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# COMPARATIVE STUDY ON REMOVAL OF TURBIDITY FROM WASTEWATER USING CHEMICAL AND NATURAL COAGULANTS

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***Abstract*- Water is the most vital parameter among the natural resources. Turbidity Imparts enormous problem in wastewater treatment. In this present study, an attempt has been made to evaluate the comparative effectiveness of chemical coagulant Alum with Natural Coagulant such as *Moringa Oleifera, Cicer Arietinum and Tamarind seed*, for reduction of Turbidity in Tannery effluent. Coagulation–flocculation is one of the most important physicochemical treatment method to reduce the Suspended and Colloidal particles in Tannery Wastewater. The tests were carried out using the Conventional Jar Test Apparatus. The Maximum Turbidity Reduction of *Alum, Moringa Oleifera, Cicer Arietinum and Tamarind seed* were found as 91.3%, 88.7%, 84.3% and 80% with Optimum Dosage of 0.6, 0.6, 0.15 and 0.2gm/ml, with Optimum pH value of 6, 7, 8. It was found that Natural coagulant *Moringa oleifera* shows better treatment with Tannery wastewater. The Chromium and TDS was analysed in treated sample of Coagulants and maximum TDS and Chromium removal was obtained 7233mg/l and 0.05mg/l in *Moringa oleifera.* The Utilisation of locally available natural coagulant was found to be suitable, easier, cost effective and environment friendly for water treatment.**

***Keywords*- Coagulation, Turbidity, Chemical and Natural Coagulants, Tannery wastewater.**

## I. INTRODUCTION

Turbidity in wastewater is caused by suspended matter, such as clay, silt, finely divided organic and inorganic matter, soluble colored organic compounds, and plankton and other microscopic organisms. Turbid water has muddy or cloudy appearance and it is aesthetically unattractive. The turbidity increases as sewage becomes stronger.

Coagulants neutralise the repulsive electric charge(negative) surrounding particles allowing them to "stick together" creating flocs. Flocculants facilitate the sticking of the coagulated particles to form larger floccules and their by fasten gravitational settling. Coagulation is the destabilisation of colloids by neutralizing the forces that keep them apart. Cationic coagulants provide positive electric charges to reduce the negative charge of the colloids. As a result, the particles colloide to form larger particles (flocks). Rapid mixing is required to disperse the coagulants thorough the liquid.

The enormous use of water in tannery industries has caused a serious problem of drainage of industries has caused a serious problem of drainage of industrial wastewater .Heavy metals are groups of pollutants which are non biodegradable and tend to accumulate in living organisms. Tannery wastewater with high concentration of dissolved solids, suspended solids, chlorides, color, chromium etc., were being discharged every day in the receiving water. Coagulation and flocculation processes are intended to form particles large enough to be separated and removed by subsequent sedimentation, or alternative clarification processes. The natural coagulants that are locally available have bright future and are concerned by many researchers because of their abundant source, low price, environment friendly, multifunction, and biodegradable nature in water purification

## II. METHODOLOGY

### *A. Preparation of Natural coagulants*

The seed pods Of Moringa Oleifera, Cicer Arietinum and Tamarind Seed are collected, and dried naturally by sunlight. And remove the seeds from the hulls manually. The dried seeds were ground to fine powder by domestic blender. This powder was sieved through 600µm sieve.

### *B. Coagulation - Flocculation process*

Jar test is the most widely used experimental methods for coagulation-flocculation. A conventional jar test apparatus was used in the experiments to coagulate sample of turbid water using natural coagulant. It was carried out as a batch test, accommodating a series of six beakers together with six-spindle steel paddles. Before operating the jar test, the sample was mixed homogenously.

**Procedure of Coagulation Process:**

- Take 500ml of sample in each of the 6 beakers.
- Add varying doses of coagulants( natural and chemical) of 0.05 to 5 mg/l in different beakers simultaneously.
- Switch on the motor and adjust the speed of paddles to about 100rpm and rapid mixing is done for 1-2 minutes.
- Reduce the speed of paddles to about 30 to 40 rpm and continue slow mixing for 20 minutes. This corresponds to process of flocculation.
- Switch off the motors and allow it to settle for 20-60 minutes . This corresponds to sedimentation or settling of impurities.
- Collect the supernant from each beaker with the help of pipette, without disturbing the sediment and measure the percentage of turbidity removal using Turbidity meter.
- Turbidity removal corresponding to various doses of natural coagulant measured and the least dose producing maximum removal was designated as optimum coagulant dose.
- Optimum system pH was found by adding optimum coagulant dose and the pH of the sample was varied from 5 to 9 and the pH value producing maximum turbidity removal (optimum pH) was determined.

## III. RESULTS AND DISCUSSION

### 1. INITIAL PARAMETER OF TANNERY WASTEWATER

In this chapter, we can discuss about the physico chemical analysis test values for the tannery waste water. The analysis of tannery waste water was done by APHA (1995) standards methods for the examination of water and waste water, 19th edition.

Table. 1 Physico-Chemical parameter of Tannery wastewater.

| S.NO | PARAMETER | INITAL VALUES |
|---|---|---|
| 1 | pH | 8.7 |
| 2 | TDS | 12,200 mg/l |
| 3 | ELECTRICAL CONDUCTIVITY | 19,000 ms/cm$^2$ |
| 4 | ODOUR | Objectionable |
| 5 | COLOR | Brownish |
| 6 | TURBIDITY | 390NTU |
| 7 | TOTAL HARDNESS | 1530mg/l |
| 8 | CHLORIDES | |
| 9 | DO | 18mg/l |
| 10 | BOD | 300mg/l |
| 11 | CHROMIUM | 0.07mg/l |

### 2. CHEMICAL COAGULANT

*Alum [$Al_2(SO_4)3.18H_2O$]*

From the Table 4.2 the volume of sample 500ml is taken at different alum dosage 0.2, 0.4, 0.6, 0.8, 1gm/ml, the percentage of turbidity removal was found to be increase while increasing the dosage level,the maximum amount of removal percentage obtained was 91.7% at o.6gm/ml.

Table. 2 Turbidity of sample using Alum

| S.NO | Volume of sample (ml) | Dosage (gm/ml) | Turbidity Reading NTU | | Removal of Turbidity (%) |
|---|---|---|---|---|---|
| | | | Initial | Final | |
| 1 | 500 | 0.2 | 390 | 48 | 87.6 |
| 2 | 500 | 0.4 | 390 | 36 | 90.7 |
| 3 | 500 | 0.6 | 390 | 32 | 91.7 |
| 4 | 500 | 0.8 | 390 | 36 | 90.7 |
| 5 | 500 | 1 | 390 | 40 | 89.7 |

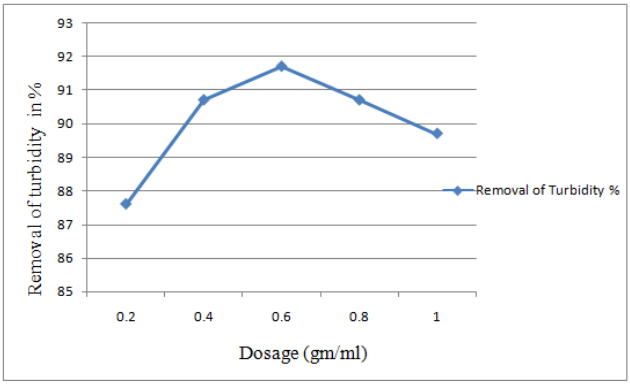


Fig. 1 Alum dosage Vs Removal of Turbidity

*Determination of optimum pH*

The optimum pH was determined at a pH of 6 and the turbidity removal was 88.3% as shown in table 4.3. It was found that the percentage of turbidity removal was gradually increased from pH 5 to 9 and the % of turbidity removal was gradually declined as shown in figure 4.2 .

Table. 3 Removal of turbidity in percentage with optimum dosage (Alum)

| S.No | Dosage (gm/ml) | pH | Turbidity reading (NTU) | | Removal of Turbidity (%) |
|---|---|---|---|---|---|
| | | | inital | final | |
| 1 | 0.6 | 5 | 390 | 52 | 86.6 |
| 2 | 0.6 | 6 | 390 | 32.3 | 91.3 |
| 3 | 0.6 | 7 | 390 | 49 | 87.4 |
| 4 | 0.6 | 8 | 390 | 56 | 85.6 |
| 5 | 0.6 | 9 | 390 | 67 | 82.8 |

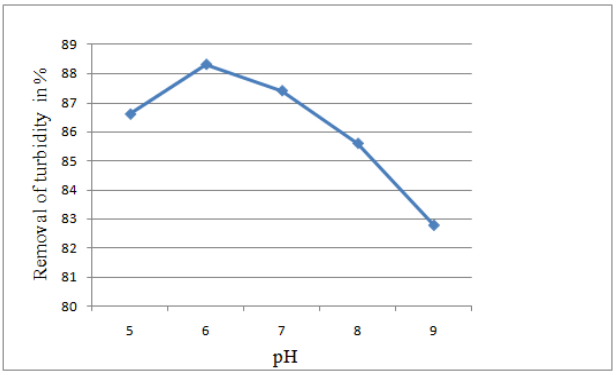


Fig. 2 pH Vs Removal of turbidity (%)

### 3. NATURAL COAGULANTS

*Moringa olifera*

From the Table 4.4 the volume of sample 500ml taken at different dosage 0.2, 0.4, 0.6, 0.8, 1mg/l using Moringa olifera, the percentage of turbidity removal was found to be increase while increasing the dosage level, the maximum amount of removal percentage obtained was 84.5% at 0.4gm/ml.

Table. 4 Turbidity of sample using Moringa olifera

| S.No | Volume of sample (ml) | Dosage (gm/ml) | Turbidity reading ( NTU) | | Turbidity Removal % |
|---|---|---|---|---|---|
| | | | Inital | Final | |
| 1 | 500 | 0.2 | 390 | 52 | 83.2% |
| 2 | 500 | 0.4 | 390 | 48 | 84.5% |
| 3 | 500 | 0.6 | 390 | 44 | 83.5% |
| 4 | 500 | 0.8 | 390 | 56 | 82.0% |
| 5 | 500 | 1 | 390 | 72 | 78.0% |

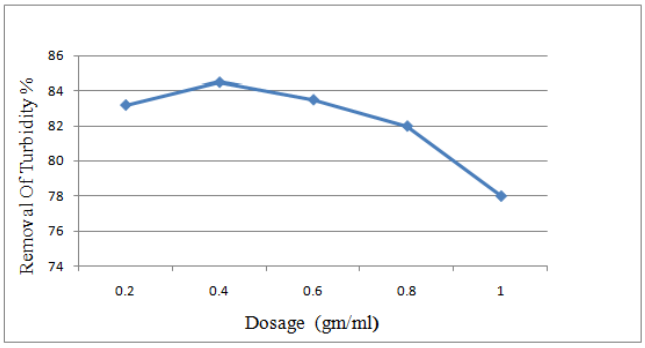


Fig. 3 Moringa Olifera dosage Vs Removal of Turbidity (%)

*Determination of optimum pH*

The optimum pH was determined at a pH of 6 and the turbidity removal was 88.3% as shown in table 4.3. It was found that the percentage of turbidity removal was gradually increased from pH 5 to 9 and the % of turbidity removal was gradually declined as shown in figure 4.3 .

Table. 5 Removal of turbidity in percentage with optimum dosage (M.O)

| S.No | Dosage(gm/ml) | pH | Turbidity reading ( NTU) | | Removal of Turbidity (%) |
|---|---|---|---|---|---|
| | | | Initial | final | |
| 1 | 0.6 | 5 | 390 | 92 | 76.4 |
| 2 | 0.6 | 6 | 390 | 44 | 88.7 |
| 3 | 0.6 | 7 | 390 | 52 | 86.6 |
| 4 | 0.6 | 8 | 390 | 48 | 87.6 |
| 5 | 0.6 | 9 | 390 | 76 | 79.4 |

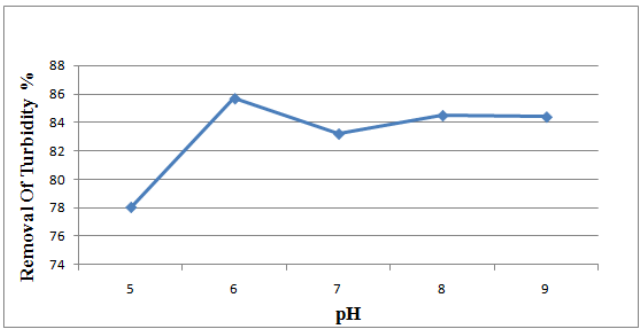


Fig. 4 pH Vs Removal of turbidity (%)

*Cicer areitinum (bengal gram)*

From the Table 4.6 the volume of sample 500ml taken at different dosage 0.05, 0.1, 0.15, 0.2, 0.25gm/ml using Cicer Areitinum as natural coagulant in jar test apparatus, the maximum amount of removal percentage obtained was 83.0% at 0.15gm/ml.

Table. 6 Turbidity of sample using Cicer Areitinums

| S.No | Volume of sample (ml) | Dosage (gm/ml) | Turbidity reading ( NTU) | | Removal of turbidity (%) |
|---|---|---|---|---|---|
| | | | Initial | final | |
| 1 | 500 | 0.05 | 390 | 93.6 | 76.0% |
| 2 | 500 | 0.1 | 390 | 84.6 | 78.3% |
| 3 | 500 | 0.15 | 390 | 66.3 | 83.0% |
| 4 | 500 | 0.2 | 390 | 74.88 | 80.8% |
| 5 | 500 | 0.25 | 390 | 109.2 | 72.0% |

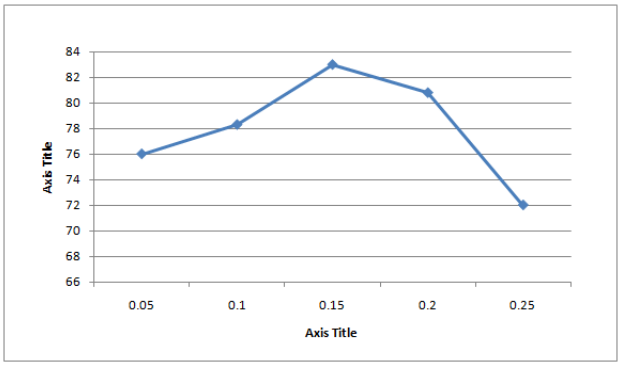


Fig. 5 Cicer Areitinum dosage Vs Removal of Turbidity (%)

*Determination of optimum pH*

The optimum pH was determined at a pH of 7 and the turbidity removal was 84.3% as shown in Table 4.7. It was found that the percentage of turbidity removal was gradually increased from pH 5 to 9 and the % of turbidity removal was gradually declined as shown in figure 4.6 .

Table. 7 Removal of turbidity in percentage with optimum dosage (C.A)

| S.No | Dosage(gm/ml) | pH | Turbidity reading ( NTU) | | Removal of Turbidity (%) |
|---|---|---|---|---|---|
| | | | inital | final | |
| 1 | 0.15 | 5 | 390 | 101.4 | 74.0% |
| 2 | 0.15 | 6 | 390 | 81.9 | 79.0% |
| 3 | 0.15 | 7 | 390 | 61.2 | 84.3% |
| 4 | 0.15 | 8 | 390 | 78 | 80.0% |
| 5 | 0.15 | 9 | 390 | 84.2 | 78.4% |

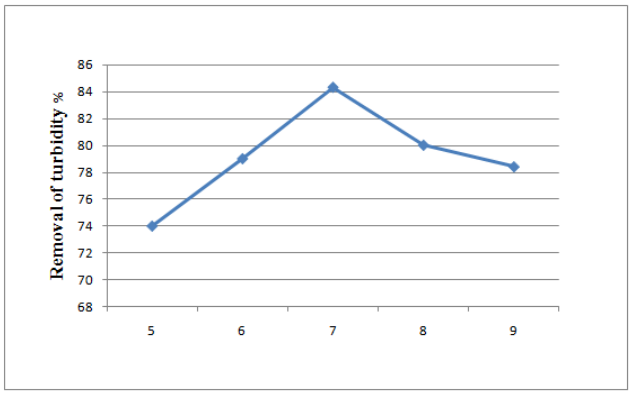


Fig. 6 pH Vs Removal of turbidity (%)

*Tamarind seed*

From the Table 4.8 the volume of sample 500ml taken at different dosage 0.1, 0.15, 0.2, 0.25,0.3gm/ml using Tamarind seed as natural coagulant, the maximum amount of removal percentage obtained was 80% at 0.2gm/ml.

Table. 8 Turbidity of sample using Tamarind Seed

| S.No | Volume of sample (ml) | Dosage (gm/ml) | Turbidity reading ( NTU) | | Removal of turbidity ( %) |
|---|---|---|---|---|---|
| | | | Inital | Final | |
| 1 | 500 | 0.1 | 390 | 109 | 72.0 |
| 2 | 500 | 0.15 | 390 | 100 | 74.3 |
| 3 | 500 | 0.2 | 390 | 78 | 80.0 |
| 4 | 500 | 0.25 | 390 | 96.3 | 75.3 |
| 5 | 500 | 0.3 | 390 | 113 | 71.0 |

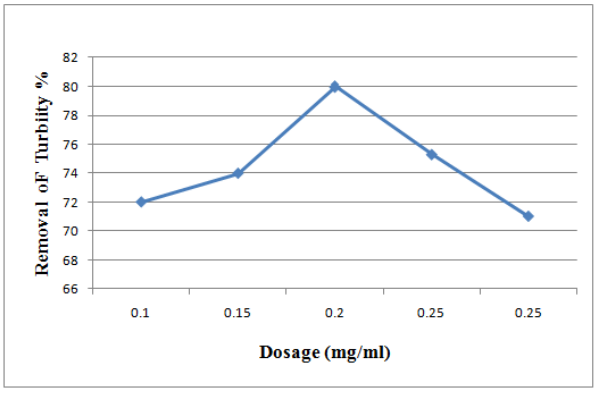


Fig. 7 Cicer Areitinum dosage Vs Removal of Turbidity (%)

*Determination of optimum pH*

The optimum pH was determined at a pH of 8 and the turbidity removal was 80.0% as shown in Table 4.9. It was found that the percentage of turbidity removal was gradually increased from pH 5 to 9 and the % of turbidity removal was gradually declined as shown in figure 4.8 .

Table. 9 Removal of turbidity in percentage with optimum dosage (T.S)

| S.No | Dosage (mg/ml) | pH | Turbidity reading ( NTU) | | Removal of Turbidity (%) |
|---|---|---|---|---|---|
| | | | inital | Final | |
| 1 | 0.2 | 5 | 390 | 128.7 | 67.0% |
| 2 | 0.2 | 6 | 390 | 97.5 | 75.0% |
| 3 | 0.2 | 7 | 390 | 88.5 | 77.3% |
| 4 | 0.2 | 8 | 390 | 78 | 80.0% |
| 5 | 0.2 | 9 | 390 | 119.3 | 69.4% |

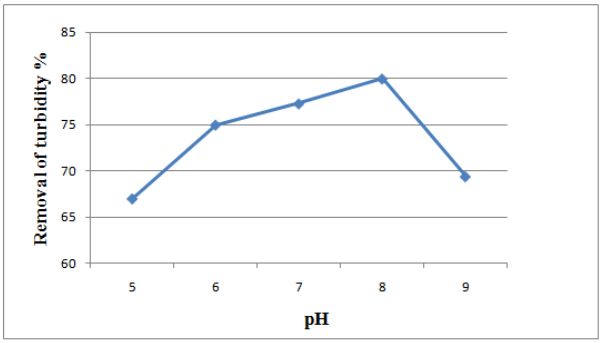


Fig. 8 pH Vs Removal of turbidity (%)

## 4.4 COMPARATIVE ANALYSIS OF COAGULANTS

Table. 10 Comparison of four different coagulants

| Coagulants | TDS | | Chromium | | Turbidity removal in % |
|---|---|---|---|---|---|
| | Initial | Final | Inital | Final | |
| Alumn | 12,200 | 7680 | 0.12 | 0.03 | 89.6 |
| Moring oliefera | 12,200 | 7233 | 0.12 | 0.05 | 84.5 |
| Cicer areitinum | 12,200 | 8500 | 0.12 | 0.04 | 83.3 |
| Tamarind seed | 12,200 | 9000 | 0.12 | 0.08 | 80 |

## V CONCLUSION

The following conclusions were drawn from the present studies on the removal of Turbidity of the natural coagulant. From the study, it clearly shows that the chemical coagulant (Alum) dosage the removal of turbidity was 91.3% at a optimum dose of o.6gm/ml with optimum pH of 6.

From the study, it clearly shows that the natural coagulant (Moringa Oliefera-Drumstick Seed) dosage the removal of turbidity was 88.7% at a optimum dose of o.6gm/ml with optimum pH of 6. The natural coagulant (Cicer Areitinum-Bengal Gram) dosage the removal of turbidity was 84.3% at a optimum dose of o.15gm/ml with optimum pH of 7. And the natural coagulant (Tamarind Seed) dosage the removal of turbidity was 80% at a optimum dose of o.6gm/ml with optimum pH of 8.

## REFERENCES

[1] APHA (1995) standards methods for the examination of water and waste water, American public Health Association, American water works Association and water pollution control Federation, 19th end, Washington, D.C

[2] Kawamura (2009), "Effectiveness of natural polyelectrolytes in water treatment," Journal of the *American Water Works Association*, , vol. 83, no. 10, pp. 88–91.

[3] 3. Ghebremichael, K.A. (2004)."Moringa oleifera seed and pumice as natural alternative materials for drinking water treatment, PhD, KTH land and water resources engineering" *American Water Works Association* .

[4] Sharma, P., Kumari, P., Srivastava, M.M. and Srivastava, S. (2006). "Removal of cadmium aqueous system by shelled Moringa oleifera" lam. Seed powder. *Bioresource Technology*. 97 (2): 299–305.

[5] G.Vijayaraghavan, T. Sivakumar, A. Vimal Kumar (2011)"Application of plant based coagulants for Waste water treatment", *International Journal of Advanced Engineering Research and Studies* Vol. I/ Issue I/October-December, 2011/88-92.

[6] Md. Asrafuzzaman, A.N. M. Fakhruddin, and Md. Alamgir Hossain (2011) "Reduction of Turbidity of Water Using Locally Available Natural Coagulants" *ISRN Microbiology Volume* , Article ID 632189,2011.

[7] Veeramalini , Sravanakumar. K and Joshua Amarnath.D (2012)"Removal of reactive yellow dye from aqueous solutions by using natural coagulant (moringa oleifera*)".International Journal of Science, Environment and Technology*, Vol. 1, No 2, 56 - 62, 2012.

[8] Tasneem banu Kazi, Arjun Virupakshi (2013) "Treatment of Tannery Wastewater Using Natural Coagulants", *International Journal of Innovative Research in Science, Engineering and Technology*, Vol. 2, Issue 8, pp: 43-47. 32

[9] Binayke Renuka A., Jadhav M.V (2013) "Application of natural coagulants in water purification",International Journal of Advanced Technology in Civil Engineering , 2(1).

[10] Hussain Sayyed , Mane Vinod, Pradhan Vidya and Farooqui, Mazahar (2012),"Efficiency of seeds of Moringa Oleifera in estimation of water turbidity", *International Journal of Research in Pharmaceutical and Biomedical Sciences* 3(3), 1334-1337.

[11] Tripathi P .N., Chaudhari M., Bokil S.D (2011) "Nirmali seed a naturally occurring coagulant", *Indian Journal of Environ Health*,,18,272–81.

[12] Jahn, S. A. (2009) " Using Moringa oleifera seeds as coagulant in developing countries". *Journal of the American Water Works Association*.96: 43-50.

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