Assessment of *Moringa oleifera* as a Natural Coagulant for Wastewater in the Philippines

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Introduction

Most water treatment facilities in the Philippines, especially large scale companies, use Aluminum sulfate as coagulant. The disadvantages of alum include health-related problems such as Alzheimer’s disease (Muthuraman and Sasikala, 2014), large sludge volume, and pH reduction (Ndabigengesere and Narasiah, 1998). This study would research on a natural coagulant that is as effective as alum, without the same disadvantages that it brings. Specifically, this paper proposes the usage of M. oleifera as an alternative coagulant because of its efficiency as a coagulant, local availability, and cost-effectiveness. In contrast to chemical coagulants, naturally occurring coagulants are usually presumed safe for human health (Ali et al, 2009), environment friendly and generally nontoxic (Choy, 2014). Natural coagulants have also been found to generate sludge volume that is five times lower than that of alum (Ndabigengesere et al., 1995). This translates to cheaper sludge treatment and handling and makes natural coagulants like M. oleifera a more sustainable option. Additionally, M. oleifera is indigenous and is available locally in the Philippines. Therefore, there would be many sources of this plant in the country and hence, a low-cost alternative to chemical coagulants. Lastly, since natural coagulants do not consume alkalinity unlike alum, pH adjustments can be omitted and this provides extra cost savings (Choy, 2014).

The general objective of this study is to evaluate the effectiveness of M. oleifera seed as a natural coagulant- its ability to remove turbidity as in the case of river water and total suspended solids (TSS) as in the case of wastewater. This will be done by determining the optimum dosage that will yield the highest removal efficiency for turbidity and total suspended solids. This research will also determine the most effective method of extracting the active coagulating component of M. oleifera. These objectives will be achieved by varying the dosage of M. oleifera, and the extraction methods used in this research. The effect of M. oleifera on pH, Biochemical Oxygen Demand (BOD), and Sludge Volume Index (SVI) will also be looked into. To further assess its effectiveness, the results of experiments done on M. oleifera will be compared to that of widely used chemical coagulant, alum. Lastly, this study would like to assess if M. oleifera seeds may be used as coagulant for large-scale water treatment processes.Material and Methods

Methodology

Water samples were collected from rivers (Marikina and Pasig) and sewage treatment plants (Olandes, K8, Pinagsama). M. oleifera seeds were dried and pulverized before the extraction of the active coagulant components.

The extraction of the active coagulating components was done using 1M NaCl solution, 1M NaOH solution and distilled water. Standard jar tests were performed for the Moringa oleifera to determine the optimum dosage, varying from 5, 10 and 15 ml. Turbidity of the river water and the total suspended solids (TSS) and of the wastewater were measured before and after the treatment. The pH levels for all samples were also measured. The biochemical oxygen demand (BOD) and sludge-volume index (SVI) of the wastewater treated by M. oleifera were also measured. The performance of M. oleifera was compared with that of the alum.

Results and Conclusions

This is the first study in the Philippines that assesses the effectiveness of M. oleifera as a natural coagulant in treating river water and wastewater, M. oleifera is indeed an effective and promising natural coagulant with turbidity removal efficiency of 92% when treating river water at optimum dosage of 15 ml and TSS removal efficiency of 95% when treating wastewater at optimum dosage of 10 ml. The most effective extraction method is using sodium chloride. Moringa oleifera seeds present a viable alternative to alum because their difference in coagulating capacity is very minimal with only 8% difference when treating river water and 3% when treating wastewater.

Analysis of the treated waters shows that Moringa oleifera seeds do not significantly affect the pH of both river water and wastewater. Compared to alum, Moringa oleifera seeds do not need pH adjustments. The sludge produced by M. oleifera is considered good sludge with SVI of 125.

There is also no significant change in the BOD of the wastewater because of the organic compounds present in M. oleifera. Therefore, there is a need for an adequate purification and isolation of the active proteins of Moringa oleifera seeds before it could be used in the large-scale water and wastewater treatment industry to avoid microbial decomposition of said organic matter.

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Figures

**Dosage (ml)**

*Figure 1. Comparison of Average* ***Turbidity Removal Efficiency*** *of M. oleifera in River Water*

**Dosage (ml)**

*Figure 2. Comparison of Average* ***TSS Removal Efficiency*** *of*

*M. oleifera in Wastewater*

**Dosage (ml)**

*Figure 3. Comparison of the Effectiveness of M. oleifera Against Aluminum Sulfate (River Water)*

**Dosage (ml)**

*Figure 6. Comparison of the Effectiveness of M. oleifera Against Aluminum Sulfate (Wastewater)*