

Using Natural Coagulants for Reduction of Turbidity of Water

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Abstract - One of the problems with treatment of surface water is the large variation in turbidity which is caused by polluted water. Commonly used chemicals for various treatment units are synthetic inorganic and organic. In most cases, these are expensive as they are required in higher dose and do not show cost effectiveness. Many of the chemicals are also associated with environmental and human health problemsic substances. Because of that we are using natural coagulants like cicer aritinum, peanut and sesame seed. Turbidity of water is obtained after treating with the above three natural coagulants with the concentration of coagulant solution as 2 %. From the results obtained it was observed that water treated with sesame seeds obtained comparatively lesser values for turbidity. The value for pH was obtained satisfactorily for water treated with sesame seeds. So sesame was selected as the best natural coagulant from the three coagulants used. Although the result obtained for turbidity after water treatment with 2 % solution was not satisfactory when compared with Alum which used as chemical coagulant. So 3% solution of sesame seeds was prepared and was treated with water. pH and turbidity of the water treated with 3% solutions of sesame seeds were obtained. From the obtained results it was clear that 3% solution of sesame seeds had given the lowest turbidity.

Key Words: Turbidity, Cicer aritinum, Peanut, Sesame seed, Coagulant.

1.INTRODUCTION

Water is undoubtedly the most important element among the natural resources. In developing countries, access to clean and safe water is a crucial issue. Thus water from all sources should have some form of purification before consumption. Various methods are used to make water safe and attractive to the consumer. The method employed depends on the character of the raw water. One of the problems with treatment of surface water is the large seasonal variation in turbidity [1]. Turbidity is caused by particles suspended or dissolved in water that scatter light making the water appear cloudy or murky [2]. Coagulation is the most commonly used method for purifying water. Coagulants can be applied in wastewater to reduce suspended solids and other pollutants. Many synthetic coagulants like aluminum sulphate (alum) and ferric

chloride are widely used in conventional water treatment processes for turbidity removal [3]. However, when aluminum is used as a coagulant in wastewater treatment, it can caused several bad effect on human health such as intestinal constipation, convulsions, abdominal colic's, loss of energy, loss of memory and learning difficulties [4]. Commonly used chemicals for various treatment units are synthetic organic and inorganic substances. In most of the cases, these are expensive since they are required in higher dose and do not shows cost effectiveness. Many of the chemicals are also associated with human health and environmental problems [5]. So, there raised a voice to develop cost-effective, easier, and environmental friendly process of water clarification. The history of the use of natural coagulants is long. Natural organic polymers have been used for more than 2000 years in India, Africa, and China as effective coagulants and coagulant aids at high water turbidities. They may be manufactured from plant seeds, leaves, and roots [6]. These natural coagulants can also be formed or extracted from microorganisms and animal [4]. Natural coagulants 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 [5].

The aims of the present study were to reduce the level of turbidity contaminants from water using locally available natural coagulants, to make the water treatment process easier and environmental friendly for household applications.

2. MATERIALS AND METHODS

All coagulation experiments were carried out using synthetic artificial turbid water. A conventional jar test apparatus was used in the experiments to coagulate sample of synthetic turbid water using coagulants.

2.1. Preparation of Synthetic Water

Synthetic turbid water for the jar tests was prepared by adding clay materials to tap water. About 40 g of the clay materials was added to 1 liter of tap water. The suspension was stirred for about 90 minutes to have a uniform dispersion of clay particles. Then it was allowed to settle for at least 24 hours for hydration of the clay materials. The

supernatant suspension of synthetic turbid water was added to the sample water to achieve the desired turbidity just before coagulation.

2.2 Preparation of peanut, Cicer arietinum and sesame seeds powder

In this study, the sesame, Cicer arietinum and peanut seeds were obtained from local market. Good quality of peanut and sesame seeds were selected.

The peanut seed cover was shelled before extraction. The extraction of the active ingredients was carried out by removing the shell to collect the kernel inside the shell. To ensure the efficiency of peanut seeds extraction, the kernels have been crushed and grinded to medium fine powder by using the domestic blender every time when the preparation of peanut seeds extraction was needed.

Then, for the sesame seeds, the seeds were cleaned and crushed using mortar and pestle. The ground sesame seed obtained was spread in a tray and left at room temperature for about 3 hours. The dried sesame seed powder was used as the coagulant for the treatment of the turbid water.

Powder of Cicer arietinum was bought from local market. The grains of powder were maintained approximate size less than 600 µm to achieve solubilization of active ingredients in the seed. Using grinder, fine powder achieved from seeds.

2.3. Stock Solution of Natural Coagulants

Distilled water was added to the powder to make 2% suspension of it. The suspension was vigorously shaken for 1 hour using a magnetic stirrer to promote water extraction of the coagulant proteins, and this was then passed through filter paper (Whatman no. 42, 125 mm dia.). The filtrate portions were used for required dose of natural coagulants. Fresh solutions were prepared daily and kept refrigerated to prevent any ageing effects (such as change in viscosity, coagulation activity, and pH) [1]. Solutions were shaken before use vigorously.

2.4. Jar Test Operations

Jar test is the most widely used experimental methods for coagulation-flocculation. A conventional jar test apparatus (VELP Scientifica) was used in the experiments to coagulate sample of synthetic turbid water using some coagulants (Figure1). It was carried out as a batch test, using a series of six beakers together with six spindle steel paddles. Before operating the jar test, the sample was mixed well. Then, the samples ought to be measured for turbidity for representing an initial turbidity. Coagulants of varying concentrations were added in the beakers. The whole procedures in the jar test were conducted in different rotating speed.

During the coagulation, a rapid mixing at a rate of 130 rpm was performed for 3 minutes, and the remaining 8 minutes was used for slow mixing at 30 rpm to allow

formation of flocs. After the treatment, the resulting mixture was left for 60 minutes to allow the formed flocs to settle at the bottom of the beakers. The treated water was then separated from the flocs by filtration using #40 grade Whatman filter paper. After the filtration, the treated surface water was sampled for residual turbidity measurement and pH measurement.



Figure -1: Jar test apparatus

3. RESULTS AND DISCUSSION

3.1. Reduction of Turbidity Using Natural Coagulants

The physical properties turbidity and pH were evaluated after jar test was conducted. Doses started from 50 mg/L to 100 mg/L for corresponding six beakers. Turbidity was measured before and after treatment.

Test-1: Using ALUM as Coagulant

Initial Turbidity – 75 NTU

Initial pH – 6.9

Settling time : 40 Minute.

Table 1: Using Alum as coagulant

No.	Dose of Coagulant (mL)	pH	Turbidity in NTU
1	50	7.35	10.5
2	60	7.46	2.82
3	70	7.52	2.26
4	80	7.6	3.2
5	90	7.54	3.5
6	100	7.5	10.3

Test-2: Using 2% solution of Sesamum indicum (sesame) as Natural Coagulant

Initial Turbidity -75 NTU

Initial pH – 7.2

Settling time : 60 minutes

5	90	7.5	7.34
6	100	7.4	10.3

Table 2: Using Sesame as coagulant

No.	Dose of Coagulant (mL)	pH	Turbidity in NTU
1	50	7.68	4.05
2	60	7.74	2.96
3	70	7.78	2.88
4	80	7.8	3.72
5	90	7.78	3.93
6	100	7.77	10.1

Test-3: Using 2% solution of cicer artinum as Natural Coagulant

Initial Turbidity – 75 NTU

Initial pH – 7.29

Settling time : 60 Minute.

Table 3: Using cicer artinum as coagulant

No.	Dose of Coagulant (mL)	pH	Turbidity in NTU
1	50	7.23	9.85
2	60	7.02	5.65
3	70	7.11	4.06
4	80	7.17	4.86
5	90	7.23	5.14
6	100	7.26	12.3

Test-4: Using Peanut as Coagulant

Initial Turbidity - 75 NTU

Initial pH – 6.95

Settling time : 60 Minute.

Table 4: Using Peanut as natural coagulant

No.	Dose of Coagulant (mL)	pH	Turbidity in NTU
1	50	7.1	11.55
2	60	7.22	9.65
3	70	7.42	7.06
4	80	7.6	6.96

Turbidity of water is measured after treating with the above three natural coagulants, the concentration of coagulant solution as 2 %. From the results obtained it was observed that water treated with sesame seeds comparatively has obtained less values for turbidity. The value for pH was also satisfactorily obtained for water treated with sesame seeds. For this reason sesame was selected as the best natural coagulant among the coagulants used. but the result obtained for turbidity after treating the water with 2% solution was not satisfactory if compared with the chemical coagulant. So 3% solution of sesame seeds was prepared and was treated with water. Turbidity and pH of the water treated with 3% solutions of sesame seeds are obtained as follows.

Test-5: Using 3% solution of sesamum indicum as natural coagulant

Initial Turbidity -75 NTU

Initial pH – 7.1

Settling time : 60 minute

Table 5: Using 3% solution of sesame seed as natural coagulant

No.	Dose of Coagulant (mL)	pH	Turbidity in NTU
1	50	7.38	3.85
2	60	7.23	2.66
3	70	7.08	1.28
4	80	7.8	1.62
5	90	7.68	1.7
6	100	7.73	6.1

3. CONCLUSIONS

Using some locally available natural coagulants, for example, Sesamum indicum, Cicer arietinum, peanut, significant improvement in removing turbidity from synthetic raw water was found. From the experimental investigation done sesame seed has obtained lesser values for turbidity. The value for pH obtained is satisfactorily for treated water with sesame seeds. Sesame was the best natural coagulant from the coagulants used. The result obtained for turbidity after treating water with 2% solution of sesame seeds was not satisfactory if compared with the chemical coagulant alum. So 3% solution of sesame seeds was prepared and was treated with water and pH and turbidity are obtained. From the results obtained it was clear that 3% solution of sesame seeds had given the lowest turbidity value of 1.28 NTU for

the coagulant dosage of 70 ml. The pH value obtained for this dosage was 7.08 which lies at the normal pH range. It is concluded that 70 ml of 3% solution of sesame seeds is the best natural coagulant. The water treated can be used for common household purposes.

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