringa Oleifera are effective natural coagulants for treating dairy waste water.

## IV CONCLUSIONS

The dairy industry is the one of the leading industry in the

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