EVALUATION OF COAGULATION EFFICIENCY OF MORINGA OLEIFERA EXTRACT AND ALUM ON FISH POND WASTEWATER

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ABSTRACT

In this study titled evaluation of coagulation efficiency of Moringa oleifera and Alum in wastewater sample was carried out using fish pond wastewater. A preliminary investigation was carried out on initial parameters of fish pond wastewater such as turbidity, pH, BOD, electrical conductivity and total dissolve solid. Coagulant from Moringa oleifera seeds were extracted and the dosages were 2 ml, 4 ml, 6 ml and 8 ml same dose was applied to alum. Optimum dosage for percentage removal in turbidity using Moringa oleifera extract and Alum was found to be 89% and 96.8% respectively at 6 ml dose. Moringa oleifera has no significant effect on TDS, pH, EC and BOD except on BOD in which it increases the BOD. Alum increased the parameters mentioned above. Therefore, Moringa oleifera can serve as alternative coagulant to chemical coagulant alum in water and wastewater treatment.

***Keywords**: Moringa oleifera, Alum, fish pond wastewater*

INTRODUCTION

Wastewater is produced by community after domestic use. Components of wastewater vary from place to place and type of industry discharges. Domestic wastewater mostly contains waste from home garden, kitchen and bathroom. Other than this wastewater can be generated intentionally or unintentionally from houses. Sanitary wastewater contains commercial, domestic and institutional or similar kind of amenities. However, these wastewaters are usually turbid in nature, contaminated with microorganisms, contain suspended and colloidal particles. Most particulate matter cannot settle by gravity and their sizes are so small that they pass through the pores of most common filtration media (cech, 2005). Conventionally, the enmeshment and removal of the colloids in water could be achieved by coagulation, using certain chemical coagulants like certified alum. Many coagulants are widely used in conventional water treatment processes for tap water production. These coagulants can be classified into inorganic coagulants (e.g.aluminumsulphate, polyaluminum chloride, and ferric chloride), synthetic organic polymers (e.g. polyacrylamide derivatives and polyethylene amine) or naturally occurring coagulants (e.g. Chitosan, plant extracts) (Mataka Henry, Masamba and Sajidu, 2006).

Alum is the most widely used coagulant in water and wastewater treatment all over the world. However, some studies have reported that aluminum that remains in the water after coagulation, may induce Alzheimer's disease (Ordonez, Hermosilla, Moral and Blanco, 2010) besides, many developing countries can hardly afford the costs of imported chemicals for water and wastewater treatment. On the other hand, naturally occurring coagulants such as *Moringa oleifera* are biodegradable and are presumed safe for human health. The use of natural materials of plant origin to clarify turbid raw waters is not a new idea. In recent time there has been more interest in the subject of natural coagulants, especially to reduce the problems of water and wastewater treatment in developing countries and to avoid some health risks (Mataka *et al*., 2006). *Moringa oleifera* is a multipurpose tree native to Northern India that now grows widely throughout the tropics. Studies also revealed that *Moringa oleifera* can be either used in shelled or non-shelled dry form seeds. However, shelled seeds are more effective. Furthermore, sludge produced by *Moringa oleifera* during coagulation is not only innocuous but also four to five times less in volumes than the chemical sludge produced by alum coagulation (kebreab, Gunaratna, Brumer, Dalhammer, 2005). This study seeks to confirm and compare the efficiency of *Moringa oleifera* seed extract and alum in fish pond wastewater sample.

MATERIALS AND METHODS

Samples Collection

Dry seeds of *Moringa oleifera* and the commercially available alum were purchased from Engr. A. A. Kure Ultra-Modern Market Minna, Niger State. Seeds were sorted out and de-shelled by hand to remove the kernels. The kernels were crushed and ground to a medium fine powder by ceramic mortar and pestle and sieved using 250 µm sieve size to obtain a fine powder in order to achieve solubilisation of active ingredients in the seed.

Wastewater Collection

The fish pond wastewater was collected from Adamu Farm Airport City Estate Maikunkele Area of Niger state. The wastewater sample used was collected in 25 litres plastic container and was analysed for some physiochemical properties.

Experimental Procedure

Sample Preparation

Twenty five (25) litres of fish pond wastewater sample was fetched from Adamu Farm, this was further dispensed into nine (9) beakers. The volume of sample in each beaker was 500 ml.

Four different concentrations of the stock solutions for the loading dose were prepared by measuring 2.0 ml, 4.0 ml, 6.0 ml and 8.0 ml of alum and *Moringa oleifera* stock solution separately into a beaker containing 500 ml of raw wastewater. The mixtures in the beakers were stirred using a glass rod to obtain a clear solution. A 500 ml of raw wastewater with no alum neither *Moringa oleifera* stock solution was kept as the control treatment. The stirring was been performed to allow flocculation to take place.

The coagulant dosage can be selected depending on the turbidity of wastewater and can also be calculated (Guibal, et al., 2006). Floc formation was observed throughout this time and was allowed to settle for one hour before obtained for samples analysis. After settling, clear water sample was collected from each of the beaker by decantation and placed in small beaker for further analysis.

RESULTS AND DISCUSSION

Table 1, present the initial experiment carried out to determine the preliminary characteristics of fish pond wastewater. The characteristics of raw fish pond wastewater are as presented below.

Table 1: Preliminary Characteristics of Fish pond Wastewater (control)

Parameter	Wastewater
Turbidity (NTU)	90.6
pH	7.28
conductivity (µS/cm)	156
BOD (mg/L)	10
TDS (mg/L)	104

Effect of Coagulants on Constituent Parameters

The treatment efficiencies of M.O. and alum are presented in Tables 2 and 3. At the varying coagulant dosage, slight change was observed on pH, TDS, EC for sample treated with *Moringa Oleifera*. Alum increased the TDS and EC of the treated water and drastically reduced the pH in response to increasing dosage. The high levels of EC in the treated wastewater were the result of the dissolution of aluminum ions. This is in agreement with the findings of Ordonez *et al*. (2010) and Alo, et al., (2012) which indicated that conductivity increases as more coagulant is added to water. The sulphuric acid that was produced in the process resulted in the drop in pH of the treated wastewater.

Table 2: Characteristics of Treated Wastewater with *Moringa oleifera* Extract

Parameter	Coagulant Dosage			
	2 ml	4 ml	6 ml	8 ml
pH	7.50	7.40	7.31	7.32
Turbidity (NTU)	15.9	12.2	9.93	14.5
TDS (mg/L)	96	100	104	107
Conductivity (µS/cm)	143	149	154	160
BOD (mg/L)	27	82	71	48

Table 3: Characteristics of Treated Wastewater with Alum

Parameter	Coagulant Dosage			
	2 ml	4 ml	6 ml	8 ml
pH	4.47	4.31	4.26	4.23
Turbidity (NTU)	3.45	3.79	2.87	3.18
TDS (mg/L)	176	247	312	370
Conductivity (µS/cm)	263	368	465	552
BOD (mg/L)	0	33	0	0

Effect of Moringa oleifera Extract and Alum on Turbidity Removal Efficency

At optimum dosage of 6mL of *Moringa oleifera* (fig. 1), the turbidity of fish pond wastewater sample reduced from 90.6 to 9.93 NTU compare to alum at optimum dosage of 6ml (fig. 1) that reduce the same 90.6 to 2.87 NTU. The removal efficiency of *Moringa oleifera* and Alum coagulants are 89% and 96.8% respectively. This result agrees with Kayaton, et al.,(2004) that *Moringa oleifera* coagulant is not efficient in treating low turbidity water. The variation in performance could be due to different protein contents of seed and development owing to varying geological locations (Narasiah, et al., 2002). Residual turbidity in the control is 50 NTU. It is therefore concluded that the method of allowing water to settle without coagulation is not efficient.

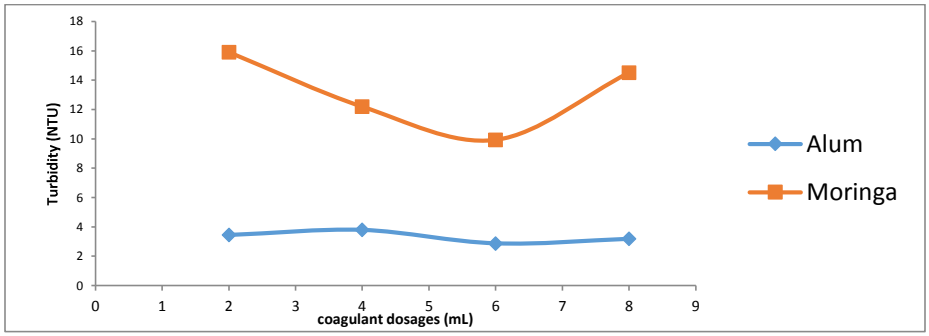

Figure 1: Effect of coagulants on Turbidity

Effect of Moringa oleifera Extract and Alum on pH

From fig. 2, there is slight change in pH after treatment. As *Moringa oleifera* dosage increases from 2 ml, 4 ml, 6 ml, to 8 ml give the yield 7.50, 7.40, 7.31 and 7.32 respectively. Thereafter, as dose of alum increases, the initial pH of wastewater which was 7.26 reduced to 4.47, 4.31, 4.26 and 4.23 respectively. The concentration of alum increases acidity of wastewater.

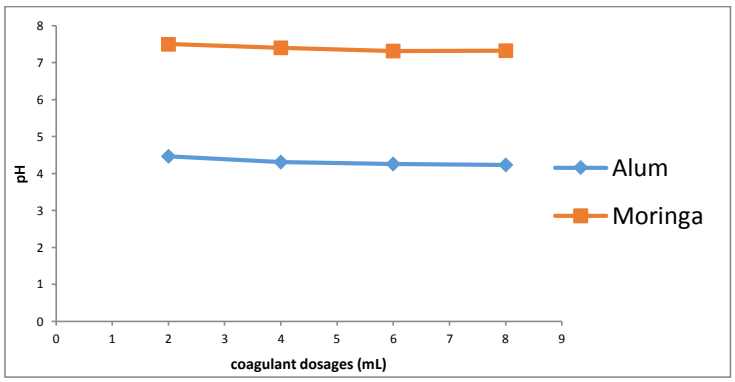

Figure 2: Effect of coagulants on pH

Effect of Moringa oleifera Extract and Alum on Total Dissolve Solid (TDS)

According to fig. 3 the *Moringa oleifera* extract has minimal effect on total dissolve solid. Increase in alum dosage leads to increase in initial TDS of 104 mg/L to 176 mg/L, 247 mg/L, 312 mg/L and 370 mg/L respectively. This show that alum increases the total dissolved solid (TDS) of wastewater.

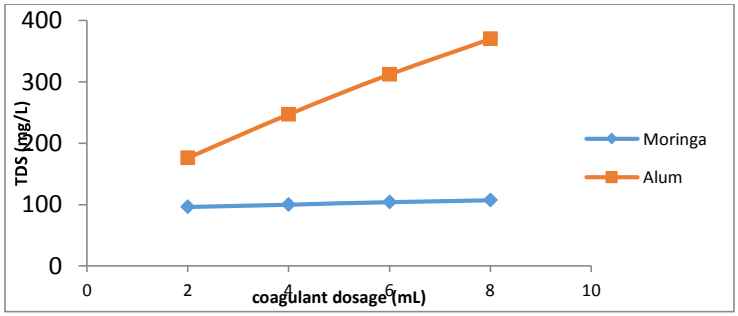

Figure 3: Effect of Coagulants on Total Dissolve solid (TDS)

Effect of Moringa oleifera Extract and Alum on BOD Removal

The initial BOD of the wastewater was 10 mg/L (table 1). Treatment with *Moringa Oleifera* extract (fig. 4) increased BOD in wastewater sample compare to alum (fig. 4) which has 100% BOD removal efficiency after treatment. The result shows that alum is more efficient in BOD removal than *Moringa oleifera* Extract.

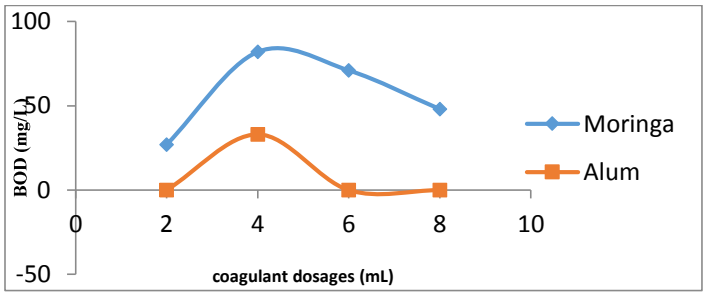

Figure 4: Effect of Coagulants on BOD

Effect of Moringa oleifera Extract and Alum on Conductivity

There was slight change in conductivity of the wastewater after treatment prior to addition of *Moringa oleifera* extract while alum increased conductivity of the wastewater due to dissolution of aluminium ions. Conductivity increases as dose of alum increases (fig 5).

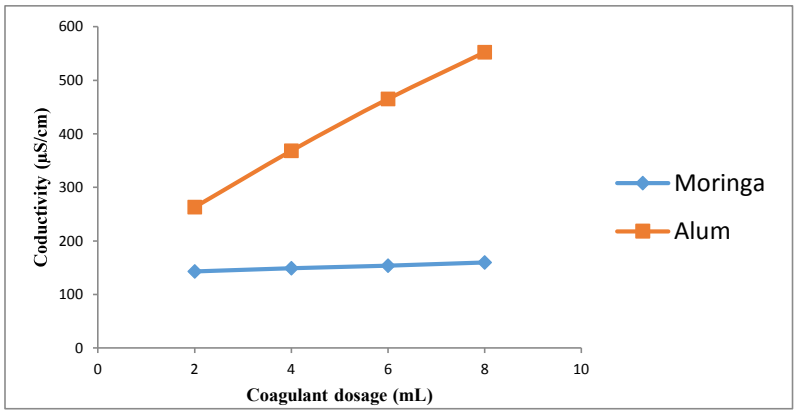

Figure 5: Effect of Coagulants on Conductivity

CONCLUSION

After the treatment of the collected fish pond wastewater using the natural coagulant *Moringa oleifera* (MO), it was observed that the optimum dosage for removal of turbidity was 89% and for Chemical coagulant Alum ($Al_2(SO4)_3.18H_2O$ was 96.8% both at 6 mL dose. When MO and Alum was used as a coagulant in the removal of TDS, pH, EC and BOD, MO extract was observed to have no significant effect on TDS, pH, EC except on BOD in which it increases the BOD while Alum increased the aforementioned parameters.

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