**TITLE : COMPARATIVE ANALYSIS OF COAGULANT PRODUCED FROM WASTE ALUMINUM CAN AND NATURAL COAGULANT PRODUCED FROM MORINGA SEEDS IN RAW WATER TREATMENT**

***Engr. Mansur Abba ( Chemical Engineer , Jibia Water Treatment Plant , Katsina State Water Board , Nigeria )***

***Engr. Suleiman Abba ( Environmental Officer , National Oil Spill Detection and Response Agency , Abuja Oil Office , Nigeria )***

***ABSTRACT***

***The research was carried out to compare the effectiveness of synthetic alum produce from waste cans and natural coagulant produced from Moringa seeds.Jar test analysis was carried out using the two coaglunts , at various concentrations. After the jar test analysis , the settled water obtained was analysed interms of pH , Turbidity , TDS , colour , rate of settling.The values recorded using synthetic alum ( powdered form ) at 0.5g , 1g , 1.5g , 2.0g , 2.5g and 3.0g were : 6.6 , 6.4 , 6.2 , 5.9 , 5.8 and 5.3 for pH . Then 5.6NTU , 4.9NTU , 4.3NTU , 3.1NTU , 2.9NTU and 2.3NTU for turbidity. For TDS , 44mg/l , 44mg/l , 41mg/l , 38mg/l , 36mg/l and 36mg/l. And 5 , 5 , 5 , 5 , 5 , and 5 for colour. Also , the results recorded for synthetic alum ( solution ) at 10mg/l , 20mg/l , 30mg/l , 40mg/l , 50mg/l and 60mg/l were : 6.8 , 6.7, 6.7, 6.4 , 6.2 and 5.8 for pH. Also , 3.3NTU , 3.1NTU , 3.1NTU , 3.0NTU , 2.9NTU and 2.3NTU for turbidity. Also, 42mg/l , 41mg/l , 41mg/l , 40mg/l , 36mg/l and 36mg/l for TDS and 5 , 5 , 5 , 5 , 5 , and 5 for colour respectively. Also , the results obtained for the natural coagulants from Moringa seeds powder at 1g , 2g , 3g , 4g , 5g and 6g , the values of the pH recorded were 6.9 , 6.9 , 7.0 , 7.1 , 7.1 and 7.2. Also , the values recorded for turbidity were 28.3NTU , 28.1NTU , 27.6NTU, 27.2NTU , 26.5NTU and 26.2NTU . And 83mg/l , 83mg/l , 79mg/l , 76mg/l , 75mg/l and 75mg/l for TDS. While the results recorded for colour were 15 , 15 , 10 , 10 , 5 and 5. Also , the results for phytochemical analysis showed the presence of Tannins , Saponins , Flavonoids and Anthracene***

***Key Words : Waste Can , Moringa Seeds , pH , Turbidity , Phytochemicals***

**1.0 INTRODUCTION**

Natural coagulants have been increasingly popular in the past few years due to its benefits and the fact that it resolves most of the associated problems when using chemical coagulants. Plant-based natural coagulants perform coagulation either by polymer bridging or charge neutralization; it can be extracted from various plant components. Coagulation and flocculation processes are widely used in water and wastewater treatment. Its main objective is to remove suspended colloidal particles and to reduce turbidity in water body (Choy *et al*., 2014). The process usually takes place in a chemical reactor in which the influent water or wastewater enter the basin and it is mix with coagulant agents using a mechanical mixer, followed by sedimentation process to remove the particulate through gravity settling [Hammer 2004]. There are many types of coagulants available. The most often used are the chemical-based coagulants such as alum and ferric salts (Fathinatu 2014). However, the use of these chemical coagulants resulted in many downsides such as harmful voluminous sludge production (Fathinatu 2014). There are also coagulants derived from plant -based materials known as natural coagulant. Natural coagulants are safe and eco friendly (Choy *et al.,* 2014) It can be extracted from plant, microorganisms and animals (Fathinatu 2014). Some of the plants are able to be a coagulant because they are able to conduct some of the coagulation mechanisms which are neutralizing the charge in colloidal particles and perform polymer bridging (Kristiano 2017 )

Water is a vital substance and of paramount importance in all Natural and anthropogenic activities. It regenerates shapes and oceans, seas, rivers, lakes, and forest becoming part of the identity of environment and landscapes and also of paramount importance for the developments and of ecosystem and human life. While in the past it has been considered an infinite good but currently misuse coupled with growing demand, has made reserves of fresh and clean water decrease (Telles and costa 2007).

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 aluminium 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 (Daniyan *et al*.,2011).

Modern beverage containers are usually composed of either aluminum, in the form of aluminum cans, or polyethylene terephthalate(PETE), the clear plastic beverage bottles. Approximately 300 million aluminum beverage cans are produced each day in the U.S.

Aluminum is one of the most indestructible materials used in metal containers. The average “life” of an aluminum can is about one hundred years. Although aluminum is the third most abundant element in the earth’s crust, the expense of extracting it from common soils is too expensive and the major source is the ore bauxite, the hydrated form of aluminum oxide, Al2O3⋅2H2O. Although there is concern regarding the depletion of aluminum ores, the major concern is the amount of electrical energy needed to extract the aluminum from its ores.To produce a single can, the energy needed is about the same as that requires to keep a 100-watt bulb lit for 6 hours. That energy can be reduced by up to 95 percent by recycling used aluminum cans. Recycling also has the benefit of reducing litter from discarded cans and a number of states have passed laws requiring a deposit on aluminum cans to encourage recycling.

In this experiment, instead of recycling aluminum in to new metal cans, a chemical process will be used that transforms scrap aluminum into a useful chemical compound, potassium aluminum sulfate dodecahydrate, KAl(S04)2•12H20, commonly called “alum”. Alum is widely used in the dyeing of fabrics, in the manufacture of pickles,in canning some foods, as a coagulant in water purification and waste-water treatment plants, and in the paper industry.

The class of chemical compounds known as “alums” are ionic compounds that crystallize from solutions containing sulfate anion, SO42-, a trivalent cation, such as A13+, Cr3+, or Fe3+, and a monovalent cation, such as K+, Na+, or NH4+

Most alums crystallize readily as octahedra or cubes which, under the appropriate conditions, may grow to considerable size. Six of the 12 water molecules per formula unit are bound tightly to the trivalent cation. The remaining six are loosely bound to the sulfate anion and monovalent cation.

**1.2 MECHANISM OF COAGULANTION**

There are mainly four types of coagulation mechanisms which are double layer compression, polymer bridging, charge neutralization and sweep coagulation. However, only polymer bridging and charge neutralization are the possible coagulation mechanisms for plant-based natural coagulant. Polymer bridging is preceded by polymer adsorption which is a process where long chain polymers attach itself to the colloidal particle’s surface because of the affinity present between them. Only some part of the polymers is attach to the particle while the unattached parts will form loops and tails used to stabilize the particles, gaining near to zero zeta potential. Charge density of the polyelectrolyte will determine the optimum dosage of polyelectrolyte needed because higher charge density corresponds to lower coagulant dosage. The basis of charge neutralization is that the adsorption of high charge density polyelectrolyte’s by low charge density colloidal particles occurs in a ‘patch wise’ manner. This is called electrostatic patch mechanism meaning that the particle’s surface having patches of positive and opposite charged regions are properly aligned.

**PROBLEM STATEMENT**

The increase in population , leads to high demand of treated water for domestic purposes , and this leads to high demand of coagulants both organic and inorganic for water treatment processes , which are also expensive . Aluminium is a valuable material with many importance , among which is the packaging of beverages.Yet , after drinking or using the beverage , the cans or the Aluminum package are discarded.This adds to solid waste into the land , and subsequent environmental pollution . Also , the seeds of Moringa are mostly discarded , and they too adds to solid waste into the environment

**JUSTIFICATION**

Production of synthetic alum from waste aluminum cans and coagulant from Moringa seeds powder will help to provide other means of producing coagulants.This will help to minimise environmental pollution , provide cheaper and effective coagulants for both domestic and industrial scale water treatment purposes.

**1.3 AIM AND OBJECTIVES**:

The aim of this research work is to compare the effectiveness of synthetic alum produced from waste aluminum cans and natural coagulant produce from Moringa seeds powder in raw water treatment.

**The objectives of the research work are as follows:**

1. To produce synthetic alum from waste aluminum cans.
2. To produce natural coagulant from Moringa seeds
3. To conduct phytochemical screening of the Moringa Seeds
4. To conduct qualitative test on the synthesized alum
5. To conduct jar test analysis using the two coaglunts
6. To conduct physicochemical analysis of the settled water produce after the jar test analysis

**1.4 ADVANTAGE AND DISADVANTAGE OF NATURAL COAGULATIONS:-**

Natural coagulant gains the advantage over chemical coagulant due to various reasons. One of the reasons are natural coagulant are safer than chemical coagulant. When using coagulant for water treatment, there will be possibilities of residue coagulant present in the water after the treatment. Chemical coagulant residue such as alum is harmful because it can cause Alzheimer disease if consumed (Garde *et al.,* 2017). On the other hand, if natural coagulant was used, the residual coagulant would not be harmful. Likewise, natural coagulant is much cheaper compared to chemical coagulant. Chemical coagulant such as alum, need coagulant aid to effectively treat high turbidity water, thus making it more expensive and difficult to be used in poor countries. Whereas natural coagulants are much cheaper and can be extracted from various plant wastes which greatly reduce the treatment cost (Antov *et al.,* 2010). Nevertheless, an abundance and locally available resource must be met to use natural coagulant commercially. Natural coagulant also has some disadvantages. Using natural coagulant will increase the organic matter present in the water, thus increasing microbial activity. Consequently, additional chlorine should be used to sanitize the treated water (Debora *et al.,* 2013). Besides that, natural coagulant such as *Moringa oleifera* need longer sedimentation time than chemical coagulant (Awad *et a.,l* 2013) and although some coagulant has antibacterial property that can treat E. coli infested water, the removal efficiency is not complete, thus secondary bacterial growth risk could occur.

**MATERIALS AND METHODS**

**SOURCES OF MATERIALS**

The raw water sample was collected at the back Zobe water treatment plant sample collection point. The seeds of the Moringa was obtained from a nearby irrigation farm at Dutsin-ma Town, Katsina State Nigeria. While the waste cans were collected from different locations in Dutsin-ma town.

**Materials and Method**

(Production of alum from aluminium cans)

* Aluminum beverage can
* Potassium hydroxide, KOH, 1.4 M solution
* Sulfuric acid, H2SO4, 9 M solution
* Ethanol
* Sandpaper
* Scissors or metal snips
* Ruler
* Beakers, 50-mL or 100-mL, 250-mL, 600-mL
* Bunsen burner or hotplate
* Vacuum filtration apparatus: Buchner funnel,side-arm flask, rubber tubing, and filter

paper

* Stirring rod
* Spatula, and Graduated cylinder.

**PROCEDURE FOR THE PRODUCTION OF ALUM FROM WASTE CAN**

An empty aluminum cans were obtained and brought in to the lab. The aluminum were coated at approximately about 5 cm x 7.5 cm from the can by the used of scissor. Sand paper, were use to scrape off any paint and/or plastic coating from both sides, as completely as possible. 1.0g of aluminum were weighted and put into 250-ml beaker. 50 ml of 1.4 M potassium hydroxide were added to the 250-mL beaker containing the aluminum pieces. The beaker was then placed on a hotplate, in a fume hood and heated , but not boiling. Bubbles of hydrogen formed from the reaction between aluminum and aqueous potassium hydroxide was observed. The reaction was complete as the hydrogen evolution ceases and there were no visible pieces of aluminum metal. While the reaction was taking place, the initially colorless mixture turns to black. The hot solution was filtered to remove any solid residue and black substance in the solution. The clear filtrate solution is transferred into a clean 250-mL beaker. As the solution was cooled, 20 ml of 9.0M H2SO4 is added to the solution and stirring gently, the final solution contained potassium ions (from the KOH used), aluminum ions, and sulfate ions. The solution was also filtered using filter paper , an ice water bath is prepared. The beaker containing the solution was placed in to the ice water bath and the mixture was allowed to chill. Cold water was added to cover the ice. The reaction beaker was set into the ice-water bath to chill at about 20minutes. Crystals of the alum was begun to form in a few minutes. The alum crystal formed was filtered from the chilled solution.

**Preparation of Moringa Seeds Powder**

The seeds of the moringa was washed with clean water, then dried under the sun for four days. The dried seeds were grinded using pestle and mortar, and the powdered Moringa seeds was obtained.

**Reagent and apparatus**

1. Beakers
2. Conical flaks
3. Weighing balance
4. Electric blender
5. Soxhlet extraction apparatus
6. Seed of watermelon plant
7. N-hexane
8. Distilled water

**Methodology**

150g of the powdered Moringa seeds were weighed and placed in a thimble, 500ml of n-hexane was added, the thimble was then be placed in a soxhlet apparatus, it was then allowed to stand for 6hrs, the set up were stopped as the extraction completed. The powdered seed were washed with distilled water and remove the residual n- hexane, the residue was dried in an oven till constant weight is obtained. The finer particle finally obtained is termed as coagulant.

**Method of water analysis**

Equipments and Instruments

1. Turbidity Meter

2. TDS meter

3. Comparator and Disc

4. PH meter

5. Beakers (500ml)

6. Pippete

7. Volumetric Flask

8. Pestle and Mortar

9. Mortar and Pestle

10. Distilled Water

**Preparation of Synthetic Alum Solution**

The stock solution of the synthetic alum was prepared by dissolving 5g of the synthetic alum powder in 1000ml of distilled water,to obtained the solution.The stock solution was used to conduct jar test analysis, as described by APHA , 2005

**Procedure of Jar Test Analysis**

The procedure of APHA , 2005 was used. The jar test machine was switched on and set at low speed.The raw water sample was put in 6 different beakers of 500ml. The stock solution of the synthetic alum was dispensed at different concentration of 20ml, 30 ml, 40 ml , 50 ml , 60ml ,70ml and 80ml respectively. The speed of the jar test machine was then increased at 400rpm for 10 minutes; which was later set at low speed again. This is to allow the margin of the smaller flocs formed to larger one. The procedure was repeated for synthetic alum powder and water melon seeds powder ; where different grams of 1g , 2g , 3g , 4g , 5g and 6g were put in a 6 beakers of 500ml of raw water sample. The following observations were made:

i. The rate of formation of flocs

ii.Rate of settling of flocs and flocs size

iii. clearity of the water

The settled water samples obtained using stock solution of synthetic alum , synthetic alum powder and Moringa seeds powder were analyzed for pH , turbidity , TDS and color.

**Determination of pH**

The 3 water samples (100ml each) were transferred into a clean dried glass beaker, then the electrodes of standardized pH meter was immersed and the meter was allowed to standardized, after which the reading was taken. The electrode was rinsed well with distilled water and tabbed slightly with tissue paper after each test as described by Geotechnical Engineering Bureau, 2007

**Determination of Turbidity**

The 3 samples of the water were transferred into the sample cell turbidity meter up to the horizontal mark, then wiped with tissue paper and subsequently placed in the turbidity meter such that the vertical mark in the sample cell coincide with the mark in the turbidity meter, after which it was covered. The readings displayed on the screen and were recorded, as described by NITTRC,2009.

**Determination of TDS**

The TDS of the samples were analyzed using TDS meter. The samples were put in a clean beakers and the head of the TDS meter was immersed in the beakers. Readings were taken for each sample separately, as described by APHA , 2005

**Determination of Color**

The color of the 3 water samples was analyzed using comparator and Disc, where the samples were put in different tubes of 10ml, and then inserted in the hole of the comparator. The disc was then scroll until a suitable and matching color was observed for each sample. The readings of the corresponding color for each was recorded, as described by APHA , 2005

**Procedure for the phytochemical analysis.**

i. Tanins: 3ml of the diluted extract was pipette into a clean test tube; ferric acid chloride solution was added dropwise into the extract. Presence of blue black colouration indicates the presence of tannin.

ii. flavonoids:3ml of the diluted extract was pipette into a clean test tube, 3ml of 0.1M HCl was added, also 0.5 of 0.5M NaCl was added. yellow color appearance indicates the presence of flavouniod.

iii. saponins :5ml of the diluted extract was pipette into a clean test tube and corked with cotton wool and shaked for about 3minutes. Persistent froth indicates the presence of saponin.

iv. Anthracene: 4ml of the diluted extract was pipette into a clean test tube equal volume of chloroform was added and shaked. The mixture was allow to separate into two layers. The chloroform layer was collected and 1ml of 10% ammonia solution was added and shake.

v. Alkaloid: 1ml of the extract was stirred with 5ml 10% aqueous HCl on a steam bath for 20 minutes cool and filter. 1ml of the filtrate was treated with few drops of mayer’s reagent. Creamy precipitate indicate the presence of alkaloid.

**RESULTS AND DISCUSION**

**Table 1. Results of physical parameters of Synthetic Alum( Powder )**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Mass of Synthetic Alum**  **( g )** | **Rate of settling**  **( minutes )** | **pH** | **Turbidity**  **( NTU )** | **TDS**  **( mg/l)** | **Colour**  **( Hazen)** |
| **0.5** | **5** | **6.6** | **5.6** | **44** | **5** |
| **1.0** | **4** | **6.4** | **4.9** | **44** | **5** |
| **1.5** | **4** | **6.2** | **4.3** | **41** | **5** |
| **2.0** | **3** | **5.9** | **3.1** | **38** | **5** |
| **2.5** | **2** | **5.8** | **2.9** | **36** | **5** |
| **3.0** | **1** | **5.3** | **2.3** | **36** | **5** |

**Table 2. Results of physical parameters of Synthetic Alum( Solution )**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Conc. in**  **(mg/l )** | **Rate of settling**  **( minutes )** | **pH** | **Turbidity**  **( NTU )** | **TDS**  **( mg/l)** | **Colour**  **( Hazen)** |
| **10** | **5** | **6.8** | **3.3** | **42** | **5** |
| **20** | **5** | **6.7** | **3.1** | **41** | **5** |
| **30** | **4** | **6.7** | **3.1** | **41** | **5** |
| **40** | **3** | **6.4** | **3.0** | **40** | **5** |
| **50** | **2** | **6.2** | **2.9** | **36** | **5** |
| **60** | **1** | **5.8** | **2.3** | **36** | **5** |

**Table 3. Results of physical parameters Moringa Seeds Powder**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Moring seeds powder**  **( g )** | **Rate of settling**  **( minutes )** | **pH** | **Turbidity**  **( NTU )** | **TDS**  **( mg/l)** | **Colour**  **( Hazen)** |
| **1** | **28** | **6.9** | **28.3** | **83** | **15** |
| **2** | **25** | **6.9** | **28.1** | **83** | **15** |
| **3** | **23** | **7.0** | **27.6** | **79** | **10** |
| **4** | **17** | **7.1** | **27.2** | **76** | **10** |
| **5** | **16** | **7.1** | **26.5** | **75** | **5** |
| **6** | **14** | **7.2** | **26.2** | **75** | **5** |

**Table 4 Result of the phytochemical analysis of moringa seed powdered.**

|  |  |  |
| --- | --- | --- |
| **S/NO** | **PHYTOCHEMICALS** | **COMFIRMATION** |
| **1.** | **ALKALOID** | **+** |
| **2.** | **TANNINS** | **+** |
| **3.** | **SAPONIN** | **+** |
| **4.** | **ANTHRACENE** | **+** |
| **5.** | **FLAVOUNOIDS** | **+** |

**Key:**

**+ Presence**

**\_ Absence**

**Table 5. Result of qualitative analysis of the synthesized alum.**

|  |  |  |
| --- | --- | --- |
| Test | Observation | Inference |
| Alum solution +  Aqueous BaCl2  Solution | White Precipitate  formed, and insoluble  (After 20 hours) | SO42-  Confirmed |
| Solid Alum Crystal+ heat (10 minutes) | Red flame turned to  Pale purple flame color | K+  Confirmed  Aluminate ion |
| Solution + H2SO4(aq)  in drop and in  Excess | Thick, white gelatinous  precipitate formed  insoluble in drop but  soluble in excess | Al3+  Confirmed |

**Discussion of Results**

**Table 1** showed the results for jar test analysis using synthetic alum powder. The values for rate of settling , pH , turbidity, TDS and color were analyzed and recorded. The values of settling time obtained at 1g , 2g , 3g , 4g , 5g and 6g were 5min , 4min , 4min , 3min , 2min and 1min respectively. The results indicated that, as the mass of the synthetic alum powder was increased ,the settling time decrease. This was observed when 1g of the synthetic alum powder was added , 5min was recorded as settling time. While 6g of the synthetic alum powder took 1min to settled the flocs in the water.The significant difference of 5min was observed among the values of the settling time. Also,the values of the pH recorded using different masses of 0.5g , 1g , 1.5g , 2g , 2.5g and 3g were 6.6 , 6.4 , 6.2 , 5.9 , 5.8 and 5.3 respectively. The results showed that increase in powdered synthetic alum increased the pH of the water to acidic range.This was observed at 1g of the synthetic, where 6.6 was recorded as pH value,and 6g of the synthetic alum powder where 5.3 was recorded as pH value.This showed the effect of synthetic alum powder on pH, because the initial value of the pH recorded for the raw water was 7.2 , which falls to 5.3 when 6g of the synthetic alum powder was added.The acceptable recommended value for pH of drinking water by WHO is 6.9 to 8.2. The values of the turbidity recorded were 5.6 NTU, 4.9NTU , 4.3NTU , 3.1NTU ,2.9NTU and 2.3NTU for 1g , 2g , 3g , 4g , 5g and 6g respectively. A significant difference of 3.3NTU of the turbidity value was recorded and it showed excellent potential in the turbidity removal. This is because, the initial value for the turbidity of the raw water was 37NTU,which showed that the synthetic alum powder was able to remove 33.9NTU of the turbidity present in the raw water, when the lowest turbidity value obtained is considered. The results for the TDS recorded were 44mg/l , 44mg/l , 41mg/l , 38mg/l ,36mg/l and 36mg/l for 1g ,2g , 3g , 4g , 5g and 6g respectively.The initial value for the TDS of the raw water was 292mg/l ,and the lowest value of the TDS recorded after the jar test was 36mg/l which was observed at 6g of the synthetic alum powder, while the highest value of the TDS recorded was 44mg/l. The recommended value for the TDS of drinking water by WHO is between 10mg/l to 300mg/l.Therefore,the synthetic alum powder has the potential to reduce TDS. The amount of both dissolved organic and inorganic substances present in the water is TDS. The values of the colour recorded was 5HAZEN in all the different grams of the synthetic alum powder.

**Table 2** showed the results for jar test analysis using synthetic alum solution.The values for rate of settling , pH , turbidity, TDS and colour were analysed and recorded.The values of settling time obtained at 1g , 2g , 3g , 4g , 5g and 6g were 5min , 5min , 4min , 3min , 2min and 1min respectively. The results indicated that, as the concentration of the synthetic alum was increased ,the settling time decrease. This was observed when 10ml of the synthetic alum solution was added , 5min was recorded as settling time. While 60ml of the synthetic alum solution took 1min to settled the flocs in the water.The significant difference of 5min was observed among the values of the settling time. Also,the values of the pH recorded using different concentration of 10ml , 20ml , 30ml , 40ml , 50ml and 60ml were 6.8 , 6.7 , 6.7, 6.4 , 6.2 and 5.8 respectively. The results showed that increase in concentration of the synthetic alum solution ,increase the pH of the water to acidic range.This was observed at 10ml of the synthetic alum solution, where 6.6 was recorded as pH value,and 60ml of the synthetic alum solution where 5.8 was recorded as pH value.This showed the effect of synthetic alum solution on pH.This is because the initial value of the pH recorded for the raw water was 7.2 , which falls to 5.8 when 60ml of the synthetic alum solution was added.The acceptable recommended value for pH of drinking water by WHO is 6.9 to 8.2.The values of the turbidity recorded were 3.3NTU, 3.1NTU , 3.1NTU , 3.0NTU ,2.9NTU and 2.3NTU for 10ml , 20ml , 30ml , 40ml , 50ml and 60ml respectively. A significant difference of 1.0NTU of the turbidity value was recorded and it showed excellent potential in the turbidity removal.This is because,the initial value for the turbidity of the raw water was 37NTU,which showed that the synthetic alum solution was able to remove 34.7NTU of the turbidity present in the raw water,when the lowest turbidity value (2.3NTU) obatained is considered.The results for the TDS recorded were 42mg/l , 41mg/l , 41mg/l , 40mg/l , 36mg/l and 36mg/l for 10ml , 20ml , 30ml , 40ml , 50ml and 60ml respectively. The initial value for the TDS of the raw water was 292mg/l ,and the lowest value of the TDS recorded after the jar test was 36mg/l which was observed at 60ml of the synthetic alum solution, while the highest value of the TDS recorded was 42mg/l. The recommended value for the TDS of drinking water by WHO is 200mg/l.Therefore,the synthetic alum solution has the potential to reduce TDS. The amount of both dissolved organic and inorganic substances present in the water is TDS.

The values of the colour recorded was 5HAZEN in all the different concentration of the synthetic alum solution.

**Table 3** showed the results for jar test analysis using water melon seeds powder.The values for rate of settling , pH , turbidity, TDS and colour were analysed and recorded. The values of settling time obtained at 1g , 2g , 3g , 4g , 5g and 6g were 28min , 25min , 23min , 16min , 16min and 14min respectively.The results indicated that, as the mass of the water melon seeds powder was increased ,the settling time decrease. This was observed when 1g of the water melon seeds powder was added , 28min was recorded as settling time. 6g of the seeds powder took 14min to settled the flocs in the water. The significant difference of 14min was observed among the values of the settling time. Also,the values of the pH recorded using different mass of 1g , 2g , 3g ,4g ,5g and 6g were 6.9 , 6.9 , 7.0, 7.1, 7.1 and 7.2 respectively. The results showed that increase in mass of the water melon seeds powder , decrease the pH of the water weakly acidic and neutral range.This was observed at 1g of the seeds powder where 6.9 was recorded as pH value,and 6g of the seeds powder where 7.2 was recorded as pH value. This showed that the water melon seeds powder has less or no effect on pH.This is because the initial value of the pH recorded for the raw water was 7.2 , which was maintained when 6g of the seeds powder was added. The acceptable recommended value for pH of drinking water by WHO is 6.9 to 8.2.The values of the turbidity recorded were: 28.3 NTU, 28.1 NTU , 27.6 NTU , 27.2 NTU , 26.5 NTU and 26.2 NTU for 1g , 2g , 3g, 4g , 5g and 6g respectively. A significant difference of 2.1 NTU of the turbidity value was recorded and it showed excellent potential in the turbidity removal. This is because, the initial value for the turbidity of the raw water was 37NTU, which showed that the water Moring seeds powder was able to remove 26.2NTU of the turbidity present in the raw water, when the lowest turbidity value (NTU) obtained is considered. The results for the TDS recorded were: 83mg/l , 83mg/l , 79mg/l , 76mg/l , 75mg/l and 75mg/l for 1g ,2 , 3g, 4g, 5g and 6grespectively.The initial value for the TDS of the raw water was 292mg/l ,and the lowest value of the TDS recorded after the jar test was 75mg/l which was observed at 6g of the water melon seeds powder, while the highest value of the TDS recorded was 83mg/l. The recommended value for the TDS of drinking water by WHO is 200mg/l. Therefore, the water melon seeds powder has the potential to reduce TDS. The amount of both dissolved organic and inorganic substances present in the water is TDS. The values of the colo r recorded were : 15 HAZEN , 15 HAZEN , 10 HAZEN, 10 HAZEN, 5HAZEN and 5HAZEN in 1g , 2g , 3g ,4g , 5g and 6g of the water melon seeds powder respectively.

**Table 4.** Presents the phytochemical analysis of the extracted watermelon seed powdered. The extracted seed found to contain the following; component: Tanins, Alkaloid, Saponins, Anthracene and flavonoid.

**Table 5.**  Presents the qualitative analysis of the synthesized alum crystal. The aluminum, Potassium and sulfate ions were positively tested as expected. This is an indication that the synthesized alum crystal possesses all necessary chemical properties expected of any alum crystal.

**CONCLUSION**

From the result obtained in this research, it showed that the use of natural coagulant is more effective than the chemical coagulants because the natural coagulant has the pH that is neither acidic not basic, hence neutral which falls within the range of 6.9 to 7.2, and chemical coagulant has an effect on a human body as such it causes a disease called Alzheimer.

Furthermore, the alum synthesized from aluminium cans has undergoes qualitative analysis which was found to contain Al3+,SO42-, and K+ ions

It can be concluded that the Moringa seed can be used as natural flocculant for water treatment.

**RECOMMENDATION**

The following recommendations were made :

The data obtained can be used for further research

Determion of heavy metals in the alum crystal synthesized from waste cans should be conducted.

Economic feasibility of the large scale production should be conducted.

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