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The Efficiency of *Eicchornia crassipes* in the Phytoremediation of Waste Water from Kaduna Refinery and Petrochemical Company

Ugya A.Y.[1] and Imam T.S.[1]
Faculty of Sciences, Department of Biological Sciences, Bayero University Kano, Kano State. Nigeria[1]
Corresponding Author Email- ugya88@yahoo.com +2347039496546

Abstract: *The study involved a laboratory experiment on the use of* ***Eicchornia crassipes*** *in the phytoremediation of a stream polluted by waste water from Kaduna Refinery and Petrochemical Company. The physiochemical characteristics of the waste water were determined before and after the treatment. The experiment lasted for three weeks and the rate of reduction was recorded. The highest rate of mean reduction were for heavy metals accounting 99.0%, 95.0%, 96.3%, 100%, 99.3% and 94.3% of Cd, Hg, Zn, Mn, Pb and Ag respectively. Other physiochemical parameters include Total Dissolved Solids (TDS) 90%, Chemical Oxygen Demand (COD) 54.3%, Nitrate 86.3%, Biochemical Oxygen demand (BOD) 13.7%, Conductivity 11%, Total suspended Solids (TSS) 55.7%, Turbidity 18%, 87% Total Solids (TS) and the pH 4%. Ecchornia crassipes is a suitable candidate for effective phytoremediation of water from Romi stream.*

Keywords: *Efficiency, Eicchornia crassipes. Phytoremediation, Romi Stream.*

I. Introduction

The world's ever increasing population and her progressive adoption of an industrial- based lifestyle has inevitably led to an increased anthropogenic impact on the biosphere (Asamudo *et al*., 2005).

In refining of refinery products opportunities exist for the release of other pollutants such as oil and grease, phenol, sulphate, suspended solids, dissolved solids, nitrates, e.t.c (Asamudo *et al*., 2005; Ji *et al*., 2007; Patel and Konungo, 2010; Nayyef and Amal, 2012) in to the ecosystem.

These pollutants are produce in an effort to improve human standard of living but ironically their unplanned intrusion into the environment can reverse the same standard of living by impacting negatively on the environment (Subhashini *et al*., 2003; Xiaomei *et al*., 2004; Asamudo *et al*., 2005).

Refinery effluents can seep into aquifers and pollutes the underground water or where it is discharge without proper treatment into water bodies, the pollutants cannot be confined within specific boundries (Asamudo *et al*., 2005; Nayyef and Amal, 2012) . They can therefore affect aquatic lifes in enormous ways.

Several technologies are available to remediate water that is contaminated by pollutant. However, many of these technologies are costly (e.g. excavation of contaminated material and chemical/physical treatment) or do not achieve a long-term nor aesthetic solution (Mulligam *et al*., 2001; Singh *et al*., 2003). Phytoremediation can provide a cost-effective, long-lasting and aesthetic solution for remediation of contaminated sites (Ma *et al*., 2001).

In many cases, especially in tropical or subtropical areas, invasive plants such as the water hyacinth (*Eichhornia crassipes*) and water lettuce (*P. stratiotes* L.) are used in these phytoremediation water systems (Karpiscak *et al.,* 1994; El-gendy *et al.,* 2005). This is because, compared to native plants, these invasive plants show a much higher nutrient removal efficiency with their high nutrient uptake capacity, fast growth rate, and big biomass production (Reddy and Sutton, 1984) . In the active growth season, for instance, water hyacinth plants can double in number and biomass in 6 to 15 days (Lindsey and Hirt, 1999).

This study was designed to assess the efficiency of *Eicchornia crassipes* in the phytoremrdiation of water from Romi Stream since Kaduna refinery and petrochemical company discharge it waste water directly into the stream.

II. Materials And Methods

2.1 Study Area.

Eicchornia crassipes was collected from a pond located in Kinkinau Ungwar Ma'azu Kaduna state, Nigeria. Water sample was collected from Kaduna refinery and petrochemical company effluent point, Romi up and Romi down.

2.2 Experinmental Method:

Eicchornia crassipes was kept on a filter paper to remove excess water and then transferred into plastic troughs having a capacity of five litres containing water from different points. Before transferring the test plant into the trough containing the water sample, the water characteristic were determined by analyzing some physiochemical parameters like TSS, TDS, BOD_5, COD, Conductivity, pH, Turbidity, Nitrate and some heavy metals such (Mn, Zn, Ag, Cd, Hg and Pb) (APHA, 1995; 1998).

After 21 days, the water was re-analyses. The value before phytoremediation was noted as initial value while the value after phytoremediation is indicated by final value. All the analysis was done using the methodology of (APHA, 1995; 1998).

III. Results And Discussion

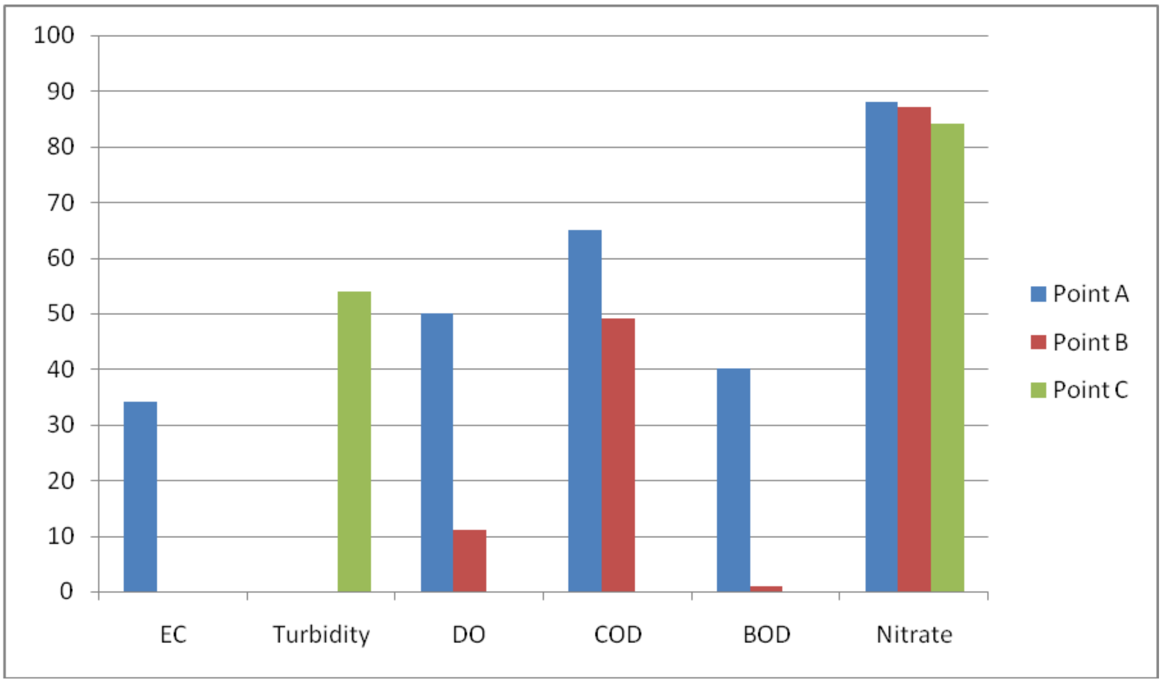

Figure 1: % Reduction of Physiochemical Parameters by *Ecchornia crassipes* (100% waste water)

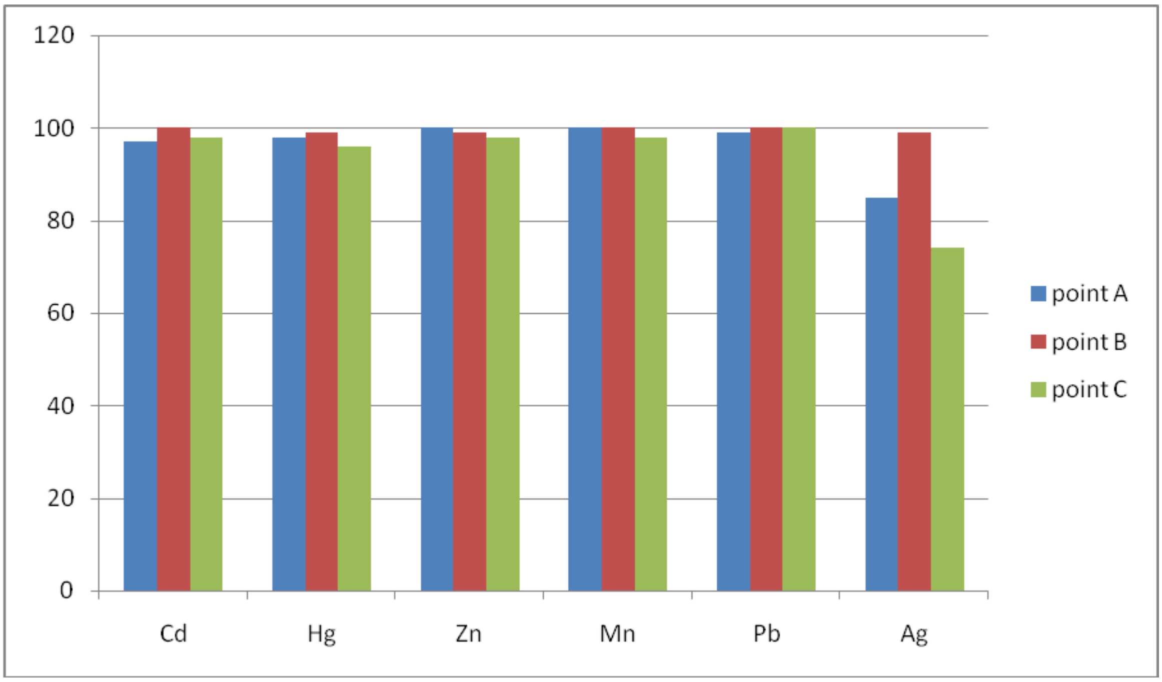

Figure 3: % Reduction of Heavy Metals by *Ecchornia crassipes* (100% waste water)

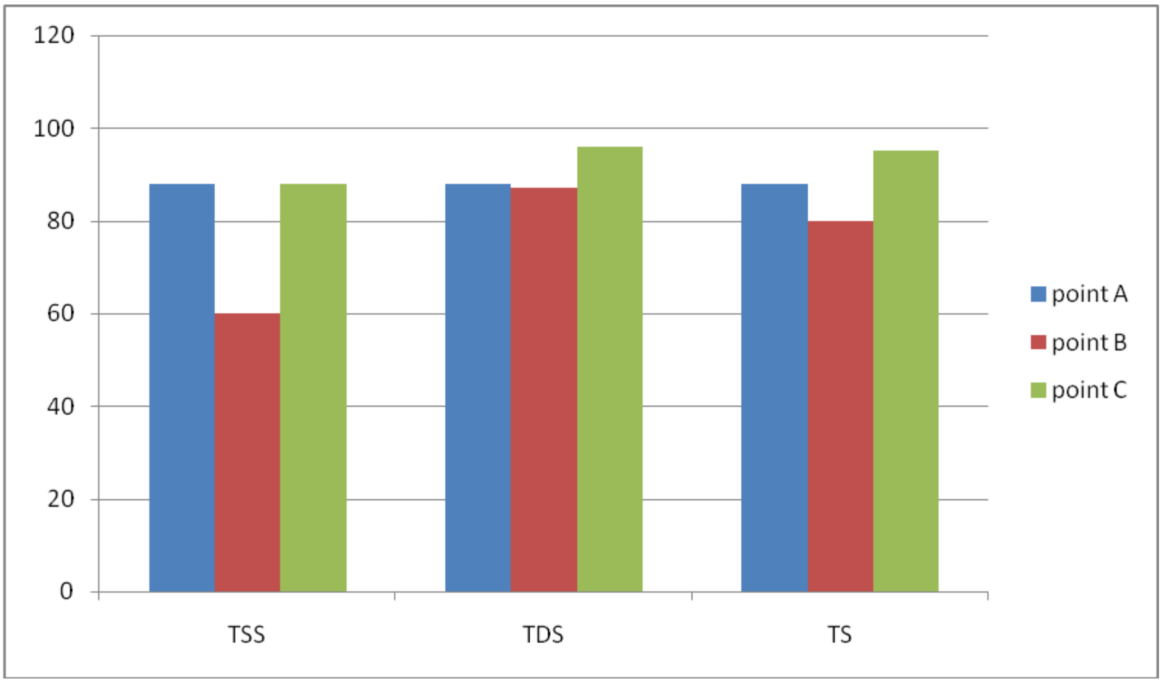

Figure 2: % Reduction of Total Solid By *Ecchornia crassipes* (100% waste water).

pH reduction recorded was high in waste water from point A (9% decrease) compare to waste water from point B (2% decrease) and point C (0% decrease instead pH was increased from 6.9- 7.5). This result is attributed to the fact that the test plant can convert alkaline or acidic pH to neutral pH (Mahmood *et al.*, 2005 Dipu *et al.*, 2011)

Dipu *et al* (2011), Aboiye (2005) and Mahmood *et al*. (2005) reported that the reduction of pH and EC of water could be attributed to the adsorption of pollutants by the test plants, Hence the reason why EC was reduced to a significant level in point A compare to point B and C. Similar result was recorded by Trivedi and Gudekar (1987) who recorded 65.31% EC reduction. Mahmood *et al.* (2005) also reported 55.71% EC reduction.

High TS, TSS and TDS reduction was recorded in all points. This high removal of solids could be attributed to the property of proper particle sedimentation by the test plant (Piyush *et al*., 2012) or the ability of the root plant to retain both coarse and fine particle and organic materials present in the waste water. Gamage and Yapa (2001) reported TDS removal of 61.07% and TS reduction of 54.4%. Brix (1998) reported average TSS removal of 84.3%. The reduction % of TS, TSS and TDS obtain in this studies is similar to the result obtained by Ghaly *et al* (2004), Watson and Chaote, (1990) and Haris (2007).

High turbidity reduction was recorded in waste water from point C compare to point A and point B. This high reduction in turbidity could be attributed to the high reduction in TS (Alicia *et al*., 1994; Haris, 2007).

High COD was recorded in the Waste water from point A compare to waste water from point B and point C. High BOD was recorded in the point A compare to waste water from point B and waste water from point C. Trivedy and Pattanshetty. (2002) Found that systems with shallow depth were more efficient in removing BOD and COD, this is the reason why high COD and BOD removal was recorded in waste water from point A. Gamage and Yapa (2001) reported high BOD (75%) and COD removal by the test plant. Kulatillake and Yapa (1984) reported high BOD (99%) and COD (80%) removal by the test plant. The result obtained in this study is similar to the result reported by Jing *et al*. (2001) who reported 13% and 51% reduction in COD and BOD respectively. This high reduction in BOD and COD IS attributed to the reduction in pH which in turn favors microbial action to degrade BOD and COD as stated by Reddy (1981) and Mahmood *et al.* (2005), Borge *et al*. (2008).

High DO reduction was reported in waste water from point A compare to waste water from point B while in point C, DO was increased from 0.2-0.5mg/l. Dar *et al*. (2011) and Shah *et al.* (2010) also observe increase in DO level whereas Mangas-Ramirez and Elias-Gutierrez (2004), Perna and Burrow (2005) found lower DO concentration beneath the test plant mats.

High nitrate removal was recorded in all point. This result shows that the test plants readily use this nitrate for growth (Maine *et al*., 2004; O'Keefe *et al*., 1984). Similar high reduction efficiency of heavy metals by the test plant was obtained by Reddy *et al*. (1982) who reported a reduction of 80%, Ingersoll and Bakers (1998) who reported reduction of over 90%, Ayyasamy *et al.* (2009) 85% reduction, Knipling *et al.* (1970) also reported high nitrate removal efficiency.

High reduction efficiency of heavy metals was recorded in all points; this could be because the concentration of the metals present was below 5mg/l (was reported by Mane *et al*. (2011), Zhu *et al*. (1999), Mishra *et al*. (2008), Valipour *et al*. (2010), Lissy and Madhu (2010), O'Keefe *et al*. (1984), Mishra and Tripathi (2010), Haider *et al*. (1984), Liao and Chang. (2004), Wang *et al*. (2002), Zayed *et al*. (1998) and Greenfield *et al*. (2007).

IV. Conclusion

Water quality study of Romi Stream has brought to the fore some important concerns that were muted by research works like Chikogu *et al*. (2012), which indicated the presence of several heavy metals in high concentration to cause contamination to biotic species of flora and fauna that, abound in the stream. Other parameters monitored such as the oxygen characteristics of the water in terms of COD, BOD and DO are all indicating toxicity above the threshold that can be purified by the stream.

Although, Research by Ugya and Imam. (2014) Shows that *Lemna minor* L. can be effectively used in the treatment of Romi stream. These studies also shows that *Eicchornia crassipes* can be effectively use in the treatment of the Kaduna Refinery waste water there by reducing the toxicity on the flora and fauna since it is able to remove and degrade pollutants present in the stream to a significant level in all point.

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