RESEARCH ARTICLE OPEN ACCESS

Treatment Of Water Using Watermelon Seeds As A Natural Coagulant

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ABSTRACT
Water is undoubtedly the most vital element among the natural resources. In many developing countries, access to clean and safe water is a crucial. More than a six million people die because of diarrhea. 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 which is caused by polluted water. Commonly used chemicals for various treatment units are synthetic organic and inorganic. The synthetic water sample was prepared by using kaolin clay powder. The initial parameters of the synthetic water were assessed using pH, TDS, Turbidity, BOD and measured as
Keywords - natural coagulant, watermelon seed powder, synthetic water, kaolin clay powder

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Date of Submission: 03-07-2022 Date of Acceptance: 16-07-2022

I. INTRODUCTION

The most important ingredient in water purification is a natural coagulant, such as Moringa oleifera (MO) seed has been used to treat wastewater because it is not harmful to humans and has no notable drawbacks

The advantages of natural coagulants that they are environmentally sustainable, environmentally friendly, inexpensive, and a simple process for developing countries. The performance is independent of raw water pH safe for human health, and antibiotic impact on various bacteria and fungi. The alkalinity of wastewater can be significantly reduced, compared to chemical coagulants. Natural coagulants are cost-effective. Common coagulants are aluminium sulphate, ferric chloride, poly aluminium chlorides and synthetic polymers. The use of coagulants such as alum is one of the commonest methods employed and it reduces the repulsive force between particulate matter, encouraging particle collision and floc formation. Recent studies have indicated a number of serious drawbacks linked to the use of aluminium salts such as Alzheimer's disease associated with high aluminium residuals in treated water, excessive sludge production during water treatment and considerable changes in Water chemistry due to reactions with the OH^- and alkalinity of water. In addition, the use of alum salts is inappropriate in some developing countries because of the high costs of imported chemicals and low availability of chemical coagulants. Also, monomers of some synthetic organic polymers such as acrylamide have neurotoxicity and strong carcinogenic properties and because of this, there has been considerable interest in the development of natural coagulants which are safe for human health and biodegradable. A number of studies have pointed out that the introduction of natural coagulants as a substitute for metal salts may ease the problems associated with chemical coagulants.

The widespread use of aluminum-based chemical coagulants causes a variety of neurological problems, whereas bio-coagulants have natural properties that make them toxic to aquatic life. Different researchers studied natural coagulant such as microbial polysaccharides bio-wastes gelatin, cellulose-based materials, chitosan, Moringa oleifera , Moringa oil Natural coagulants are commonly used in less developed populations as a point-of-use product, as they are fairly cost-effective compared to chemical coagulants.

The coagulation process involves adding iron or aluminum salts, such as aluminum sulphate, ferric sulphate, ferric chloride or polymers, to the water. These chemicals are called coagulants, and have a positive charge. The positive charge of the coagulant neutralizes the negative charge of dissolved and suspended particles in the water. When this reaction occurs, the particles bind together, or coagulate (this process is sometimes also called flocculation). The larger particles, or floc, are heavy and quickly settle to the bottom of the water supply. This settling process is called sedimentation. In a water treatment facility, the coagulant is added to the water and it is rapidly mixed, so that the coagulant is circulated throughout the water.

Alum (aluminium sulphate), has been the most popular for treatment of water and wisely used in treatment plants. It has been found to pose some health, economic and environmental problems upon usage; among which are neurological diseases such as percentile dementia and induction of Alzheimer's disease. Sludge produced is also voluminous and non-biodegradable after treatment leading to increase in cost of exchange to nations. The effect of most chemical coagulants like aluminium on the pH of the treated water attracts extra cost on lime which should be added to buffer its effects. Alum is a type of chemical compound, usually a hydrated double sulphate salt of aluminium with the general formula XAI $(SO_4)_2$. Alum used here is aluminium sulphate. Aluminium sulphate is a chemical compound with the formula Al (SO). It is soluble in water and is mainly used as a coagulating agent in the purification of drinking water and wastewater treatment plants.

II. MATERIALS AND METHODS

A. Preparation of fine seed powder

`Fig. 1. Citrullus lanatus

Fresh seeds of watermelon (Citrullus Lanatus) of the Cucurbitaceae family were purchase from online. The seeds were washed severally with water, sun-dried for a week, sorted to remove bad ones and shelled. The dried seeds were ground to fine powder by domestic blender. This powder was sieved through 450µm sieve. The 10 g of fine powder was mixed well with 100 ml distilled water solution and the suspension was stirred using a magnetic stirrer for 10 minutes for homogeneous mixing. The solution was prepared fresh before each set of experiment. The seed solution was then used as the coagulant.

B. Preparation of synthetic water sample

Fig. 2. Manilkara zapota

Synthetic turbid water was prepared by adding kaolin, in raw water for all coagulation experiments. The kaolin suspension was prepared by dissolving 10 g of kaolin powder in 1 L of water. The suspension was stirred slowly at 20 rpm for 1hr to achieve uniform dispersion of the kaolin particles. The suspension was then permitted to stand for 24 hr. to allow for complete hydration of the kaolin. This suspension was used as a stock solution for the preparation of water samples of varying turbidity for the coagulation tests.

C. Experimental process

1) Jar test

Fig. 3. Jar test apparatus

Measure the initial turbidity of the water sample. Take 1000ml of sample of water in 6 beakers. Cumulatively add 1ml of coagulant or standard alum solution from 1st to 6th beaker. Switch on the instrument and adjust speed of the peddles to 180rpm and rapid mix the sample for 5minute. Bring down the speed to 40-60rpm and allow for 10 minutes. Switch off the instrument and allow it to settle for 10 minutes. Take 50ml supernatant from each jar without disturbing the sample.

To determine optimum dosage: Cumulatively add 1ml of coagulant or standard alum solution from 1st to 6th beaker. The raw water sample was then added to make up the 250ml mark and the jars were then placed in the flocculator and the stirrers lowered into each. The stirring speed was set at 150rpm for rapid mixing for 2 minutes and 80rpm, 8 minutes for slow mixing. After this was completed, the samples were allowed to settle. From the results obtained the dosage with the best results in colour and the turbidity removal was taken as the optimum.

1) Turbidity

Turbidity is the measure of resistance of water to allow the light pass through it. It is caused by the pressure of suspended and colloidal matters such as clay, finally microscopic organisms. To estimate the turbidity of such sample can be made using digital Nephelo turbidity meter. Measurement of turbidity using the photoelectric turbidity meter is based upon comparison of the intensity of light scattered by standard reference suspension under same conditions.

2) pH Meter

The pH is one if the basic waters and wastewaters characteristics. It expresses the intensity of acid or alkaline conditions by indicating the hydrogen ion activity. Some of the processes in water quality engineering that require pH monitoring and control are the following: disinfection, coagulation, softening, biological treatment etc. Natural waters usually have pH values close to neutral.

3) TDS (Total dissolved solids) and Conductivity Test

Total dissolved solids comprise inorganic salt, principally calcium, magnesium, potassium, sodium, bicarbonates, chlorides, and sulphates and some small amount of organic matter that are dissolved in water.

Conductivity meter measure the ion capacity in aqueous solution to carry electric current. As the range in aqueous solution are usually small, the basis units of measurements are milliSiemens/cm (mS/cm) and microSiemens/cm (µS/cm)

III. RESULTS AND DISCUSSION

The synthetic water sample was prepared from the kaolin clay powder. Below are the initial water properties.

A. Before treatment.

Characteristics of synthetic Water used for the study

PARAMETER	INITIAL RESULT
Turbidity (NTU)	119
pH	8.7
TDS (ppm)	200
Conductivity (µS/cm)	686
Temperature (^{0}C)	25.3
Acidity (mg/L)	-
Alkalinity (mg/L)	90
Total Hardness (mg/L)	165
Dissolved Oxygen (mg/L)	3.0
BOD (mg/L)	2.75

B. Turbidity

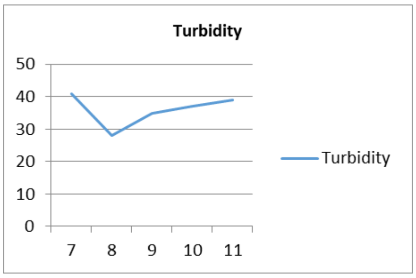

Fig. 1. Graph showing the effect of coagulant dosage on Turbidity

This graph shows the effect of coagulant dosage on Turbidity. The initial reading was 114 for raw water sample, and we add 2ml of watermelon seed coagulation then it gradually decreases to 6NTU. For 4ml of dosage it increases to 13NTU, then it slightly increases to 28NTU at 6ml dosage. Like that it increases to 35 NTU at 8ml and at the final reading it reaches to 46 NTU at 10ml.

C. Total Hardness

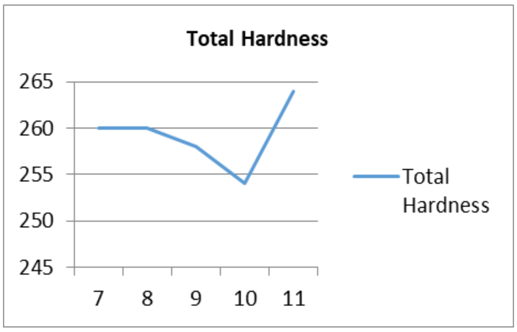

Fig. 2. Graph showing the effect of coagulant dosage on Hardness

This graph shows the result of coagulant dosage on Hardness. The initial reading was 158 mg/L for raw water sample. Then it increases to 160 mg/L at 2ml and it's is constant at 4ml. Then 158 mg/L at 6ml, and it decreases to 154 mg/L at 8ml.then it gradually increases to 164 mg/L for10ml dosage

D. Dissolved Oxygen

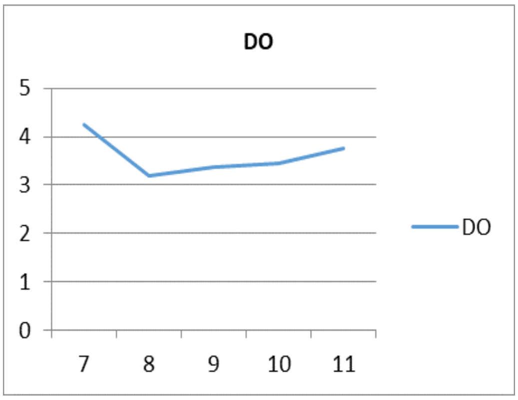

Fig. 3. Graph showing the effect of coagulant dosage on dissolved oxygen

This graph shows the result of coagulant dosage on Dissolved Oxygen. The initial reading was 3.25mg/L for raw water sample. Then it decreases to 2.76 mg/L at 2ml dosage. And we add 4ml it reduces to 2.56 mg/L and it is constant in 6 ml also. Then it decreases to 2.46 mg/L at 8ml and at the final reading it decreases to 2.36 mg/L at 10ml.

E. Total dissolved solids

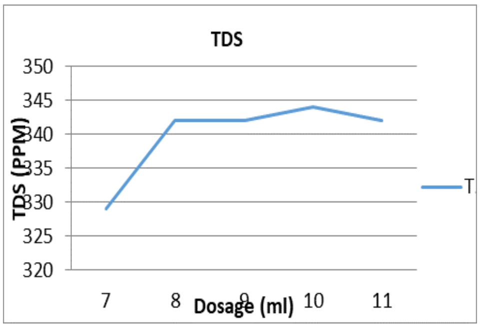

Fig. 4. Graph showing the effect of coagulant dosage on total dissolved solids

The above graph shows the result of coagulant dosage on TDS (ppm). The initial reading was 195 ppm for raw water sample. Then we add 2 ml dosage of watermelon seed coagulation it increases to 197 ppm. Then it reaches to 198 ppm at 4ml, at 6ml it increases to 200 ppm. Then it increases to 204 ppm at 8ml. And at the final reading it increases to 205 ppm at 10ml.

IV. CONCLUSION

By using watermelon` seed powder as a natural coagulant, it has been observed that optimum dosage was observed to be *2ml* for a reduction in turbidity from 114 NTU to 6 NTU with an reduction efficiency being 95%. By conventional coagulant i.e., Alum it has been observed that optimum dosage was observed to be *8ml* for a reduction in turbidity from 114 NTU to 6 NTU with an reduction efficiency being 95%..For the proportion *40 : 60* of Alum and natural coagulant it has been observed there is a reduction in turbidity from 114 NTU to 5NTU with an reduction efficiency of 96%.From the above observation it is evident that the coagulation was more effective when coagulants were considered in proportion of 40 : 60.

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