A Comparative Study on Various Parts of Indian Musa Species As Natural Plant Based Coagulant

S Srinivasan [1], Mrs. Poornima[2]
[1]Dept of Environmental Engineering
[2]Assistant professor
[1, 2] Excel College of Engineering, Salem, Tamilnadu

Abstract- *Coagulation is an effective, simple and widely practiced water treatment process. The usage of chemical coagulant poses detrimental effect on living organism and human health and produces large amount of toxic sludge. In this study the utilization of various parts of banana plant as a natural coagulant for the treatment of household wastewater is made. The natural coagulant made from banana plant is prepared using simple extraction method. Kitchen wastewater is been studied to imitate the medium strength of household wastewater. The treatment of kitchen wastewater using banana coagulants is found to be the most effective in removing turbidity of the kitchen wastewater with good removal efficiency under optimum condition. The project work is carried out in Jar Test Apparatus as to find the efficiency of clog thus formed by the addition of various parts of plant-based coagulants. The turbidity of wastewater is reduced when the dosage of natural coagulant increases thus the changes in the characteristics of the domestic wastewater after treatment is identified from the obtained results. The results reveal that the banana peel powder has the higher removal efficiency of turbidity about 88.51%and 80.06% of COD where banana stem juice has good potential to remove TSS of about 84.17% and TDS of about 77.43% from the domestic wastewater.*

I. INTRODUCTION

1.1 GENERAL

In wastewater treatment, coagulation has been practiced since earliest times and the main objective is to remove colloidal impurities hence also removing turbidity from the water. Coagulant is added to the water to withdraw the forces that stabilizes the colloidal particles and causing the particles to suspend in the water. Once the coagulant is introduced in the water, the individual colloids must aggregate and grow bigger so that the impurities can be settled down at the bottom of the beaker and separated from the water suspension. Aluminium and iron coagulants are commonly used in most of the industries. However, when aluminium is used as a coagulant in wastewater treatment it causes bad effects on human health such as intestinal constipation, loss of memory, convulsions, abdominal colic, loss of energy and learning difficulties.

1.2 PLANT BASED COAGULANT

Nowadays, there has been great attention in the improvement and implementation of natural coagulants in wastewater treatment. These natural coagulants can be formed or extracted from animal, microorganisms and also plant based natural coagulants are mostly either polysaccharides or proteins.

(a) Double layer compression
(b) Sweep flocculation
(c) Adsorption and charge neutralization
(d) Adsorption and inter particle bridging

1.3 BANANA AS PLANT BASED COAGULANT

Banana is an herbaceous plant of the genus Musa paradisiaca sapientum of the family Musaceae. Banana is one of the most widely grown tropical fruits because of its high food value and an important addition to the diet. The stem from which the fruit bunches have been taken should be cut off and the stem will be left abundantly in the plantation and normally will just rot or be used as fertilizer.

II. LITERATURE REVIEW

2.1 LITERATURESURVEY ON VARIOUS PLANT BASEDCOAGULANTS

Ali GH et al (2008) studied the efficiency of environment friendly plant seeds extract as a coagulant agent for removing pollutants. Optimum dose of different water extract of Moringa Oleifera, Mangiferaindica and Prunusarmeniaca were used as a coagulant in a semi pilot system. The system was followed by roughing filter and sand filter and operated at two flow rates were 0.15l/sec and 0.1l/sec. Optimum dose of Mangiferaindica seeds extract revealed a pronounced efficiency for removing bacteria and algae from water but it gives a greenish colour for the produced water. Both

Moringaoleifera and Prunusarmeniaca water seeds extract have high efficiency in removing total algae count more than bacterial indicators.

Nur Fathinatul Akmalbinti Saharudin et al (2014) stated that assessing the possibility of using natural coagulants as an alternative to the current commercial synthetic coagulant such as aluminium sulphate and to optimize the parameters related in the working condition of coagulation process. Thenatural coagulant efficiency which can remove up to 99.1% of turbidity in synthetic wastewater is comparable to the synthetic coagulant.

Muruganandam L et al (2017) studied that the raw tannery effluent was bluishblack in colour, mildly basic in nature, with high COD and turbidity is diluted and dosed with organic coagulants Moringa Oleifera of 15 mg/L dose at 6 pH gave the best reduction efficiencies for major physicochemical parameters followed by Aloe Vera and Cactus under identical conditions. The study revealed that the untreated tannery effluents can be treated with environmental confirmative naturally occurring coagulants.

III. MATERIALS AND METHODOLOGY

3.1 GENERAL

The laboratory experiment is carried out to determine the initial characteristic and the final result of the collected wastewater by testing with the prepared plant-based banana coagulants. The utilization of various parts of banana as natural coagulant for the treatment of wastewater is cost effective and is an eco-friendly technique. As sludge treatment and handling costs are lowered, thus making it a more sustainable option.

3.2 COLLECTION OF WASTEWATER

The wastewater used for the treatment is collected from own household kitchen sink during peak hour and is stored at optimum temperatureof4°Ctopreventthe humidity and preservative nature. The water is processed and treated as to find the initial and final characteristics by the following references and test procedures.

3.3 MATERIALS AND CHEMICALS

Materials used for the study are beakers, conical flasks, measuring jars, stirrers, burette and pipette. The chemicals used are concentrated sulphuric acid (Conc. H2SO4), mercuric sulphate, ferrous ammonium sulphate (FAS), ferroin indicator, sodium persulfate, anthrone reagent and methyl orange indicator.

3.4 CLEANING OF GLASSWARE

To avoid unforeseen errors in the experiments due to process of chemicals and other foreign matters in the glassware such as beakers, Erylen Meyer's flasks, burettes and pipettes used for experiments were first cleaned with detergent and then soaked in chromic acid cleaning mixture by adding 1000 mL concentrated sulphuric acid with35 mL of saturated sodium dichromate solution.

3.5METHODOLOGY

The schematic representation of methodology of the work as carried in the treatment of domestic waste water using natural plant-based coagulant.

3.6 DETERMINATION OF INITIAL WASTEWATER CHARACTERISTICS

Suspended Solid (TSS) is carried out by analytical analysis.

3.6.1 DETERMINATION OF PH

CALIBRATION OF INSTRUMENT:

In a 100 ml beaker pH 9buffer solution is taken then the electrode is dipped in the beaker and the pH is checked. If the instrument is not reading pH value 9, using the calibration knob the reading is adjusted to 9.0 and the electrode is taken out which is washed with the distilled water.

TESTING OF SAMPLE:

In a clean dry 100 ml beaker wastewater sample is taken. Place the electrode in the sample and check for reading in the pH meter. Wait until to get a stable reading. Now pH of the wastewater sample is noted. The pH meter as used to determine the pH of wastewater.

3.6.2 DETERMINATION OF CHEMICAL OXYGEN DEMAND (COD)

Determination of Chemical Oxygen Demand is identified by taking 0.1 ml of sample mixed with 9.9 ml of distilled water in a 250 ml refluxing flask to which a pinch of mercury sulphate is added. 15ml of sulphuric acid is added slowly, followed by 5 ml of 0.25 M Potassium dichromate solution. The mixture is refluxed for two hours. Then the sample is diluted to twice its volume with distilled water and

titrated with Ferrous Ammonium Sulphate (FAS) solution using ferroin indicator. The end point is the appearance of a pink colour. Calculation is done by using the formula (3.1)

3.6.3 DETERMINATION OF SOLUBLE CHEMICAL OXYGEN DEMAND (SCOD)

In an Eppendorf tube, 1.5 ml of sample was taken and centrifuged at 1500 rpm for 10 minutes. Then 1 ml supernatant of centrifuged sample was taken and made up to 10 ml in reflux flask to which a pinch of mercury sulphate is added, 15 ml of sulphuric acid is added slowly, followed by 7 ml of 0.25N potassium solution. The mixture was refluxed for 2 hours. After cooling, the mixture was diluted to twice its volume with distilled water and titrated against 0.25N ferrous ammonium sulphate using ferroin indicator. The appearance of reddish-brown colour is taken as the end point. Calculations are done by using the equation.

3.6.4 DETERMINATION OF INITIAL TURBIDITY

Turbidity is used to measure the optical characteristics of the wastewater which is measured by the amount of light is transmitted through the wastewater sample. Turbidity of the sample was measured using portable spectrophotometer. The principle of the turbidity measurement is based on a comparison of the intensity of light scattered by the sample. The sample cell was placed and the turbidity value is observed in NTU unit.

IV. RESULT

COAGULATION USING BANANA FLOWER POWDER

The reduction in turbidity while using natural plant based coagulant banana flower powder(BFP)which is extracted using NaCl and when the supernatant is added in the sample wastewater is shown in the figure 4.2. The turbidity removal efficiency under addition of natural plant banana flower powder as coagulant is shown in table 4.3.As the increasing the coagulant dosage decreases the final turbidity value of the wastewater.

Table 4.3 Turbidity removal using banana flower powder as coagulant

Coagulant Dosage(mL)	Turbidity(mg/L)	Removal efficiency (%)
2	77.63mg/L	61.76%
4	55.34mg/L	72.74%
6	42.57mg/L	79.03%
8	33.33mg/L	83.58%

The turbidity value decreases from the initial characteristics of wastewater turbidity value of 203mg/L to 77.63 mg/L at 2mL, 55.34 mg/L at 4mL, 42.57mg/L at 6mL and 33.33mg/L at 8mL coagulant dosages. The highest turbidity removal efficiency of 83.58% is achieved while using 8mL coagulant dosage of banana flower powder and a large reduction in turbidity occurs when the coagulant dosage increases.

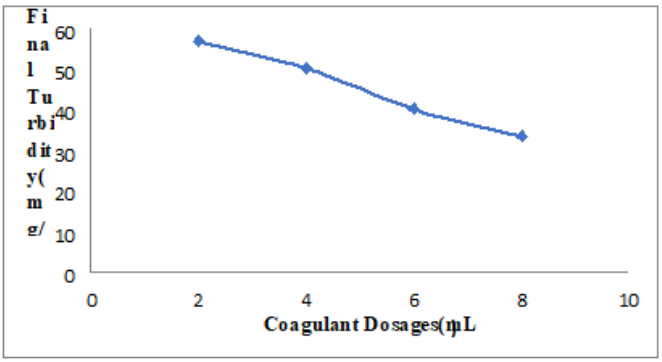

Figure 4.2 Effects of Banana flower powder in turbidity

V. CONCLUSION

From the experimental results, it is concluded that using banana as plantbased coagulant gives tremendous potential result as a natural plant-based coagulant in the treatment of wastewater. The turbidity, TSS, TDS and COD removal percentage after treatment using various parts of banana plant were 88.51%, 84.17%, 77.43% and 80.06% by optimizing coagulant dosage at pH 7 which reveals that the banana peel powder has better turbidity and COD removal, the better reduction in TSS and TDS values were obtained while using banana stem juice as coagulant. It is identified that increasing the dose of coagulants increases more removal efficiency with satisfactory results and is suggested that using of banana as plant based coagulant other than commercial alum can restrict the expense of treatment in a significant scale.

REFERENCES

[1] Abirami M, Rohini C (2017),'A comparative study on the treatment of turbid water using Moringaoleifera and Alum as coagulants', International conference on emerging trends in engineering, science and sustainable technology,Vol.2,Issue 6,pp.41-48.

[2] Agunwamba J. C., M. I. Aho, M. B. Iorwua and M. T.Tiza, (2016),' Response surface optimizations of treated turbidwater using banana stem juice', International Journal for Innovative Research in Multidisciplinary Fields, Vol.2,Issue8, pp.185-194.
[3] Ahmad, T., & Danish, M. (2018),'Prospects of banana waste utilization in wastewater treatment', Journal of Environmental Management,Vol.206, Issue 10,pp.330-348.
[4] Ali GH, Hegazy BE, Fouad HA, Rehab M (2008),' Comparative study on natural products used for pollutants removal from water', Journal of Applied Science Research, Vol.5, Issue 8, pp.1020–1029.
[5] Amran AH, Zaidi NS, Muda K, Loan LW (2018),'Effectiveness of natural coagulant in coagulation process,',Inernaional Journal of Engineering ndTechnology,Vol. 7,Issue 4,pp.34–37.