International Journal of Recent Engineering Research and Development (IJRERD)
ISSN: 2455-8761
www.ijrerd.com || Volume 03 – Issue 02 || February 2018 || PP. 65-73

Okra Seeds for Surface Water Treatment

Shameema K.P
Malabar College of Engineering and Technology, Kerala Technological University, Desamangalam, Kerala

Abstract: Surface water is being polluted by sewage, industrial water discharge and run off from the land, while ground water is polluted by salt water intrusion and waste dumping site. This polluted water will have to go through treatment processes before it can be distributed to the consumers for domestic use, including drinking. One of the processes of water treatment is coagulation. In this project okra seeds and alum are used as coagulant for water treatment. Okra is locally named as lady's finger. This project aimed to the evaluation of treatment efficiency of okra seeds and alum as coagulant. Before treating water sample, the initial parameters were checked, especially pH, turbidity, total hardness, chlorides, dissolved oxygen and total solids. Sedimentation jar test methods were used to determine the coagulation properties of the okra coagulant and alum coagulant.

Keywords: okra, coagulant, alum, turbidity

1. Introduction

Water quality is most important thing in human's life. Without water, both in quality and safety, the human health will expose to high risk due to low quality of safe drinking water, and human life can be threatened with many diseases such as cholera, typhoid fever, bilharzias and dysentery. Unfortunately clean and treated water is not available to each house in most developing countries. Poor hygienic conditions inadequate water supply and poverty are the main factors of increase waterborne diseases among these countries. Most of the people in developing countries struggle to obtain access to safe water, especially in remote areas, where a treated drinking water supply is not available. They receive their drinking-water by some ways such as a small tanker driven by animal or carriage by themselves from public water sources and most of this water is collected by women and children without hygienic practices and the sources itself may be poor in cleaning, unimproved, unprotected and normally located far away from their living area. To overcome water contamination, chemical coagulants (aluminum salts, ferrous salts etc) have been used in treating of drinking water, but the excessive use of chemical coagulants increases the treatment cost and can be causing health and environment problems.

In recent years, natural alternative methods have been developed for water treatment, especially in the rural area by using natural materials found in plants such as Okra, Rice, fenugreek and papaya as coagulant materials to remove the contaminants from drinking water. Besides, toxic substances like aldehydes, ketones, amines, carboxylic acids etc are present in water even in very small quantities, which deplete the dissolved oxygen, altering the survival pattern for aquatic life. The precise quantity of damage in the developing countries is not really available but huge billions of gallons of sewage and detergent-based wastes are disposed off daily. Water, which is safe for drinking must be free of pathogenic organisms, toxic substances and an excess of minerals and organic debris. It must be colourless, tasteless and odourless.

Water is the basis of life and about 75% of the body weight is made up of water. In developing countries 15 million infants die every year due to contaminated drinking water, poor hygiene and malnutrition. About 80% of illnesses in developing countries are directly connected with contaminated drinking water. However, major improvements in health conditions through provision of sufficient safe water can only be achieved through domestic hygiene practice and proper methods of water purification. Ground water, surface water and rainwater are often the major sources of water. Ground Water: is the most important source of water for drinking as long as it does not contain high mineral content. Ground water could be taken from wells or bore holes. Surface Water: requires treatment to make it safe for human consumption. Surface water is almost always contaminated by people and animals who defecate in or near the water. The surface water is obtained from streams, lakes, ponds etc, Water gets contaminated in so many ways particularly through the discharge of wastes from industries, thereby making it unsafe for consumption. Waste water generally contains biological components, pathogenic organisms and non-biological substances. For better quality of water we have to treat waste water. For the treatment of water we can use both chemical and natural coagulants.

1.2 Coagulants

In waste water treatment, coagulation is a process that occurs when a coagulant is added to water to destabilize colloidal suspensions. And in flocculation involves the addition of polymers that clump the small destabilized particles together into larger aggregates so that they can be more easily separate from the water. Coagulation is a chemical process that involves neutralization of charge whereas flocculation is a physical process and doesn't involves neutralization of charges. Iron and aluminium salts are the most widely used coagulants but salts of other metals such as titanium and zirconium have been found to be highly effective as well. In a colloidal suspension, particles will settle very slowly or not at all because the colloidal particle carry surface electrical charges that mutually repel each other. A coagulant (typically a metallic salt) with the opposite charge is added to the water to overcome the repulsive charge and "destabilize" the suspension. For example the colloidal particles are negatively charged and alum is added as a coagulant to create positively charged ions. Once the repulsive charges have been neutralized, the vander waals force will cause the particles to agglomerate and form floc.

1.3 Alum

One of the earliest, and still the most extensively used coagulant, is aluminium sulphate, also known as alum. Alum is acidic with light tan to grey in colour and available in blocks, lumps and powder with a density of 1000 to 1100 kg/m^3 and specific gravity of 1.25 to 1.36. alum can be bought in liquid form or in dry form. It is readily soluble in water. When alum is added to water, it reacts with water and results in positively charged ions. The ions can have charges as high as +4, but are typically bivalent (with a charge of +2). The bivalent ion resulting from alum makes this a very effective coagulant.

1.4 Okra Seeds

- Plant species – A.esculentus
- Family- Mavacae
- Common Name- lady's finger or Gumbo

Okra Abelmoschus esculentus L. (Moench), is an economically important vegetable crop grown in tropical and subtropical parts of the world. In the range of studied, it is observed that whatever the volume of gumbo mucilage, the turbidity decreases when the pH increases. The flocculating activity can be either due to a chemical reaction, or a complex formation.

2. Methodology

2.1 Materials

The materials used in this study were purchased from nearby vegetable market (Pattambi). The okra seeds were used for preparation of coagulant extract. Hydrochloric acid and sodium hydroxide were used to adjust pH of the solution.

2.1.1 Okra (lady finger)

Okra is already an important vegetable crop grown in tropical and subtropics parts of the world. The okra seeds are used for the treatment of water sample. For the water treatment, the oil contained in the okra seeds was first extracted, before the okra seeds used.

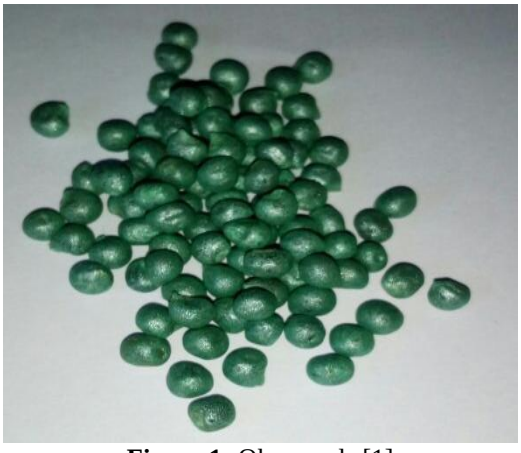

Figure 1: Okra seeds [1]

2.1.2 Water sample

The water sample for the testing was collected from a well (this water is turbid and foul smelling due to activities of neighborhood). The collection of water sample was used within the period of 2-3 weeks and stored the water sample at the temperature of about 2°C using refrigerator. The samples were collected, and the initial characteristics were recorded.

2.1.3 Alum

Alum is used as chemical coagulant. . It is readily soluble in water. When alum is added to water, it reacts with water and results in positively charged ions. The ions can have charges as high as +4, but are typically bivalent (with a charge of +2). The bivalent ion resulting from alum makes this a very effective coagulant.

Figure 2: Alum solution

2.2 Methods

2.2.1 Preparation Of Okra Seed Coagulant

The okra seeds were brought form local market .The seeds were initially washed to remove all impurities in it, they are sun dried for 24 hrs at normal temperature, then grinded the dried seeds using pestle and mortar to obtaining powdered form and sieve to a mesh(150)μ particles size to remove the large particles size of the seeds. 10g of seeds powders was mixed with 1000 ml of distilled water to form 1000ml of suspension. The suspension was then thoroughly mixed using a clean magnetic stirrer for 5minutes for uniform mixing of components. Then this solution was left for 15 minutes, then filtered to remove particles and dried the powder for 6-8 hrs. This powder is used as our okra seed coagulant.

2.2.2 Preparation of Alum

As per standard method, for the preparation of alum coagulant, 1 gram of aluminium sulphate, 3 spatula ammonium chloride, ammonia solution are added in 100 ml distilled water. Ammonia solution is added until a white gelatinous precipitate is formed. In this alum coagulant, 1 ml of solution contain 10 mg of alum.

2.2.3 Experimental Work

Before the treating water sample, we have to check their initial parameters, especially pH turbidity, total hardness, chlorides, total dissolved solids (TDS), total suspended solids, total solids and dissolved oxygen with the corresponding laboratory tests. Sedimentation jar test methods are used to determine the coagulation properties of the derived okra coagulant. 6 beakers were used simultaneously with various doses of coagulants with the same quantity of sample. The jar test is conducted using 500ml of each of the surface water samples. In these samples some amount of coagulant (Okra seeds extract) is added to the sample, and subjected to jar test mixing at 120 rpm for 3min and later slow mixing at 20 rpm for 20 min. Thereafter, switched off the stirrer and allowed the flocks to settle without disturbing the beakers for 30 min.

Figure 3: Jar test Apparatus [1]

The samples for residual turbidity measurement are withdrawn using a pipette from a height of 5cm below the surface of each beaker, and the residual turbidity is measured for each sample of beaker at different settling time (Here for 15, 30, 45 minutes and at 1 hour). Then turbidity is also measured at different pH (at pH 5, 6, 7, 8, and 9). Same procedure was repeated for alum coagulant.

3. Results and Discussions

3.1 Raw Water Characteristics

The initial parameters of collected sample water were found. Turbidity, pH, total hardness, chlorides, dissolved oxygen, total dissolved solids, total suspended solids, total solids were found and tabulated below:

Table 1: Initial characteristics of collected water

Sl.No	Parameters	Raw Water Characteristics Before Treatment	IS standard Desirable Limit for Drinking Water
1	Turbidity (NTU)	18.7	5
2	pH	6.88	6.5-8.5
3	Total Hardness (Mg/L)	228	300
4	Chlorides (Mg/L)	43.98	250
5	Dissolved Oxygen (Mg/L)	4	>6
6	Total Dissolved Solids (Mg/L)	506	500
7	Total Suspended Solids (Mg/L)	203	200
8	Total Solids (Mg/L)	709	--

The collected wastewater has a turbidity of 18.7 NTU. Then the water is treated with okra seeds and alum coagulant. And the parameters of treated water were found out using proper techniques. Characteristics of treated water were tabulated below:

Table 2 : characteristics of water after treatment with alum and okra seeds

Sl. No	Parameters	Raw Water Characteristics Before Treatment	Characteristics After Treatment	
			Using Alum	Using Okra Seeds
1	Turbidity (NTU)	18.7	2.7	2.7
2	pH	6.88	6.38	6.56
3	Total Hardness (Mg/L)	228	201	198
4	Chlorides (Mg/L)	43.98	41.2	40.08
5	Dissolved Oxygen (Mg/L)	4	5.6	6.2
6	Total Dissolved Solids (Mg/L)	506	408	439
7	Total Suspended Solids (Mg/L)	203	156	178
8	Total Solids (Mg/L)	709	564	617

3.2 Effect of Settling Time in Turbidity Removal

Jar test were conducted using alum and okra seed coagulants. To find out the effect of settling time on turbidity removal, the turbidity were checked using nephelometre at various settling times such as after 15, 30, 45 and 60 minutes. The obtained values are tabulated below:

Table 3: Turbidity removal at 15, 30, 45 and 60 minutes using alum as coagulant

Sl. No	Alum Dosage(Mg/L)	Turbidity Removal			
		15 Minutes	30 Minutes	45 Minutes	60 Minutes
1	10	3.6	3.5	3.1	2.8
2	20	3.4	3.1	3	2.4
3	30	3.1	2.7	2.3	1.9
4	40	3.2	2.9	2.7	2.3
5	50	3.3	3.1	2.9	2.5

Table 4: Turbidity removal at 15, 30, 45 and 60 minutes using okra seed as coagulant

Sl. No	Okra Dosage (Mg/L)	Turbidity Removal			
		15 Minutes	30 Minutes	45 Minutes	60 Minutes
1	50	4.2	3.9	3.5	3.1
2	100	3.9	3.7	3.2	2.9
3	150	3.2	3.1	2.8	2.6
4	200	2.9	2.7	2.5	2.3
5	250	3.6	3.4	3.1	2.8

From the obtained values it is clear that when settling time increases the turbidity removal also increases in tests with alum and okra seed. Here the okra seed dosages used in the jar test are 50, 100, 150, 200 and 250 mg/l and the alum dosages in the jar test with alum are 10, 20, 30, 40 and 50 mg/l. The optimum coagulant dosage in each cases are find out using the graph between turbidity removal Vs coagulant dosage.

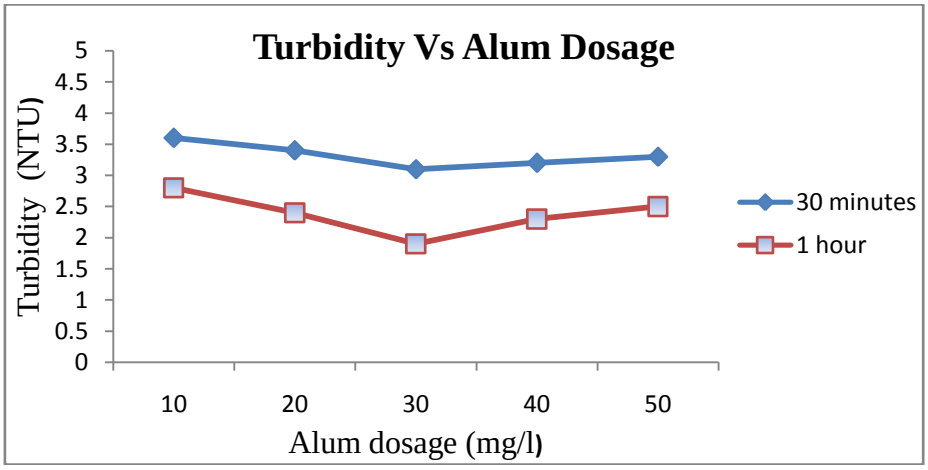

Figure 4: Graph Of Turbidity Removal Vs Coagulant Dosage In Jar test using alum

The optimum coagulant dosage of alum is 30 mg/l and the maximum turbidity removal using alum in 30 minutes and 60 minutes are 2.7 and 1.9 NTU respectively. That is in percentage 85.56 % turbidity removal in 89.83 % in 30 minutes and in 60 minutes respectively.

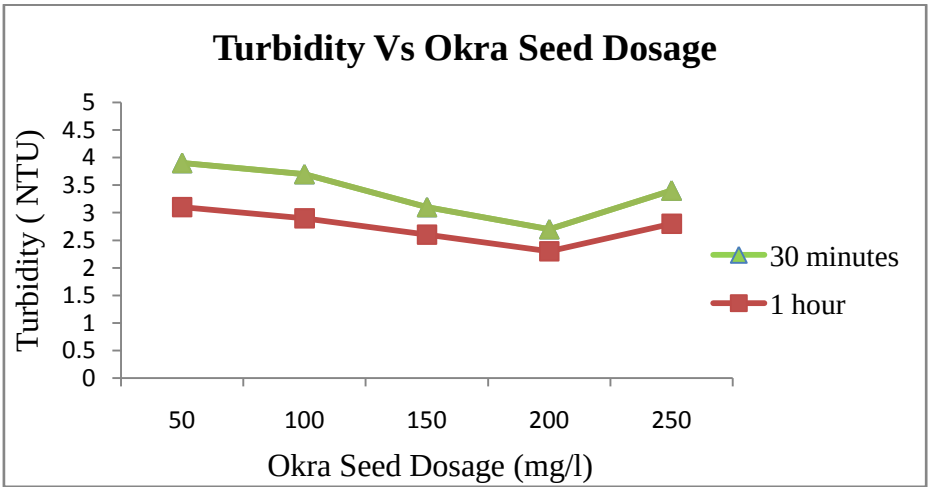

Figure 5 : Graph Of Turbidity Removal Vs Coagulant Dosage while using okra seeds

From this graph it is clear that the optimum coagulant dosage of okra seed for turbidity removal is 200 mg/l. and the maximum turbidity removal at 30 minutes and 60 minutes are 2.7 and 2.3 NTU respectively. That is in percentage 85 % turbidity removal in 87 % in 30 minutes and in 60 minutes respectively.

3.3 Effect Of pH

The effect of pH on the turbidity removal from waste water is evaluated. For this jar test is conducted using different pH waste water. For adjusting pH of solution sodium hydroxide and hydrochloric acid were used. After conducting jar test the turbidity of each solutions were found using nephlometer. The obtained values were tabulated below:

Table 5 : Turbidity removal at different pH waste water solutions using okra seed and alum as coagulant

Sl. No	pH Value	Turbidity Removal Using Okra Seeds (NTU)	Turbidity Removal Using Alum (NTU)
1	5	3.2	3
2	6	2.8	2.9
3	7	2.6	2.7
4	8	2.9	2.8
5	9	3.1	2.7

From the values it is clear that when pH increases to 7 the turbidity removal also increases and for further increase in pH the turbidity removal decreases. So we can say that the maximum turbidity removal using okra seed as coagulant will occur at neutral.

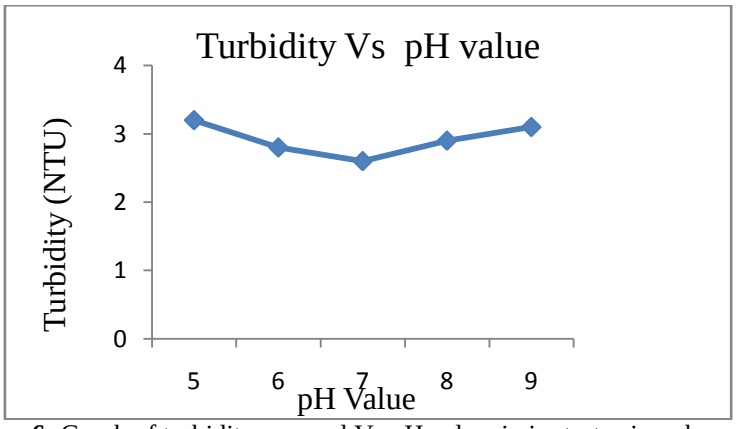

Figure 6: Graph of turbidity removal Vs pH value in jar test using okra seeds

From the values it is clear that in case of alum the maximum turbidity removal occurs at pH 7 and 9. So we can say that the maximum turbidity removal using alum as coagulant will occur in a range of 7 to 9.

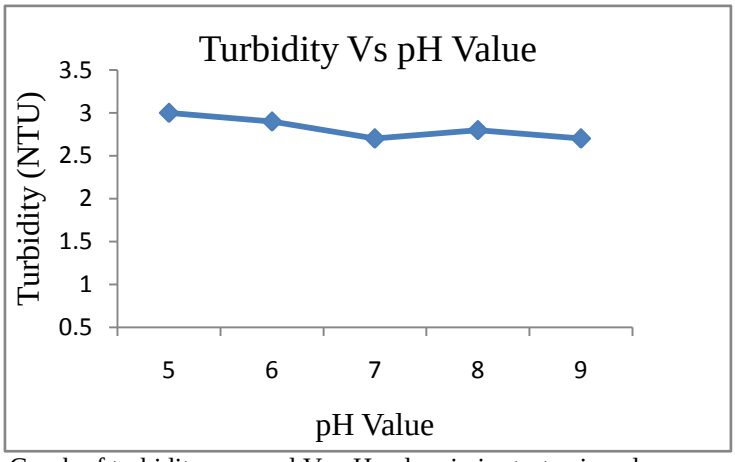

Figure 7: Graph of turbidity removal Vs pH value in jar test using alum

3.4 Comparison Between Alum And Okra Seed Coagulant

The main objective of this study is to determine the efficiency of okra seed coagulant in waste water treatment and to compare the efficiencies of alum and okra seed coagulant. The main comparison is given in table below:

Table 6: comparison between alum and okra seed coagulant

	ALUM	**OKRA SEED**
Coagulant type	Chemical	Natural
Optimum coagulant dosage(Mg/L)	30	200
Optimum pH	7 to 9	7
Turbidity removal in 15 minutes (NTU)	3.1	2.9
Turbidity removal in 60 minutes (NTU)	1.9	2.3
Turbidity removal at optimum pH (NTU)	2.7	2.6
Turbidity removal efficiency (%)	85	85

This is the graph showing comparison between turbidity at different time and at optimum pH in treatment with alum and okra seed coagulant.

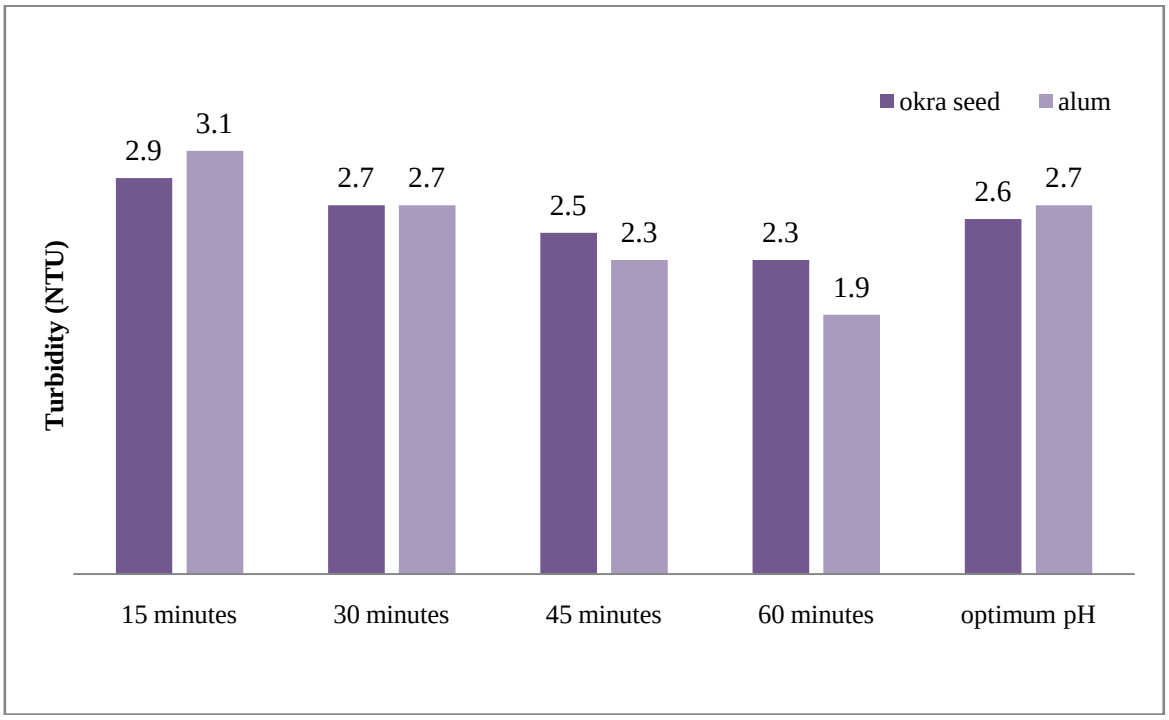

Figure 8: Comparison between turbidity at different time and at optimum pH in treatment with alum and okra seed coagulant.

4. Conclusions

The present study deals with the evaluation of treatment efficiency of natural coagulant okra seed, commonly available in nearby market. Primarily the basic operational parameters- pH and coagulant dosages were optimized. Coagulation ability of okra seed extract and alum were assessed by the use of standard jar test experiment in sample water with various coagulant doses. The various characteristics of untreated water sample were determined. The pH is 6.88, turbidity is 18.7 NTU, total hardness is 228mg/l, chlorides is 43.98 mg/l, dissolved oxygen is 4 mg/l, total dissolved solids is 506 mg/l and total suspended solids is 203 mg/l. In case of treatment with okra seed and alum the optimum dosage for better efficiency were found as 200 mg/l and 30 mg/l respectively. The optimum pH for both coagulants efficiency were also found. While using okra seed as coagulant optimum pH is 7. the reduction in turbidity for water sample is 85.56%. while using alum as

coagulant optimum pH range is 7 to 9. The reduction in turbidity for water sample is 85%. The results obtained from this project have revealed that okra seed coagulant was effective in the removal of turbidity of surface water as same as alum coagulant because the turbidities of the water samples were removed in almost equal percentage (85%). When alum is used as coagulant there will be aluminum content in treated water, it will lead to several diseases (neurological diseases, alzheimers disease etc), sludge produced will lead to increase the cost of treatment, and coagulant have high cost. So it is concluded that natural coagulant okra seed is efficient as alum in turbidity removal and haven't any harmful effects.

References

[1]. P. Akshitha et.al (2013), "Coagulation Efficiency of Okra Seed Extract for Surface Water Treatment" International Journal of Science and Research, Volume 5, Issue 3 .

[2]. S. Kumar et.al(2013), "A Review On:Abelmoschus Esculentus (Okra)" , International Research Journal of Pharmaceutical and Applied Sciences volume 3, Issue 4, Page No: 129-132.

[3]. Abdulwahab et.al (2015), "Assessment of coagulation efficiency of okra seed extract for surface water treatment", International Journal of Science and Research, Volume 6, Issue 2, Page no: 719-725.

[4]. K. A. Yongabi (2010), "Biocoagulants for Water and Waste Water Purification", International Journal of Science and Research, Volume 2, Page no: 444-458.

[5]. Ms. Renuka A. Binayke1, Prof. M.V.Jadhav, "Application of natural coagulants in water purification", International Journal of Engineering and Technology , Volume 2, Issue 1, page no: 118-123.

[6]. S.Thakur and S.Choubey (2014), "Assessment of coagulation efficiency of Moringa oleifera and Okra for treatment of turbid water", International Journal of Engineering and Technology, Volume 6, Issue 2, Page no: 24-30.

[7]. B.Okolo et.al (2014), "The Performance of Okra seed Extract in Removal of Suspended Particles from Brewery Effluent by Coag-Flocculation Process", British Journal of Applied Science & Technology, Volume 4, issue 34, page no:4791-4806.

[8]. Okolo BI, Nnaji PC, Menkiti MC, Ugonabo VI, Onukwuli OD. Parametric response evaluation for Xanthosoma spp. induced Coag-flocculation of brewery effluent. Green and Sustainable Chemistry. 2014;4:7-14.

[9]. Edilson de jesus, Paulo Victor Cruz, Jose Adair Pacifico, Antonio Santos Silva. Removal of turbidity, suspended solids and ions of Fe from aqueous solution using Okra powder by coag-flocculation process. American Journal of Water Resources. 2013; 1 (3):20-24.

[10]. Muyibi SA, Okuofu CA. Coagulation of low turbidity surface water with *Moringa oleifera* seed. International Journal of Environmental Studies. 1995;48:263-273