MAKERERE UNIVERSITY

COLLEGE OF NATURAL SCIENCES

DEPARTMENT OF CHEMISTRY

BACHELOR OF SCIENCE IN INDUSTRIAL CHEMISTRY

FINAL YEAR PROJECT REPORT ON THE COAGULATION OF TURBID WATER USING JACKFRUIT SEED EXTRACT.

BY;

SSEKITOLEKO MARK

REGISTRATION NUMBER: 15/U/12794/PS

STUDENT NUMBER: 215007032

COURSE CODE: ICH 3232

SUPERVISOR: DR. NSAMBA HUSSEIN KISIKI

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JUNE 2018
DECLARATION.
I SSEEKITOLEKO MARK declare that the work produced in this report is from my research and the information given by the supervisor.

Signature

Date
27/11/2018
APPROVAL

This Report has been handed in to Dr. HUSSEIN KISIKI NSAMBA on this day of 27th
month .........., year 2019

Mark Ssekitoleko: ............................................................

Dr.Nsamba Hussein Kisiki: ................................................
DEDICATION
This report is dedicated to all the people living in remote regions of Uganda where clean water is inaccessible, and most especially to my mother Namatovu Teddy
APPRECIATION
First and foremost, I thank the Lord Almighty so much for the life and ability to carry on this course and the project bit successfully. Great thanks to my parents for the motivation and financial support and for being the good they’ve been. Thanks to NWSC for giving me that chance of using their resources during the period of doing the project. Not forgetting, my supervisor and fellow course mates for all the forms of support and guidance, together with encouragement, thanks so much
ABSTRACT
Turbid water was treated using both an extract of jackfruit seed (1% W/V) and a solution of aluminum sulphate (1% W/V) in separate experiments to monitor the coagulation and flocculation effects of each solution on the water. The set up with aluminum sulphate was used as a basis for comparing the performance of the seed extract since aluminum sulphate is well known for this work. The results showed that at all concentrations, the seed extract provided coagulant activity but at a less efficient performance than the aluminum sulphate. Turbidity removal expressed in percentage was used as a basis for conclusions as well as the comparison of the total suspended solids before and after treatment with the coagulant. The results showed that jackfruit seed extract is a potential valuable coagulant that can be used in absence of sophisticated methods of water treatment.
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CHAPTER 1: INTRODUCTION

INTRODUCTION TO RESEARCH PROJECT

As world demand for limited water resources grows, more sophisticated and extensive means will have to be employed to treat water. (S. Frontmatter, S. Manahan, Environmental Chemistry, 2000, 8th Edition, page 242)

Turbid water is characterized by suspended matter which may settle under gravity provided enough time is allowed for sedimentation, and/or colloids that are distributed throughout the water which may not settle even when much time is allowed. During the process of water treatment, these particles need to be removed and the process of particle segregation is adopted, which involves particles aggregation and precipitation from the colloidal suspension.

The hydrophobic colloids are readily coagulated by addition of small quantities of salts that contribute ions to solution. Such colloids are stabilized by electrostatic repulsion. Ions reduce the electrostatic repulsions so that the particles aggregate.

This experiment is carried out to evaluate the effectiveness of the natural coagulant compared to the widely used aluminum sulphate.

PROBLEM STATEMENT

There is limited access to clean and clear water in rural areas that obtain their water from ponds with stagnant water, therefore there is need to diversify water treatment methods and avail cheap and easy to adopt options, for example the use of the readily available materials or wastes for water treatment.

OBJECTIVES

Main objective

Coagulation of turbid water using jack fruit seed extract.
Specific objectives

Determination of turbidity removal of jackfruit seed extract

Comparison of efficiency of the jackfruit seed extract performance to the performance of aluminum sulphate.

JUSTIFICATION OF THE PROJECT

Jack fruit seeds are easily accessible in rural areas from jackfruit seed. The application of this treatment procedure does require a lot of input and can easily be adopted by the people living in the rural areas.

SIGNIFICANCE OF THE PROJECT

Existence of cheap and easy to apply methods of water treatment can help reduce the risks of diseases from consumption of unclean water.

SCOPE OF PROJECT

This method is not the best and should only be used where water treated by the national treatment plants is inaccessible for example deep in villages, and it can be employed to clarify turbid water from ponds prior to domestic use.
CHAPTER 2: LITERATURE REVIEW

GENERAL LITERATURE REVIEW

Jack fruit (Artocarpus heterophyllus) seed is known to contain phytochemicals like tannins and proteins that have coagulant and disinfection properties (Ndyomugyenyi et al. 2008).

A coagulant chemical when uniformly applied to water forms fine precipitating or settleable solids with the suspended matter (coagulation occurs). The fine settleable solids formed may be agglomerated into larger particles (flocs) by agitation of the water (flocculation occurs). The flocs formed will then normally settle at the bottom of the sedimentation tank or clarifier where it will be occasionally removed as sludge (water is clarified). The remaining flocs in the water will be removed by filtration.

SPECIFIC LITERATURE REVIEW

Seed extract using water shows Water extracts had optimal coagulant activity at a lower dose than salt extracts although salt extracts performed better at higher turbidity and coagulant activities increased with seeds extract doses as also demonstrated by other studies (Okuda et al., 2001b; Ghebremichael et al., 2005; Kalibbala 2007; Marobhe, 2008). The observations can be explained by the ability of salts to increase extraction efficiency of coagulants but not the coagulation process (Okuda et al., 2001b).

The apparent observed increased coagulation activity by NaCl is due to the salting-in mechanism in proteins found in the extracts leading to increased protein solubility as the salt ionic strength is increased.
CHAPTER 3: MATERIALS AND METHODS

The materials used in the experiment included;

- Jackfruit seed (Artocarpus heterophyllus)
- Oven
- Mortar and pestle
- Aluminum sulphate (Alum)
- Distilled water
- 500ml beakers (12)
- 1000ml measuring cylinders.
- UV spectrophotometer (HACH DR 6000)
- Turbidimeter (HACH 2100Q)

Methodology;

Preparation of jackfruit seed extract

The white seed coats were removed manually to leave the brown kernel. The seeds were dried in an oven at 50°C for 24 hours, crushed in a mortar and pestle to produce a powder. The powder was sieved using a 0.5mm mesh. Five grams of the powder were dissolved initially using 200ml of 1M NaCl, filtered, and then the solution made up to 500ml in the beaker to make a 1% W/V stock solution, form this solution, aliquots were taken as the coagulant solutions.

Aluminum sulphate solution (1% W/V) was prepared by dissolving 10g in a litre of distilled water.
Jar test was used to assess coagulant activity with varying coagulant doses i.e. 0, 20, 40, 60, 80, 100mg/L

The jar test procedure;

500ml raw water samples were put in six glass beakers of 1 litre volume numbered 1 to 6

The glass beakers were put in a floc tester and the lights under each jar position switched on. The stirrers were lowered into each jar ensuring that they never touched the walls of the beakers, and the motor of the stirrers switched on to agitate the water.

Different concentrations of coagulant added in the order of the numbered beakers from a concentration of 0 to 100mg/L i.e 0, 20, 40, 60, and 100mg/L, are added to the glass beakers (jars)

Initially, the samples were rapidly mixed at 300RPM (Revolutions Per Minute), for four minutes and then reduced to 50RPM, for 20 minutes before allowing quiescent settling for 15 minutes.

The supernatant after settling was analysed for total suspended solids as well as turbidity.
Turbidity for the raw water and the supernatant in each case was measured using a turbidimeter, the results were tabulated.

Turbidity removal was calculated as a % from the formula;

\[
\text{turbidity removal} = \frac{Tu - Ts}{Tu} \times 100
\]

Where Tu was turbidity of untreated water,

And Ts was the turbidity of the supernatant in the treated samples
CHAPTER 4: RESULTS, DISCUSSION AND CONCLUSION

RESULTS
The results obtained were summarized in the tables below

*Table 1: quality characteristics of turbid water used*

**quality characteristics of the raw water**

<table>
<thead>
<tr>
<th>Turbidity</th>
<th>87</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total suspended solids</td>
<td>113</td>
</tr>
</tbody>
</table>

After treatment with the coagulant, the results were as follows

*Table 2: Results and characteristics of water after treatment with the coagulant*

<table>
<thead>
<tr>
<th>Concentration of coagulant (mg/L)</th>
<th>Turbidity (NTU) of the supernatant</th>
<th>TSS</th>
<th>Turbidity removal (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Alum</td>
<td>Jackfruit seed extract</td>
<td>Alum</td>
</tr>
<tr>
<td>0</td>
<td>69.6</td>
<td>71.34</td>
<td>88.00</td>
</tr>
<tr>
<td>20</td>
<td>15.67</td>
<td>23.49</td>
<td>14.00</td>
</tr>
<tr>
<td>40</td>
<td>3.48</td>
<td>3.41</td>
<td>1.00</td>
</tr>
<tr>
<td>60</td>
<td>0.87</td>
<td>5.22</td>
<td>0.00</td>
</tr>
<tr>
<td>80</td>
<td>1.75</td>
<td>6.96</td>
<td>0.00</td>
</tr>
<tr>
<td>100</td>
<td>2.61</td>
<td>7.85</td>
<td>1.00</td>
</tr>
</tbody>
</table>

The graphs for the data obtained are as follows;
Figure 2: A graph of turbidity of the supernatant after treatment of the turbid water with different coagulant concentrations

Figure 3: A graph showing turbidity removal in percentage against the coagulant concentrations
DISCUSSION

Under all the treatments, there was a reduction in the turbidity of the water under treatment. The turbidity removal efficiency of aluminum sulphate was higher than that of jackfruit seed extract for all the coagulant concentrations the highest value for alum being 99%, while that of the seed extract was 94%.

There was a decrease in the total suspended solids under both scenarios which meant the seed extract can resemble aluminum sulphate in destabilization of colloidal suspensions, and therefore in the coagulation of turbid water.

Jack fruit (Artocarpus heterophyllus) seed is known to contain phytochemicals like tannins and proteins and so these have disinfection properties (Ndyomugyenyi et al. 2008), and so they have coagulant properties as well.

Aluminum sulphate is a better coagulant than jack fruit seed extract. However short comings of this comparison may include the fact that a unit gram of coagulant solid mass...
of jackfruit seed does not completely dissolve in solvent while preparing the coagulant extract, only a proportion of the seed powder dissolves. Therefore, the graphs are comparing a much less mass of seed against a larger mass of aluminum sulfate.

CONCLUSION
Jack fruit seed extract can be used for clarification of turbid water during its treatment for domestic use.
REFERENCES


