International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 03 | Mar 2020 www.irjet.net p-ISSN: 2395-0072

Evaluation of Aluminium Removal Efficiency of Jackfruit Seed Powder and Guava Leaf Powder

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Abstract - *Water is the most essential resource for the existence of life on earth. At the same time waste water generation is increasing day by day. This has led to various techniques for waste water treatment. Natural coagulants are very effective for the treatment of waste water. The present study investigates removal of Aluminium ions from industrial effluent by using jackfruit seed (Artocarpus heterophyllus) and guava leaf (Psidium guajava) powder. The parameters like pH, alkalinity, acidity, turbidity; TSS, TDS, Al ions, etc are tested.*

Key Words: Jackfruit seed (Artocarpus Heterophyllus), Guava leaf (Psidium guajava), pH, Alkalinity, Acidity, Turbidity, TSS, TDS, Aluminium ion

1. INTRODUCTION

Most of the developing countries are facing the problem of water scarcity. The availability of fresh water is limited on earth compare to the demand. To meet the high demand of water, different waste water treatment methods can be adopted. Coagulation is one of the cheapest method of waste water treatment. The most commonly used primary coagulants are salts of aluminium and iron. The usage of alum-based coagulants in drinking water treatment process caused residues in completed drinking water treatment, which eventually supplied to consumers. This cause risk to their health. Furthermore, alum-based coagulants are expensive.
Different industries discharge waste water containing high aluminium concentration. This causes so many problems to the environment and humans. Usage of aluminium based coagulants, also increases the aluminium ion concentration in the waste water.

Aluminium based coagulant such as alum (aluminium sulphate ($Al_2(SO_4)_3$) or polyaluminium chloride (PACl) are commonly used in drinking water treatment to enhance the removal of particulate, collodial and dissolved substances via coagulation processes. The treatment of surface water with aluminium sulphate has been in operation for over a hundred years all over the world. The use of alum as a coagulant for water treatment often leads to higher concentrations of aluminium in the treated water than in the raw water itself (Srinivisan et al. 1999).

Chemical coagulants can be replaced by natural coagulants. Natural coagulants are eco-friendly and cost effective.

Jackfruit (Artocarpus heterophyllus) trees belong to the family Moraceae. They grow abundantly in India, Bangladesh, and in many parts of Southeast Asia (Rahaman and others 1999). It is one the most significant evergreen trees in tropical areas and widely grown in Asia including India. These jackfruit seed are very cost effective in nature.

Guava (Psidium guajava) is a tropical and semitropical plant. The use of natural plants as natural coagulants in clarifying turbidity of water has been a common practice since ancient times. Concerning these practices, the extract of this plant as coagulant is believed to have high potential in drinking water treatment to replace the current conventional coagulants due to its ability in absorb excess water during diarrhea. Moreover, this method seems to be inexpensive, environmental friendly as well as an effective agent in drinking water treatment, especially in removing heavy metal and suspended solids (Yap, 2013).

Anu Sundaresan and Anu N (2016), conducted a study on Feasibility of Natural Coagulant for the Treatment of Dairy Wastewater. In this study using the two seeds an effective removal of turbidity is obtained. Coagulating with jack fruit seed attained 94% removal efficiency, while with the Common Beans seed obtain a highly removal efficiency upto 99%.

1.1 Objectives of the Study

The main objective of the study is to determine the Al removal efficiency of jackfruit seed powder and guava leaf powder. Then comparing the results and identify either jackfruit seed powder or guava leaf powder is more effective as natural a coagulant.

1.2 Scope of the Study

This study is mainly deals with the usage of natural coagulants for aluminium ion removal from waste water. Usage of natural coagulants alone or in combination with other chemical coagulants will reduce the cost of treatment process. By conducting this study the optimum dosage of coagulant is determined.

2. MATERIALS AND METHODS

The effluent was collected from an Aluminium powder coating industry at Thrissur. The samples were collected in sterilized bottles and were preserved in the refrigerator during storage. Initial characterization of waste water like pH, alkalinity, acidity, turbidity; TSS, TDS, Al ions, etc were determined.

Fig -1 : Image of sample

Table -1: Effluent characteristics before treatment

Sl . no	Parameter	Value
1	pH	4.2
2	Total hardness (mg/l)	550
3	BOD(mg/l)	280
4	COD(mg/l)	520
5	TSS(mg/l)	3
6	TDS(mg/l)	6955
7	Turbidity(NTU)	3
8	Aluminium ion(mg/l)	71.67

3.1 Jackfruit Seed Powder Preparation

The jackfruit seed were collected from locality. The collected seeds were thoroughly washed using distilled water and dried for 48 hours in hot air oven. Then the seeds were grained to fine powder. The powder was sieved using 0.45 mm mesh and stored in an airtight container to prevent the entry of moisture into it and to avoid loss of its activity. This fine powder was used as coagulant for this analysis.

Fig -2 : Jackfruit seed powder

3.2 Guava Leaf Powder Preparation

The guava leaves were collected from locality. The collected leaves were thoroughly washed using distilled water and dried for 48 hours in hot air oven. Then the leaves were grained to fine powder. The powder was sieved using 0.45 mm mesh and stored in an airtight container to prevent the entry of moisture into it and to avoid loss of its activity. This fine powder was used as coagulant for this analysis.

Fig -3 : Guava leaf powder

3.3 Experimental Setup

The aluminium ion from the effluent is removed by coagulation process. Coagulation studies were performed to determine the optimum condition and to study the coagulant dosage and contact time. Each coagulant with 0.5g, 1.5g, 2.5g, 3.5g and 4.5 g are mixed with 1000ml of effluent to study its effects. At the end of the desired contact time, the samples were filtered using filter paper and the filtrate was analysed. Characteristics of effluent after and before treating and after treating are also analysed. The parameters include pH, turbidity, hardness, BOD, COD, TSS, TDS, and Al are tested. Al removal efficiency can be determined by the following formula:

Percentage removal of Al ion =

$$\frac{\text{initial Al concentration} - \text{final Al concentration}}{\text{initial Al concentration}} \times 100$$

Fig - 4 : Jar test apparatus

4. RESULTS AND DISCUSSIONS

Jackfruit seed powder is added into the waste water at various concentrations of 0.5, 1.5, 2.5, 3.5, and 4.5 g. As the jackfruit seed powder dosage increases, aluminium removal efficiency also increases up to 3.5 g/l, beyond this limit it reaches the equilibrium. There is no further increment in aluminium removal efficiency. Optimum coagulant dosage is 3.5 g/l. The maximum efficiency obtained is 92%.

Table -2 : Coagulant Dosage V/S Percentage Al Removal Efficiency

Coagulant dosage	Percentage Al removal efficiency of jackfruit seed powder
0.5	62
1.5	74
2.5	91
3.5	92
4.5	92

Guava leaf powder is added into the waste water at various concentrations of 0.5, 1.5, 2.5, 3.5, and 4.5 g. The aluminium removal capacity of guava leaf powder is increases with the dosage of coagulant. The plot is an ascending curve. The optimum coagulant dosage is 4.5 g/l and obtained maximum efficiency is 84%.

Table -3 : Coagulant Dosage V/S Percentage Al Removal Efficiency

Coagulant dosage	Percentage Al removal efficiency of guava leaf powder
0.5	54
1.5	60
2.5	72
3.5	76
4.5	84

This graph shows the alominium removal efficiency of jackfruit seed powder and guava leaf powder. Both the coagulants have high aluminium removal removal efficiency. While jackfruit seed powder is obtain more efficiency than guava leaf powder

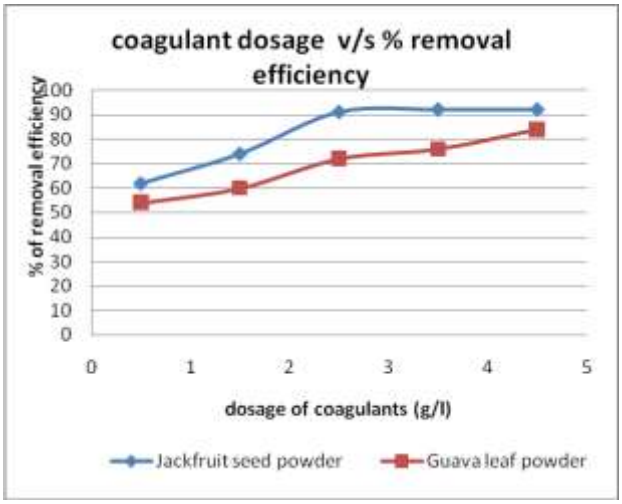

Chart -1 : Coagulant dosage v/s % removal efficiency

Table -4 : Comparison of the Results

Parameters	Jackfruit seed powder	Guava leaf powder
Optimum coagulant dosage	3.5	4.5
Percentage aluminium removal efficiency	92	84

The optimum jackfruit seed powder dosage is 3.5 g/l and the aluminium removal efficiency is 92%.

The optimum dosage of guava leaf powder is obtained as 4.5 mg/l and the aluminium removal efficiency is 84%.

5. CONCLUSIONS

In this study jackfruit seed powder and guava leaf powder are used as coagulants. The optimum dosage for jackfruit seed and guava leaf powder is 3.5 g/ l and 4.5 g/l respectively. The aluminium removal efficiency of jackfruit seed and guava leaf powder were obtained as 92% and 84% respectively. From this comparison it can be concluded that jackfruit seed powder is more efficient than guava leaf powder as a natural coagulant. The usage of natural coagulants in waste water treatment units will help to reduce the cost of the process.

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