International Journal of Recent Engineering Research and Development (IJRERD)
ISSN: 2455-8761
www.ijrerd.com || Volume 03 – Issue 04 || April 2018 || PP. 114-120

Surface Water Treatment Using Water Melon Seed As Natural Coagulant

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Abstract: This paper reports the potential of watermelon seed as a natural coagulant for water treatment. It was aimed at identifying watermelon seed as a possible replacement for alum and other synthetic polyelectrolyte's in treating water. Laboratory scale studies using jar test experiments were performed on medium turbid water to determine the effect of dosage, pH stirring time and speed on coagulation. When used watermelon seed powder as coagulant, it caused favorable changes in the pH of the treated water and the best colour and turbidity removal at acceptable pH was obtained. The results showed that watermelon seed can be used as a natural coagulant for water treatment.

Keywords: water melon seed, coagulant, turbidity

1. Introduction

Water supply is a basic need required for living creatures and human being specifically. Developing countries and third world countries are facing potable water supply problems because of inadequate financial resources. The cost of water treatment is increasing and the quality of river water is not stable due to suspended and colloidal particle load caused by land development and high storm runoff during the rainy seasons. During the rainy seasons the turbidity level increases and the need for water treatment chemicals increase as well, which leads to high cost of treatment which the water treatment companies cannot sustain. As a result, the drinking water that reaches the consumer is not properly treated. Therefore, it is of great importance to find a natural alternative for water coagulant to treat the turbidity. In this world the amount of resources available to living creatures are limited. Safe drinking water is essential to the health and welfare of a community, and water from all sources must have some form of purification before consumption.

Drinking water treatment involves a number of combined processes based on the quality of the water source such as turbidity, amount of microbial load present in water and the others include cost and availability of chemicals in achieving desired level of treatment.

Conventional methods used for purification of water include coagulation, sedimentation, filtration, aeration and also chemical treatment. In drinking water treatment, the coagulation process is used to destabilize suspended particles and to react with organic materials in the raw water. Proper coagulation is essential for good filtration performance and for disinfection by product (DBP). Common coagulants are aluminum sulphate, ferric chloride, polyaluminium 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 aluminum salts such as Alzheimer's disease associated with high aluminum 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. In addition, monomers of some synthetic organic polymers such as acryl amide 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. Using natural coagulants instead of aluminum salts might give advantages, such as lower costs of water production, less sludge production and ready availability of reagents. There are also some disadvantages such as increased concentration of nutrients and chemical oxygen demand (COD) in the treated water due to the organic nature of this type of coagulants.

This paper aimed at investigating the potential of water melon seed as a coagulant for water treatment. This material was selected because the watermelon seed has high protein content and some authors have considered that the active coagulant agents in plant extract are proteins. The objective of this study is to determine the potential of watermelon seed as a natural coagulant, and investigate the coagulation characteristics of water melon.

1.2 Coagulants

Coagulation with extracts from natural and renewable vegetation has been widely used. There is a variety of natural coagulants used around the world, depending on the availability. Natural coagulants are not available in a usable form and need to be prepared. This is usually done just before hand to keep the coagulant fresh. For example, prickly pear cactus needs to be peeled and cut and moringa seeds need to be dried and crushed into a powder. Users add the prepared dose of coagulant to the water. The water is then stirred for a few minutes to help create flocs. The flocs can be settled out and the clear water is decanted, or removed by filtration. Moringaoleifera, Cicerarietinum, and Dolichos lablab, Watermelon are the examples of natural coagulants.

1.3 Watermelon Seed

Watermelon is a warm-season crop from the cucurbit family, which also contains other melons such as cantaloupe and gourds such as squash and pumpkin.Watermelon seed was found to be 8.32% moisture and 91.7% dry matter The composition of the watermelon seed kernel was determined to be 35.7% crude protein, 50.1% crude Oil, 4.83% crude fiber, 3.60% total ash, and 5.81% nitrogen free extract Approximately 4.36% of the rind is peel and the other is the inside whitish portion One study states that the rind is 93.8% moisture, 0.49% ash, 0.1% nitrogen, and 2.1% sugars determined the skin of fully ripened watermelon to contain approximately 20% cellulose, 23% hemicelluloses, 10% lignin, 13% pectin, 7 mg/g silica, and 12% silica free minerals. According to research conducted by the ARS laboratory the rind contains 2-20 mg/g dry weight of the amino acid citrulline The rind is higher in percent fresh 30% Rind 68% Flesh2% Seeds 8weight, dietary fiber, and potassium but lower in total sugar than the flesh.

2. Methodology

2.1 Materials

The materials used in this study were purchased from nearby village. The watermelon seeds were used for preparation of coagulant extract.

2.1.1 Watermelon Seed

Water melon seed is an attractive and economic alternative for the removal of turbidity from waste water. Most of people waste water melon seed because lack of knowledge about benefits of seed. Watermelon seeds are a source of protein, B vitamins, minerals (such as magnesium, potassium, phosphorous, sodium, iron, zinc, manganese and copper) and fat among others.Water melon seed is the material used as a coagulant for waste water treatment.

Figure 1: Watermelon seeds

2.1.2Water sample

The sample water used throughout the study was collected from the attur pond. The raw water was stored in the plastic bottle in the laboratory.

2.2 Methods

2.2.1 Preparation of Watermelon Seed Coagulant

The coagulant which is used is watermelon seed for treatment of surface water such as pond water. Locally available dry watermelon seeds were obtained from the village Nellipoyil situated in Calicut district. The fruits were sliced open using a clean stainless steel laboratory knife. The seeds were washed severally with

water, sun-dried for a week, sorted to remove bad ones, packed in an air tight container. 150g of the crushed seeds were then sieved and packed. The finer particles were then used as the coagulant.

Figure 2: Watermelon seeds and powder

2.2.2 Experimental Work

The study of coagulation jar apparatus has been used. The jar apparatus has the six beakers and six steel paddles which helps in the agitation process. The initial speed of agitation is 100rpm for 1 min, followed by 30 rpm for 10min. The settling time applied for coagulation process is 20 min. Turbidity measurements were conducted using Digital Nephelo turbidity Meter. The pH was measured using a Digital pH Meter.

Figure 3: Jar Test Apparatus

3. Results and Discussions

3.1 Raw Water Characteristics

Waste water sample is collected from Attur pond, Thrissur district. Samples were collected according to standard procedures and follow guidelines for surface water sample collection. Rope and bucket method adopted for sample collection. This method is simplest method used to collect water samples from surface water sources. It contains a clean bucket or jar attached to a rope or a pole. In many cases these ropes vertically tied to horizontally holding poles .To collect the sample, simply submerge sampling container to desired depth. With open topped sampler such as buckets and jars collect samples. The sample collecting containers were sterilized before filling. Characteristics of waste water is shown in Table.

Table 1: Waste Water Characteristics

Sl.No	Parameter	Desirable Limit	Permissible Limit	Waste Water Characteristics
1	Turbidity(NTU)	5	10	14
2	pH	6.5-8.5	No relaxation	8.6
3	Hardness (as $CaCO_3$ in mg/l)	300	600	8
4	Chlorides (as Cl in mg/l)	250	1000	70
5	Dissolved oxygen (mg/l)	-	<20	26
6	BOD (mg/l)	-	>5	7
7	Alkalinity (mg/l)	200	600	182
8	Sulphate (mg/l)	200	400	25
9	Dissolved Solids (mg/l)	500	2000	150

3.2 Optminum Dosage And Turbidity Removal

The optimum dosage is the minimum dosage corresponding to the lowest residual turbidity and it is find out from the graph showing coagulant dosage Vs turbidity. Table 2 shows the effect of coagulant dosage on Turbidity.

Table 2: Effect of Coagulant Dosage On Turbidity

Sl.No	Coagulant Dosage (g/l)	Residual Turbidity (NTU)
1	0.05	0.80
2	0.1	0.71
3	0.15	0.82
4	0.2	1.15
5	0.25	1.42
6	0.3	1.5

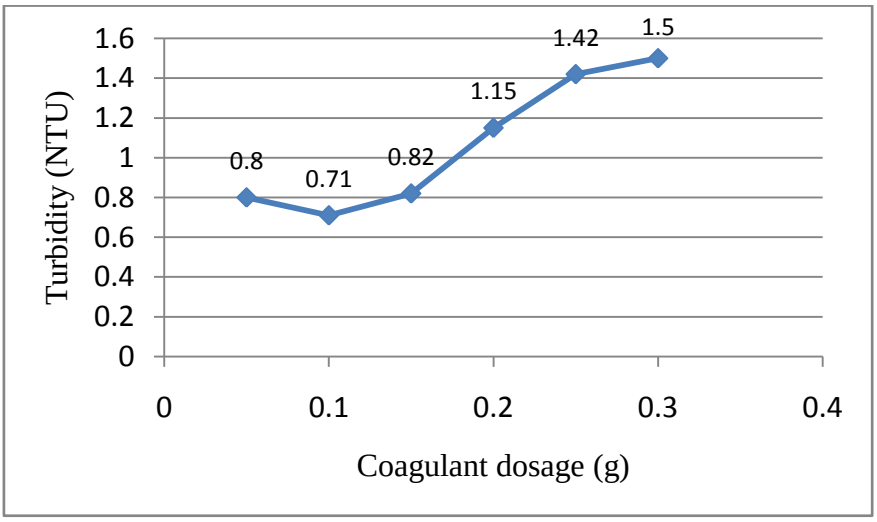

Figure 4: Effect of Coagulant Dosage On Turbidity

The graph of turbidity against coagulant dosage is plotted. Where coagulant dosage (g/l) on X-axis and corresponding turbidity (NTU) on Y-axis. **T**he optimum dosage of pond water was found to be 0.1g/l. Turbidity decreased from 14 NTU to 0.71 NTU for pond water when treated with watermelon seed as coagulant. Turbidity removal efficiency was 94.92% at optimum dosage 0.1g/l. As per the results obtained, watermelon seed was able to significantly reduce turbidity removal in pond water.

3.3 Optimum pH and Turbidity Removal

The optimum pH is the minimum pH corresponding to the lowest residual turbidity and it is find out from the graph showing pH Vs turbidity. Table 3 shows the effect of pH on Turbidity.

Table 3: Effect Of pH OnTurbidity

Sl.No	pH	Turbidity (NTU)
1	6	0.97
2	6.5	0.90
3	7	0.47
4	7.5	0.50
5	8	0.55
6	8.5	0.64

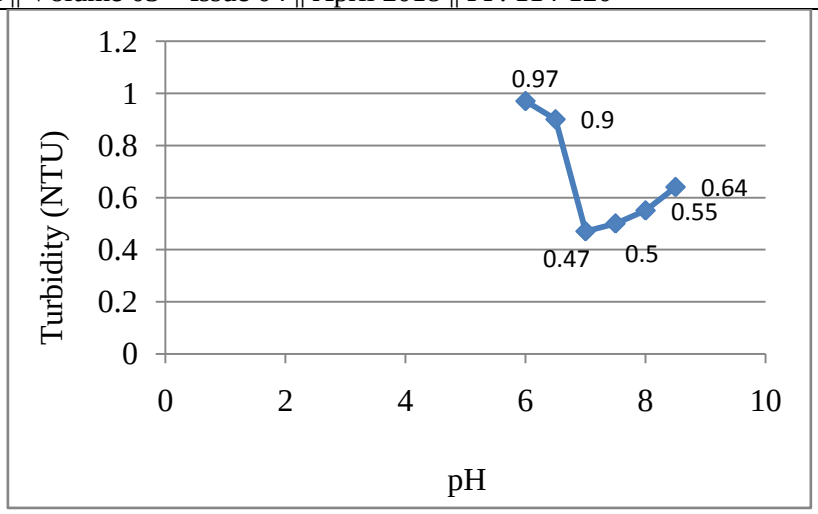

Figure 5: Effect Of pH On Turbidity

The optimum pH at constant dosage 0.1g/L was found to be 7 for pond water. Turbidity decreased from 14 NTU to 0.47 NTU after treated with watermelon seed as natural coagulant. Turbidity removal efficiency was 96.64% for pond water with natural coagulant at optimum pH.

3.4Optimum Settling Time AndTurbidity Removal

The optimum settling time is found out from the graph showing settling time Vs turbidity. Table 4.3 shows the effect of settling time on Turbidity.

Table 4: Effect of Settling Time On Turbidity

Sl.No	Time (min)	Turbidity Removal in (%)
1	30	0.81
2	60	0.63
3	90	0.56
4	120	0.50
5	150	0.30
6	180	0.26

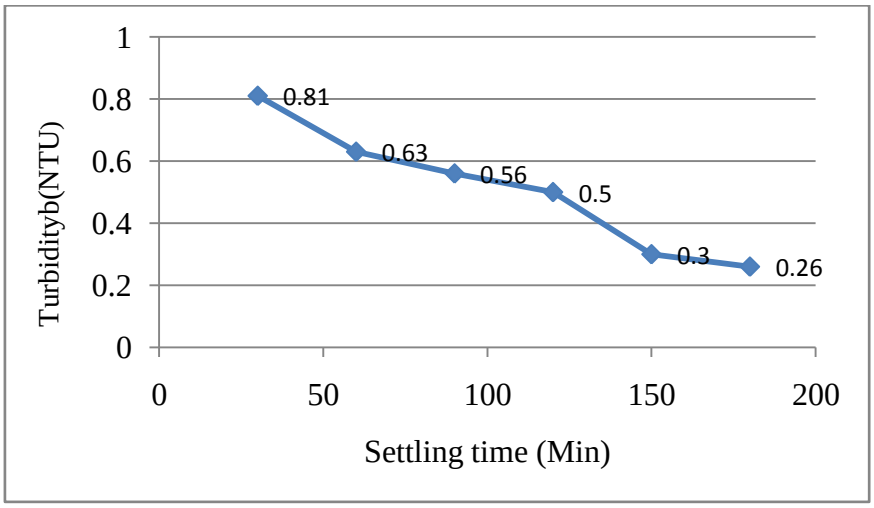

Figure 6: Effect Of Settling Time On Turbidity

The graph of turbidity against settling time is plotted. Where settling time (min) on X-axis and corresponding turbidity (NTU) on Y-axis. The turbidity of pond water was found to decrease by increasing the settling time when treated with watermelon seed as coagulant. Maximum turbidity removal efficiency is 98.14% at optimum dosage 0.1g/l and settling time of 180 minutes. As per the results obtained, watermelon seed was able to significantly reduce turbidity removal in pond water.

3.5Characteristics Of Waste Water After Treatment

Jar test is conducted with optimum dosage of 0.1 g/l at pH of 7 and settling time of 180 minutes, characteristics of waste water as shown in table 5.

Table 5: Characteristics Of Waste Water After Treatment

Sl. No	Parameter	Initial Characteristics	Characteristics After Treatment
1	Turbidity (NTU)	14	0.69
2	pH	8.6	7
3	Hardness (as CaCO3 in mg/l)	8	6.5
4	Chlorides (as Cl in mg/l)	70	54
5	Sulphate(mg/l)	25	17
6	Alkalinity(mg/l)	182	143
7	Biochemical oxygen demand (mg/l)	26	19
8	Dissolved oxygen (mg/l)	7	11
9	Dissolved solids(mg/l)	150	145

From the table it is observed that all the parameters reduced from the initial value after treated with watermelon seed as natural coagulant.

4. Conclusions

Result shows that the use of watermelon seed as natural coagulant is receiving attention for their effectiveness in water treatment. Access to clean and safe water is difficult in rural areas because water is generally available in rainy season which is muddy and full of sediments, due to lack of purifying agents communities drink the water contaminated with sediment and human feces. Therefore, the use of natural coagulants that are locally available, abundant and inexhaustible provides a solution to the need for clean and safe drinking water in the rural communities. The technologies involved are economical, traditional, easy to implement and decreases morbidity and mortality from water borne diseases and thus, improve public health in rural areas.

In this mini project, turbidity removal efficiency was found to be 94.92% at 0.1 g/l of optimum coagulant dosage. At optimum ph of 7 the turbidity removal efficiency was obtained as 96.64%. At settling time of 180minutes turbidity removal was obtained is 98.14% and it is observed to be decreased by increase in settling time. Watermelon seeds are very efficient in turbidity removal of pond water and it is capable of reducing parameters such as turbidity, pH, hardness, chloride, dissolved solids, sulphates, alkalinity, BOD and DO. This is mainly due to the more settling occurs in pond water with less distraction. Hence, it can be concluded that watermelon seed can be used as coagulant.

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