

# REMOVAL OF TURBIDITY FROM DAIRY WASTEWATER USING NATURAL COAGULANTS IN COMBINATION.

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**Abstract:** Dairy plays a role in various aspects of Indian society that includes cuisine, religion, culture, and the economy of our country. The effluent from the dairy industry contains high concentrations of dissolved sugars, proteins, fats, etc. The present work was to identify natural and alternative coagulants for the removal of turbidity from wastewater and to check the efficiency of orange peel and neem leaf powder in combination with different ratios on the treatment of dairy wastewater. The sample has been collected from the dairy, Mandya district. The initial characteristics like turbidity and pH of dairy wastewater were found using standard methodologies. The natural coagulants were added with different ratios and different doses to assess the effectiveness and dosing level. The present study reveals the efficiency of the selected two natural coagulants, and they have the potential to adsorb and remove the chemical constituents from the dairy wastewater.

**Index Terms**— Turbidity, pH, Natural coagulants, Neem leaf powder, orange peel powder

## 1. INTRODUCTION

### 1.1 GENERAL

Water is an inorganic, transparent, tasteless, odorless, and nearly colorless chemical substance, which is the main constituent of Earth's hydrosphere and it is the basic necessity of life. World Health Organization estimates that about 85% of the rural population scarcity of potable drinking water. In developing countries, 15 million infants die every year because of drinking contaminated water, poor hygiene, and malnutrition. About 80% of illnesses in developing countries are directly interlinked with contaminated drinking water (WHO). Thus providing pure water for consumers will help immensely in decreasing the infection rate as well as diseases.

The health issues can be improved through domestic hygiene practice and proper methods of water purification. In dairy, water is a key processing medium used throughout various processing steps like pasteurization, clarification, cleaning, sanitization, heating, cooling, and cleaning of external areas. As a result, a huge amount of water gets contaminated and the effluents contain high concentrations of TSS, fats, etc.

Conventional treatment of these effluents includes a primary treatment to remove the suspended solids and fats and a secondary biological treatment, during which many problems are reported. These processes 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 with the degradation of fats, oils, and other specific types of pollutants.

Present investigative studies were undertaken to explore the feasibility of physical and chemical processes, particularly the combination of coagulants (neem leaf powder and orange peel powder) for wastewaters. Dairy wastewater was collected from one of the dairy, Mandya district, Karnataka, and used during experimental investigative studies to explore the possibility of application of coagulants for treatment of dairy wastewater to improve its characteristics and make it suitable for further treatment and disposal into water bodies as well as on land. This paper is the report on investigative studies and findings for the effectiveness of herbs as the natural coagulant.

### 1.2. OBJECTIVES

The objectives of this study were,

1. To test the efficiency of orange peel powder and Neem leaf powder in combination with different ratios.
2. To compare the coagulants with different ratios of the most effective natural coagulant.
3. To identify the most appropriate ratio for treating dairy wastewater.

## 2. LITERATURE REVIEW

<sup>1</sup>Sivakumar D, Shankar D, Janaki Sundaram S: "Treating dairy industry effluent using orange peel powder" [July Sep 2016]

This study mainly concentrated on removing COD and TDS from dairy industry effluent using orange peel powder, a cheap agro-based product. Experiments were carried out

with different dosages, rapid mixing, and slow mixing contact time. In this study, an optimum dosage of 80 gm/l, for rapid mixing with a contact time of 25 min and for slow mixing with a contact time of 50 min for COD and TDS removal from dairy. The results revealed that the removal of COD and TDS using orange peel powder is about 85.5 % and 81.6 %. Thus, the study concludes that the usage of orange peel powder is an effective adsorbent for removing COD and TDS from dairy.

<sup>2</sup> Anju S and K.Mophin-Kani: "Exploring the use of Orange peel and Neem leaf powder as an alternative coagulant in the treatment of dairy wastewater" [April 2016]

The present study aimed to investigate the efficiency of the natural coagulants orange peel and neem leaf powder for the removal of turbidity individually. The coagulants were added in different doses like 0.2g, 0.4g, 0.6g, 0.8g & 1g to assess the effectiveness and dosing level. Previous results using various natural products as coagulants showed a measurable increase in the quality of water with pilot and field studies.

<sup>3</sup> Divya KS, Dr.Syed Ariff V Vaishnavi, Sadiya Banu A S, G Swetha Ravi Kiran S: "Experimental Study On The Treatment Of Dairy Waste Water Using Low-Cost Natural Adsorbents" [2019]

Dairy is the one food industry with more usage of water for the production of milk products. The wastewater from the dairy is biodegradable and organic. It is found that dairy industries generate 2.5 to 3 liters of wastewater per liter of milk processed. Such untreated wastewater contaminates water bodies and land therefore treatment of dairy wastewater is necessary before disposal to the environment. The present work aims to determine the behavior of various parameters of dairy wastewater using low-cost natural adsorbents in their powdered form like rice husk, curry leaf, orange peel, neem leaf in the treatment of dairy wastewater. The result reveals the reduction in the concentrations of the parameters like COD, BOD, Turbidity, and pH of the dairy wastewater.

### 3 MATERIALS AND METHODS

#### 3.1 ORANGE PEEL POWDER



Fig.1 Orange peel powder.

Orange peel was collected from the local market and washed

several times with tap water to remove the adhering dirt. Further, the sample was dried under sunlight for four to six days and chopped by manual cutters into small pieces. Later on, grind it to obtain small particle size powder and finally sieved with different mesh sizes ranging from 150 microns, 600 microns, 1200microns, 3.0mm, 4.0mm and 5.0mm mesh size. Again, washed with distilled water to remove any acidity or alkalinity, and oven-dried at 80<sup>o</sup> C for 24 hours. Oven-drier is used for drying.

#### 3.2 NEEM LEAF POWDER

Neem leaves were collected and washed with tap water to remove impurities and dirt present in leaves. The leaves are then dried under sunlight for two to three days, and it is then grounded to make fine neem leaf powder. If required, neem leaves can be washed with acid or alkali to remove fine dust particles present in the leaf.



Fig.2 Neem leaf powder

### 3.3. JAR TEST APPARATUS



**Fig 3:** Jar Test Apparatus.

The jar test is a laboratory procedure used to determine the dosage of coagulant. Jar test apparatus is selected for coagulation- sedimentation studies. The water for which the optimum dosage of coagulant is to be determined is placed in jars or beakers having the capacity of about 500ml to 1000ml. The various amounts of coagulants are then added to each jar. The driving unit is started and the driving shaft rotates the paddles situated at the lower ends of the stirring rods. The paddles are rotated for 2 minutes at the speed of 80 to 100 rpm and then slowly at about 40rpm for 20 minutes. The amount of coagulant into the jar which produces good floc with least amount of coagulant is preferred.

### 3.4. COAGULATION

Coagulation is an essential process in the treatment of both surface water and industrial wastewater. Its application includes removal of dissolved impurities and turbidity from the water by the addition of conventional chemical-based coagulants, namely, Alum ( $AlCl_3$ ), Ferric Chloride ( $FeCl_3$ ), and Poly-Aluminium chloride (PAC). The application of these coagulants increases the size of the particles and then settles down at the bottom in the coagulation sedimentation tank.

#### 3.4.1 Principles of Coagulation

The principle of coagulation is explained from the following two considerations

1. Flock formation.
2. Electric charges.

**1. Flock formation:** When coagulant is added to water, they produce a gelatinous precipitate. This precipitate is

known as floc and this floc helps in arresting the suspended impurities in water

**2. Electric charges:** The ions in the floc are found to possess positive electric charges. Hence, they will attract the negatively charged colloidal particle of clay and thus they cause the removal of such particles from water.

### 2.5. CHARACTERISTICS OF DAIRY WASTEWATER

It has been observed that the wastewater generated has high concentrations of pollution characteristics because of washing of floors, cans, and machines. Twenty liters sample was collected from dairy, Mandya district, and analyzed for various parameters following the procedure given in Standard Method (AWWA, APHA, 1987). 142 Bhutada et. The result of average characteristics of wastewater (collected during 8 to 10 am on respective days) shows that the turbidity was in the range of 194NTU where the pH of wastewater was about 8. The experimental studies were carried keeping in view the disposal of dairy wastewater on land through irrigation and alternative for further treatment for discharge in water bodies.

### 4. RESULTS AND DISCUSSION

#### 4.1 EXPERIMENTAL RUNS FOR COAGULATION STUDIES WITH NEEM LEAF AND ORANGE PEEL POWDER WITH A 1:1 RATIO.

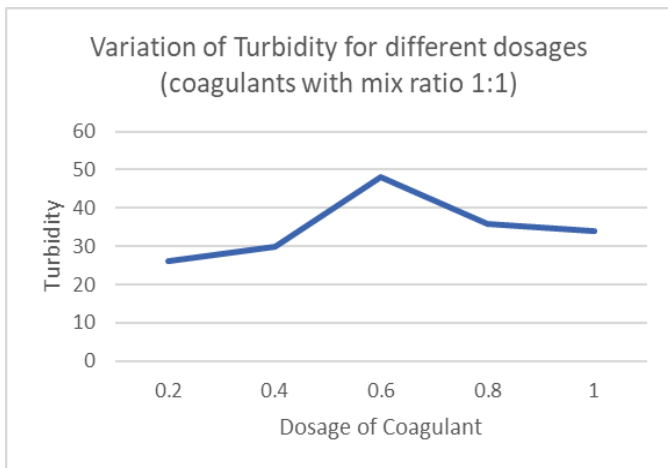
Dairy wastewater was used for coagulation studies with neem leaf and orange peel powder in combination. Experimental runs were carried using the Jar Test apparatus. Quick mixing at 100 rpm for 2 minutes and slow mixing at 30-40 rpm for 20 minutes followed by 45 minutes settling during experimental runs. Five doses of neem leaf and orange peel powder in combination with a ratio of 1:1 and the dosage range of 0.2g to 1gm, were applied to wastewater. The study showed that the turbidity is reduced from 194NTU to 26NTU with 86% removal efficiency. The dosage of coagulants and the corresponding values of turbidity and pH is given in the table below. The result indicates that the removal of turbidity from the dairy waste.

**Table.1** Characteristics of dairy waste treated with neem leaf and orange peel powder with the ratio of 1:1

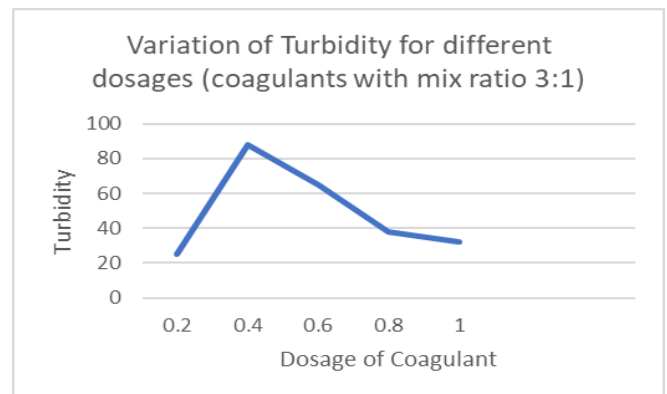
Dosage (g)	0.2	0.4	0.6	0.8	1
Turbidity (NTU)	26	30	48	36	34
pH	7.2	7.4	7.2	7.4	7.3

**Table.2** Characteristics of dairy waste treated with neem leaf and orange peel powder with the ratio of 3:1

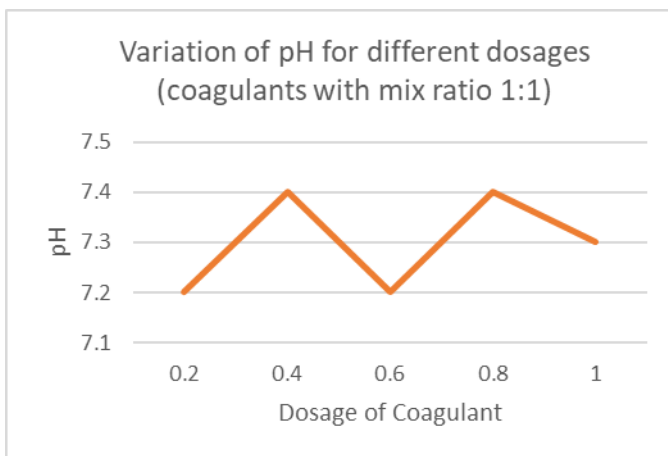
Dosage (g)	0.2	0.4	0.6	0.8	1
Turbidity (NTU)	25	88	65	38	32
pH	6.1	6.3	6.4	6.8	6.5



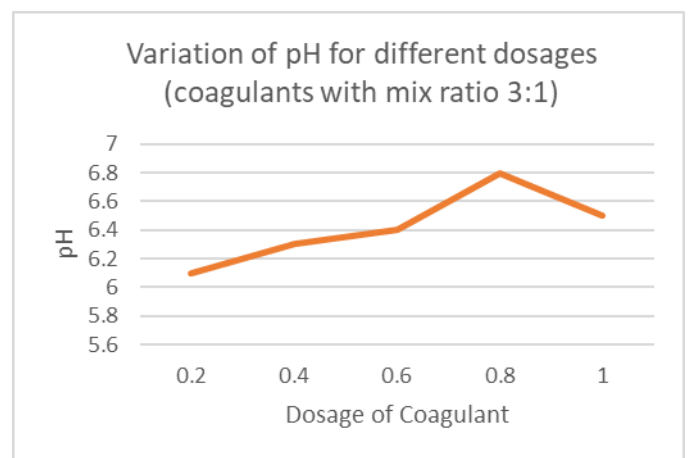
**Chart.1** Variation of Turbidity.



**Chart.3** Variation of Turbidity.



**Chart.2** Variation of pH.



**Chart.4** Variation of pH.

**4.2 EXPERIMENTAL RUNS FOR COAGULATION STUDIES WITH NEEM LEAF AND ORANGE PEEL POWDER WITH 3:1 RATIO.**

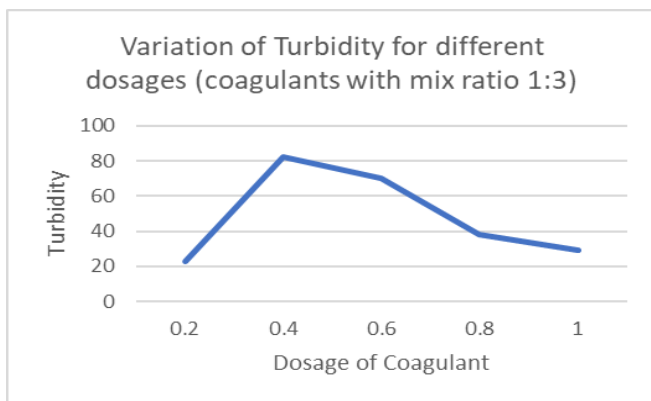
Orange peel and Neem leaf powder in combination with a ratio of 3:1 are added in five doses and the experiment was conducted in the same manner as stated above. The turbidity was reduced from 194NTU to 25NTU with 87% removal efficiency. The dosage of coagulants and the corresponding values of turbidity and pH as given below.

**4.3 EXPERIMENTAL RUNS FOR COAGULATION STUDIES WITH NEEM LEAF AND ORANGE PEEL POWDER WITH 1:3 RATIO.**

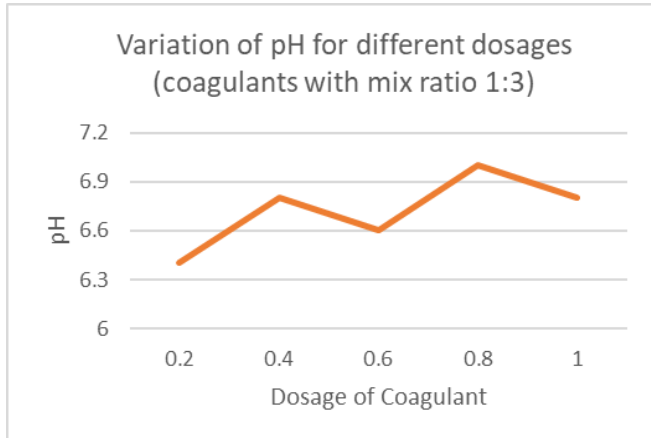
The experiment was conducted in the same manner as stated above with a 1:3 ratio. The turbidity is reduced from 194NTU to 23NTU with 88% removal efficiency. The dosage of coagulants and the corresponding values of turbidity and pH as given in the table below.

**Table.3** Characteristics of dairy waste treated with neem leaf and orange peel powder with the ratio of 1:3

Dosage (g)	0.2	0.4	0.6	0.8	1
Turbidity (NTU)	23	82	70	38	29
pH	6	6.8	6.6	7	6.8



**Chart.5** Variation of Turbidity.



**Chart.6** Variation of pH.

## 5. CONCLUSION

Dairy is one of the biggest industries in India and needs a large amount of water for various purposes. The wastewater discharge from a dairy is equally large in volume with high pollution characteristics. The present study was carried to determine the efficiency of natural coagulants in combination (neem leaf powder and orange peel powder) for treating dairy wastewater with different ratios and dosages. The turbidity has reduced from 194(NTU) to about 26(NTU), 25(NTU), 23(NTU) with ratios 1:1, 3:1, and 1:3. The pH of the

raw dairy wastewater was 8 with alkaline nature on using coagulants has reduced to 7.2 for 1:1, 6.1 for 3:1, and 6.4 for 1:3 ratios. Hence the study reveals that the coagulants with combination have given satisfactory results with 86% (1:1), 87% (3:1), and 88% (1:3).

## 6. REFERENCES

1. Anju S and K.Mophin-Kani 2016. Exploring the use of orange peel and neem leaf powder as the alternative coagulant in the treatment of dairy wastewater, IJSER.
2. Ndabigengesere, K. and Subba Narasinh, 1998. Quality of water treated by coagulation using Moringa oleifera seeds. *Water Research*. 32 (3) : 781-791.
3. Ndabigengesere, A. and Narasiah K.S. 1996. Influence of operating parameter on turbidity removal by coagulation with Moringa oleifera seeds. *Environmental Tech*. 17: 1103 -1112.
4. Ndabigengesere, K. Subba Narasinh 1995. Active agents and mechanism of coagulation of turbid waters using Moringa Oleifera. *Water Research*. 29 (2): 703 -710.
5. Khurody, D.N. 1972. Disposal of wash from large dairies. *Indian Journal of Environmental Health*. 14 (3):259 -265.
6. Kawamura, S. 1991. Effectiveness of Natural Polyelectrolyte in water treatment. *J. Am. Wat. Wks. Association*. 83:88 - 91.
7. Li Guibai, John Gregory 1991. Flocculation and sedimentation of high turbid waters. *Water Research*. 25 (9):1137-1143.
8. Metcalf and Eddy, 2004. *Wastewater Engineering - Treatment Disposal and Reuse* McGraw Hill, Fourth Edition.
9. Muyibi A, and Evison L.M. 1996. Coagulation of turbid water and softening hard water with Moringa oleifera seeds. *Int. J. Environmental Studies*. 49:247-259.
10. American Public Health Association, American Water Works Association, and Water Pollution Control Federation (WPCF) (1989). *Standard Methods for the examination of Water and Wastewater*, 17th Ed., APHA Pub.Office, Washington D.C.
11. Alagarswamy, S.R., Gandhirajan M., Govindraj, 1981. Treatment of Dairy wastes- A case study. *Indian Journal of Environmental Health*. 23 (2): 107-17.
12. Azaharia Samia Al Jahn 1998. Using Moringa seeds as the coagulant in developing countries. *Journal of American Water Works Association*. pp 43 - 50.