EFFECTIVENESS OF NATURAL WATER COAGULANT, *STRYCHNOS POTATORUM* ("INGINI") SEEDS ON THE REMOVAL OF DRINKING WATER POLLUTANTS

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Introduction

Water is a unique gift of nature and is the most widely occurring resource on the earth. Water covers nearly two third of earth surface. Out of that only 1% of fresh water is available for all living organisms. According to the United Nations, 1.1 billion people still do not have access to an adequate supply of drinking water. Treatments of drinking water with the common inorganic coagulants have a number of disadvantages especially for developing nations. The *Strychnos potatorum* ("Ingini") is one of the natural coagulants that have been tested over the years as an alternative to the use of inorganic and synthetic coagulants. It occurs from Congo and Tanzania to northern South Africa and it was probably introduced in Asian countries like India, Sri Lanka and Myanmar by Arabic traders. The seed and its powder form have been used for water clarification on small scale in some parts of the developing world. The removal of particulate matter in water treatment has gained greater importance to achieve turbidity standard, and the recognition that naturally suspended particles represent transport vehicles for undesirable organic and inorganic contaminants, taste, odor and colour-causing compounds, and pathogenic microbial contaminants. The tree is also an important medicinal plant.

This research describes investigations of the effectiveness of the *Strychnos potatorum* seed and seed powder coagulant for the removal of turbidity, water hardness causing cations (Mg^{2+}, Ca^{2+}), heavy metal cations (Pb^{2+}, Cr^{3+}, Cd^{2+}), Fluoride ions (F^-) and determination of Chemical Oxygen Demand (COD) of treated water.

Materials and Methods

Seeds and finely grounded *Strychnos potatorum* ("Ingini" - Sri Lankan plant) seed materials used in this study were purchased from the local market and used without further grinding and sieving. Turbid water was prepared by soaking natural clay overnight in distilled water and ionic water samples were prepared using corresponding salt dissolving in deionized water. Jar test experiments were carried out to evaluate parameters by leaving overnight contact period on without disturbing condition. Turbidity was measured by HACH, 2100P portable Turbidimeter and % removal of turbidity was calculated. Metal ion concentrations were measured using Thermo – M Series Atomic Absorption Spectrophotometer (AAS). Percent

removal of ion was calculated. IR analyses of the used adsorbents were performed by FTIR-Prestige - 21 (SHIMADZU) spectrophotometer. X – Ray Fluorescence (XRF) Spectra of used adsorbents were obtained using Fischer XRF spectrophotometer, after eight times cool washing and two times hot washing with deionized water.

Results and Discussion

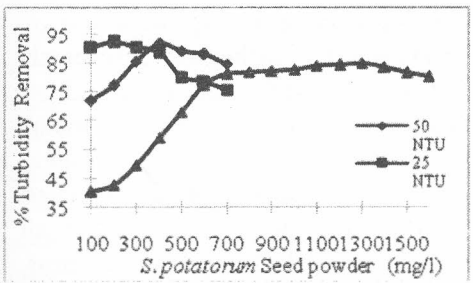

Fig.1. Effect of adsorbent dose on % removal of turbidity.

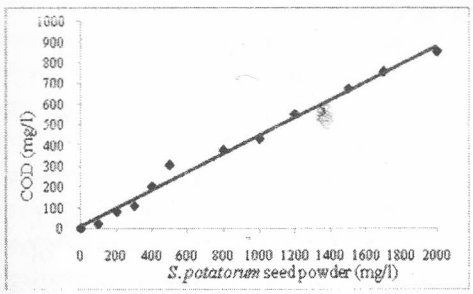

Fig.2. Effect of adsorbent dose on COD.

Turbidity removal was increased with increasing seed powder dose. The minimum doses of seed powder, 200, 400 and 1300 mg/l gave maximum % turbidity removal 92%, 91% and 85% for initial turbidities of 25, 50 and 100 NTU respectively (Figure 1). Although, pH value decreased and there was no desired variation in conductivity of treated water as seed powder dose increased. The COD of treated water increased with the seed powder dose due to extraction of various organic compounds from seed materials (Figure 2). The removal of Ca^{2+} and Mg^{2+} ion was individually tested on different doses of *Ingini* seed powder and it was found that both ion concentrations were higher in water after treatment in comparison to its concentration in control(Figure 3).

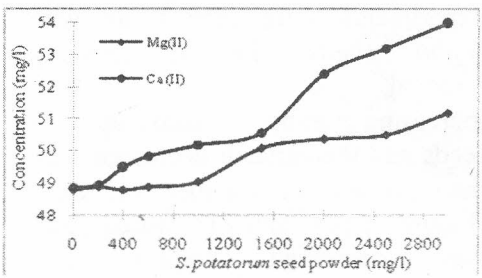

Fig.3. Effect of adsorbent dose on Ca^{2+} and Mg^{2+} concentration.

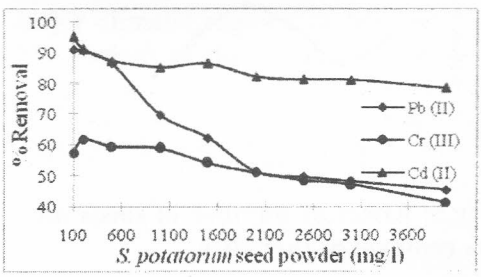

Fig.4. Effect of adsorbent dose on % removal of metal ions.

Removal of Pb^{2+}, $Cr^{3+}$and Cd^{2+} on *Ingini* seed powder was also separately investigated on adsorbent loading dose. In the present case, % removal of above heavy metal ions decreased when the seed powder dose progressed (Figure 4). The effect is possibly due to the lumping of the available exchangeable sites or

surface area of the adsorbent by floc formation. IR-spectra of seed powder indicated the presence of ionizable functional groups; their ionization leaves vacant sites which can be replaced by metal ions. Further, XRF spectra give solid evidence that tested heavy metals are not run off on adsorbent. Furthermore, removal of F^- ions present in drinking water was not effective with seed powder treatment.

As a comparison, some of above experiments were carried out with *Ingini* seeds. Percent turbidity removal was increased with increasing number of seeds up to 4 seeds and thereafter it decreased with the increase in number of seeds (Figure 5). pH value of finished water was decreased slightly and conductivity increased slightly when addition of seed progressed.

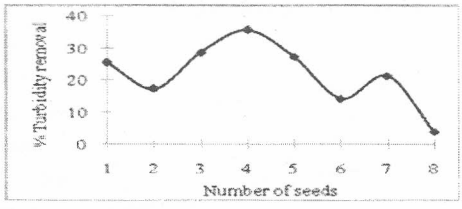

Fig.5: Effect of number of seeds on % removal of turbidity.

Similar results were obtained on Ca^{2+} and Mg^{2+} ions removal as in the seed powder experiment in which concentration of both ions were increased with the addition of seeds. Figure 6 presents the increase in % removal of Pb (II) and Cr (IV) metal ion removal with the increasing number of *Ingini* seeds.

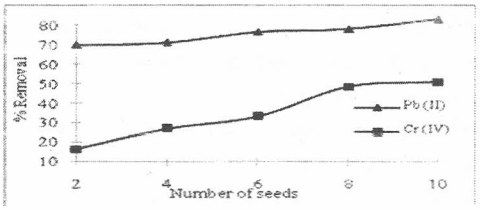

Fig.6: Effect of number of seeds on % removal of metal ions.

Conclusions

Seed powder and seeds of *S. potatorum* contain materials that are effective as coagulant for treatment of turbid water. Furthermore, research revealed that seed material could be used to remove heavy metal contaminations in drinking water. Furthermore, addition of higher doses of either seed powder or number of seeds increased the water hardness and organic matter.

References

Babu, B. and Chaudhuri, M. (2005). Home water treatment by direct filtration with natural coagulant, Journal of Water and Health, 03 (1): 27-30.

Jayaram, K., Murthy, I. Y., Lalhruaitluanga, H., & Prasad, M. N. (2009). Biosorption of lead from aquous solution by seed powder of *Strychnos potatorum* L. Colloidel and Surfaces B: Biointerfaces, 71 (2): 248-254.

Perera, B.A. (2009). Studies on the potential use of *Strychnos potatorum* seeds for water purification, International forestry and environment symposium, 19 Dec 2009. Sri Lanka.