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Comparison of Performance of Natural and Chemical Coagulant and Blend of these Coagulant

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Abstract- Natural coagulants have shown their coagulation efficiency as reported in a substantial number of research papers. But still the use and widespread application of natural coagulants in the water industry for water treatment is low. Because the lack of knowledge and availability of time. Health problems caused by chemical coagulant have been in news for several time; various reports have mentioned the direct and indirect toxic effects of metal in the form of tumours, Alzheimer and allergies and mouth burning by the use of alum. Natural coagulants have been increasingly popular in the past few years due to their benefits and the fact that it resolves most of the associated problems when using chemical coagulants. Glycine max and blend of alum with aloe barbadensis and glycine max are used as coagulants in this study in place of regularly used chemical coagulants to reduce the turbidity of synthetically prepared turbid water of 100 NTU. The tests were carried out using jar apparatus to determine the optimum dose of natural coagulant. Different concentration of the stock solution is prepared and mixed in synthetic turbid water in different quantity and we get the efficiency of the glycine max, blend of alum with glycine max and blend of alum with aloe barbadensis were 88.6%, 90.4% and 91.8% respectively. The effect of the natural coagulant on other water quality parameters such as pH, hardness, alkalinity, electrical conductivity etc was also found out. The use of natural coagulants is easily available that's why it is cheap in the local area where test is carried out in India, and environment-friendly approach for waste-water treatment as observed in this study.

Keywords- Natural coagulant; Alum; Glycine max; Coagulation; Aloe barbadensis; Synthetic turbid water.

I. INTRODUCTION

Access to safe drinking water is one of the major global concerns of humankind. In developing countries like India, Africa and other the cost of imported chemical, such as Aluminium sulfate for coagulation and chlorine for disinfection and other chemical for conventional water purification is expensive. Also by use of this coagulant to handle the solid waste generated from this chemical coagulant is expansive. Water is one of our basic human needs and lack of potable water is a major cause of death in the world. Access to safe drinking water is fundamental in ensuring in well being of mankind.

The ability to provide safe source of water has increased dramatically in the last 100-150 years, at least in the developing world. In less developed countries, increasing population, urban migration and environmental strain have increased the necessity for drinking water treatment. Water is essential for human survival. The total amount of water in the world is about 1400 million cubic Km. More than 97% of this is sea water; of the rest 22% is ground water and 77% is ice locked away in the glaciers and the polar ice cap. This leaves less than 1% of the supply of fresh water to take part in the hydrological cycle; about half of this is found in river, lakes and swamps.

But much of the fresh water is highly polluted. In India 90% of the water available is from rivers all of which are considerably polluted. Coagulation and flocculation followed by sedimentation, filtration and disinfection, often by chlorine, is used worldwide in the water treatment industry before the distribution of treated water to consumers.

Aluminium sulfate (Alum) is by far the most widely used coagulants in water and wastewater treatment. However recent studies have pointed out several serious drawbacks of using aluminium sulfate, such as Alzheimer's disease and similar health related problems associated with residual Aluminium in treated waters, besides production of large sludge volumes. There is also the problem of reaction of alum with natural alkalinity present in the water leading to a production of Ph, and low efficiency in coagulation of cold waters.

A significant economic factor is that many developing countries can hardly afford the high costs of imported chemicals for water and wastewater treatment. The term coagulation is used to mean first stage in the formation of precipitate while flocculation consist building up the particles of flocs to a larger size which can be removed by sedimentation. Present study is aimed to test the natural

coagulant that is abundantly available in central India as renewable sources of natural coagulants. These natural coagulants were chosen to examine the quality of the surface water treated by them and to compare them with that of the water treated with alum. Natural coagulant glycine max, cicer arietinim, aloe barbadensis have been used to examine their applicability in surface water treatment.

II. MATERIALS AND METHODS

1. Synthetic Turbid Water Solution:
Clay was used for preparing synthetic turbid water. The clay was weighed and was mixed in 1 L of distilled water using jar apparatus and its turbidity was measured in a nephelo turbidity meter. 10gm of clay was mixed with distilled water to get the desired value of 100NTU turbidity. The solution of clay and distilled water were mixed at a high rpm 150 rpm for 1 minute in jar test apparatus followed by 30 minutes of slow mixing at 30 rpm to obtain a uniform solution of clay and distilled water. After that, it was left to stand for 24 hours.

The suspension is then stirred so as to achieve uniform and homogenous sample and from this turbidity of desired NTU was prepared. The turbidity of the sample was measured by nephelo turbidity meter and expressed in nephelo turbidity unit (NTU). The synthetic turbid water of 100NTU was prepared using 10gm amount of soil in 1L distilled water as shown in Fig 5.

2. Alum Solution:
10gm of alum was added to 1000ml distilled water and stirred by the use of magnetic stir. After completely dissolved in distilled water we get 1%wt solution as shown in Fig 1.

Fig 1. Alum stock Solution

3. Natural Coagulant Solution:

3.1 Glycine max: Well matured and dry seeds of glycine max was obtained from plant from rural area and removed seeds from pods, then seeds was de-husked manually by hand and placed in an oven at 40ºC until they were dry. The dry seeds were then ground into a fine powder using kitchen mixer, the powder was then sieved through a 500µm sieve. 10gm of powder passed from 500µm was measured and added to 1000ml of distilled water forming a suspension, jar apparatus used to stir suspension for 1 hour and then it was left to settle for 30 min after which it was then filtered by using waltman filter to obtain a 1wt% glycine max. For oven dry fig2.

3.2 Aloe barbadensis: After gaining sufficient height upto 40cm we cut it and wash it by using tap water because we use aloe barbadensis in powder form by cut in small pieces and put it on oven for 24 hour in 100º C . Then blend it in kitchen grinder into small pieces and then passed it from 500µm sieve. Take 10 gm of uniform powder and add to the 1000 ml distilled water and sitr for 1 hour and then left to settle for 30 min after which it was then filtered by using filter paper to obtain 1wt% aloe barbadensis . for oven dry fig3.

III. EXPERIMENTAL PROCEDURE

Coagulation activity of each natural coagulant was carried out using jar apparatus. Jar test was employed to determine the coagulation properties of the coagulant solution used in this research. six glass beakers(1100ml) were filled with 1000ml of synthetic turbid water. A rapid mixing period of 2 min at 100 rpm was then followed by a slow mixing period of 30 min at 40 rpm to allow coagulation to occur. Various dose of each natural coagulant were added into the beakers during rapid mixing. The solution was then kept to stand for 30 min, the sample were collected from about 2cm below the surface to get better result because some light weight particles are in suspension which not participate in coagulation. All experiments were run at room temperature 27±2 ºC

Fig 2. Jar Apparatus.

In this study the effect of initial Ph value of turbid water and the dose of coagulant solution for each studied natural coagulant on the coagulation process was investigated. The performance of each coagulant was evaluated by measuring the finished water turbidity, the pH of treated water samples and the required dose to produce maximal turbidity removal. The turbidity reduction in percentage by the difference between initial and residual turbidity of surface water over the initial turbidity, multiplied by 100.

$$\text{Turbidity removal efficiency} = \frac{\text{Initial turbidity} - \text{Final turbidity}}{\text{Initial turbidity}} \times 100$$

Fig 3. GLYCINE MAX for dry.

Fig 4. ALOE BARBADENSIS for dry.

IV. RESULTS AND DISCUSSION

1. Investigation of Optimum Dose of Coagulant:
To determine the optimum conditions for coagulation and flocculation, the dosage of coagulant to be used is one of the important parameters. If the dosage is insufficient or overloaded then the desired results will not be obtained and would result in poor performance of turbidity removal. So, it is crucial to determine the optimum dosage to minimize the coagulant dose cost and to obtain the optimum performance in the treatment of water.

To determine the optimum dosage a set of experiments were performed on synthetic turbid water of 100±2 NTU using jar test apparatus at different dosages of natural coagulants ranging from 10 - 50ml/L prepared from the stock solution of 6gm/L, 10gm/L, and 15gm/L concentration.

Different dosages of coagulants were put in different beakers filled with 1000ml of synthetic turbid water of 100 NTU after this the beakers are placed on jar test apparatus. The solution of turbid water and coagulant is mixed at a high rpm of 150 for 1 minute and then at a lower rpm from 30-35 for 30 minutes. The solution is then allowed to settle for 30 minutes and then their turbidity is measured in a nephelometer. Fig 6 shows treated water after settling for 30 minutes.

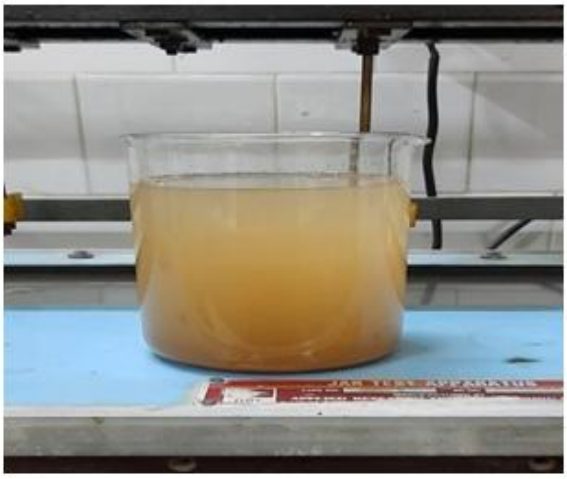

Fig 5. Synthetic turbid water.

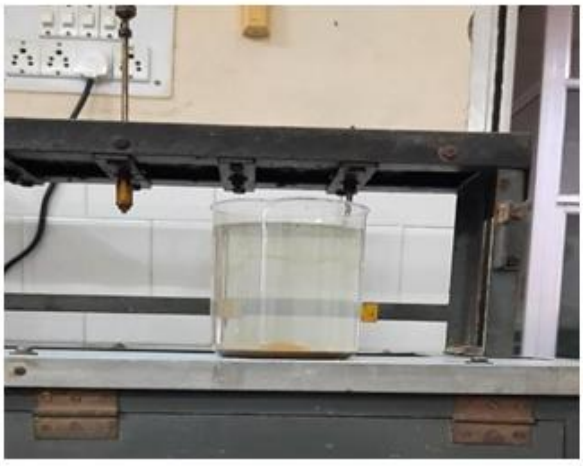

Fig 6. Synthetic turbid water after coagulation.

The test was performed using 6gm/L,10gm/L, and 15gm/L concentration stock solution of glycine max and alum with aloe barbadensis and glycine max as coagulant, and different dosages of these stock solution is then used to find out the optimum dose of the coagulants. The dosage

of coagulant varies from 10- 60 ml. The stock solution of 10 gm/l gave the optimum result with the efficiency of 88.6% when 50ml of the stock solution was mixed with 1 L of synthetic turbid water as shown in Fig 6. Similarly blend of alum with glycine max and aloe barbadensis were mixed in 1:1 in synthetic turbid water and their efficiency were 90.4% and 91.8% respectively.

2. Results of Raw and Treated Water:

Table 1. Values of Synthetic turbid waterbefore coagulation.

Water quality parameters	Measured value
Turbidity	100NTU
pH	7.85
Hardness	220mg/L
Alkalinity	140mg/L
TDS	332mg/L
Temperature	24.7°C

Table 2. Values of Synthetic turbid waterafter coagulation with glycine max.

Water quality parameters	Measured value
Turbidity	11.4NTU
pH	6.5
Hardness	260mg/L
Alkalinity	137mg/L
TDS	298mg/L
Temperature	24.7°C

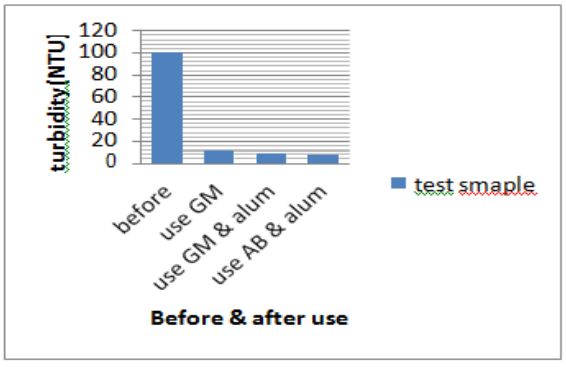

Fig 7. **Text Here Your Fig Title.**

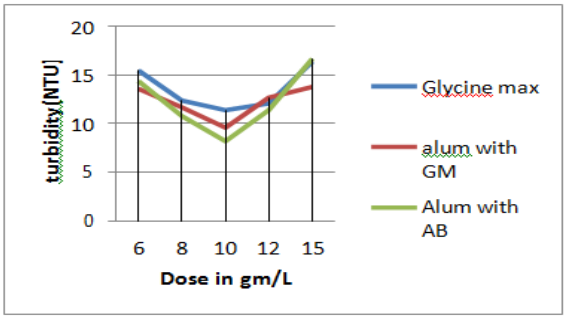

Fig 8. **Text Here Your Fig Title.**

Table 3. Values of Synthetic turbid water after coagulation with a blend of alum andglycine max.

Water quality parameters	Measured value
Turbidity	9.6NTU
pH	6.4
Hardness	190mg/l
Alkalinity	134mg/l
TDS	342mg/l
Temperature	24.5C

Table 4. Values of Synthetic turbid water aftercoagulation with a blend of alum and Aloe barbadensis

Water quality parameters	Measured value
Turbidity	8.2 NTU
pH	6.34
Hardness	252mg/l
Alkalinity	144mg/l
TDS	352mg/l
Temperature	24.5°C

V. CONCLUSION

The study demonstrates that Glycine max and blend of alum with aloe barbadensis and glycine max were efficient in treating turbid water. The maximum turbidity removal efficiency of Glycine max, blend of alum with Glycine max and blend of alum with Aloe barbadensis were 88.6%, 90.4% and 91.8% respectively.

However, more study is required to obtain more information about plant-based natural coagulants as these have a high potential in removing turbidity from water and wastewater.

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