INTERNATIONAL JOURNAL OF ADVANCED BIOLOGICAL RESEARCH

www.scienceandnature.org

POTENTIAL OF *MORINGA - OLEIFERA SEED POWDER* AS A COAGULATION AGENT FOR REFINERY WASTEWATER TREATMENT IN WARRI, DELTA STATE, NIGERIA

[a]Ubuoh, E. A. [b]Akhionbare, S. M. O. [b]Onifade A. O.
[a]Department of Environmental Technology, Federal University of Technology, Owerri
[b]Department of Environmental Management Technology (FUTO), Federal College of Land Resources Technology (FECOLART), Owerri.

ABSTRACT
Laboratory analysis was carried out to investigate the potential of *Moringa oliefera* seed as a coagulation aid for purification of Warri refinery and Petrochemical Company (WRPC) wastewater unit based on turbidity. The Jar Test method was used to determine the optimum coagulation dosage and the pH level of raw refinery wastewater. The evaluation was done at three mixing durations to include 5, 10, 15 minutes at the coagulation dosages of 0, 50, 80, 110 and 140 mg/l respectively. The results indicated that the mean turbidity level recorded 80.67 NTU when 50 mg/l was of the *Moringa oleifera* powder was added to raw wastewater and shocked between 5 – 15 minutes, reduction between the range of 50.45 – 51.54 NTU, with the mean reduction of 56.01 NTU. There was further reduction in turbidity concentration from mean reduction of 56.01 NTU to the mean reduction of 12.95 NTU when 140 mg/l *Moringa oleifera* was mixed. However, there was a slight increase in the turbidity level from 10.24 – 12.54 NTU between dosage 80 – 110 mg/l of powder mixture to raw refinery wastewater, indicating the optimum dosages for maximum reduction of turbidity in raw refinery wastewater. pH of raw refinery wastewater recorded 7.2 during and after coagulation indicating neutrality of refinery wastewater. Reduction of turbidity raw refinery wastewater at the various dosages of moringa oleifera powder was found to be significant: (F =6, 342.75) at 95% Alpha level.

KEYWORD: *Moringa Oleifera* Seed, Coagulation, Refinery wastewater, Turbidity

INTRODUCTION

With increase in exploitation of petroleum products in Nigeria to feed the local and international demands, so is the problem of wastewater generated during the process of refining the product. Wastewater from refinery involves dissolved and suspended substances that are biologically decomposable, which have detrimental effects on environment (Ojuma *et al*., 2005). Moreover, because of the presence of these substances into water bodies, several kinds of diseases like cholera, hepatitis, schistosomiasis, amoebic dysentery parathyphoid fever usually spring up due to the pollution of the water bodies by effluent water discharged (Cunningham and Cunningham, 2004). Edward *et al*. (2001) noted that the evaporation of these toxic substances into the atmosphere can result to acid rain, ozone layer depletion and global warming. It is therefore becoming necessary to subject this wastewater to treatment so as to remove these pollutants before it could be discharged into various water bodies that serve as sources of water for domestic purposes and living organisms.

The chemical coagulant such as alum has been discovered to be cost ineffective due to the high cost of purchasing the chemicals (Alhassan, 2008). Effectiveness of *Moringa Oleifera* as waste purifications has been confirmed by Meitzur and Price (1996), Chebremichael *et al*. (2005), Akinwole and Jioke (2006), GHEF (2007). Quite a number of coagulants of plants origin which are effective in domestic water treatment have been identified. Plants containing these coagulants include *Moringa Oliefera* seeds (Oluwalana *et al*., 2004). Maize (Raghuwanshi *et al*., 2002) . The use of these plants based on coagulants have been found to be cost effective and also minimized the adverse effects chemicals posed to the environment. Of all the plants that have been investigated over the years, the seeds of *Moringa Oleifera* have been used for the treatment of different kinds of wastewater , but its potentiality has not been fully utilized in the treatment of wastewater from refinery.

This study therefore focused on the determination of the effectiveness of the *Moringa oleifera* in the purification of refinery wastewater.

MATERIALS AND METHODS

Study area

Geographical Setting

Warri is located in the western portion and the coastal zone of Nigerian Niger Delta (Fig.1) some 40 km away from the shore of Atlantic Ocean. The town has a population figure of over 300, 000 people. The town is a prominent centre of commercial activities in southern Nigeria. It has a port, a petroleum refinery and several oil wells/fields in its environs. Warri occupies a low-lying area with height generally below 6 m above sea level (Olobaniyi and Owoyemi, 2006).

Geology

Warri is underlain by a sequence of sedimentary formations with a thickness of about 8000 metres and

include from bottom to top, Akata Formation, Agbada Formation, Benin Formation and Somebreiro – Warri Deltaic Plan Sands (Allen, 1965; Reyment, 1965; Short and Stauble, 1967; Weber and Daukuro, 1975).

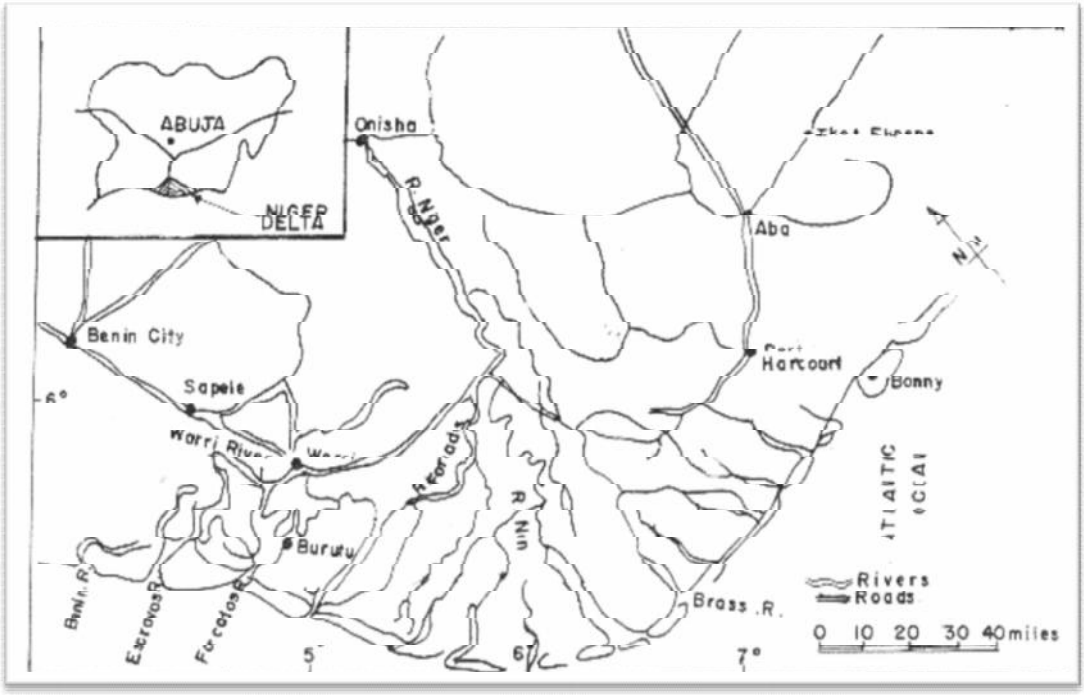

FIGURE 1: Geographical Map of the Niger Delta Region showing Warri inset: Map of Nigeria showing the Niger Delta

Experimental Runs

The study was carried out using the following materials:

1. Local refinery wastewater of Warri in Delta State
2. Seeds from *Moringa oleifera* from Kaduna State
3. Turbidimeter
4. Beaker
5. 0.5 mm mesh sieve
6. Stirrer

Sampling Technique

The *Moringa oleifera* seeds used for the treatment were collected from a matured pods of *Moringa oleifera* tree in Kano State. About 2 kg of the seeds were collected while 20 litres of refinery wastewater for analysis was sampled directly from Warri refinery and Petrochemical Company (WRPC) wastewater unit.

Moringa oleifera Preparation

Maringa oleifera seeds collected for the analysis were shelled off and sun- dried to maintain constant weight. The sun-dried seeds were grinded into powdered form using machine. The powdered obtained from grinding was sieved with a 0.5 mm mesh size netting in readiness for use. The powder sieved was put into clean bottle and corked to prevent air penetrating into the bottle to avoid contamination and removal of the chemical composition the seed. The bottled powder was and sample of refinery wastewater were taken to Imo State Water Cooperation, Owerri for laboratory analysis.

Laboratory analysis of Refinery wastewater

The refinery wastewater was split into 50 ml. One was kept as reference and other were treated with the coagulation dosages used for the laboratory test were within the range of 50 mg/l, 80 mg/l, 110 mg/l and 140 mg/l. Each sample was batch shocked for 5min, 10min. and 15min :(30 minutes) using electrical shaker and magnetic stirrer. The samples were then paper filtered and analyzed. The results consisted of the following analyses : pH , and turbidity. A turbidimeter (HACH 2100Q Portable Turbidimeter, HACH, Colorado) was used to determine the turbidity of the refinery wastewater samples. The turbidimeter determined its effect optically by comparing light intensities produced by scattering of light rays against blue cobalt glass on the sampled refinery wastewater and the standard solution and the results expressed in Nephelometer Turbidity Units (NTU). The pH values was determined through the use of a pH meter (Hanna , Model 211). The pH meter was immersed into refinery wastewater samples where the readings for hydrogen ion concentrations were taken.

RESULTS AND DISCUSSION

Wastewater collected from Warri refinery and Petrochemical Company (WRPC) wastewater unit is mostly the effluent of various operational units that are mixed and discharged as waste to the environment. This mixture contains some heavy metals, petroleum hydrocarbons, NH_3 –N and other compounds such as Fe, Al, Cu, Ni, COD and BOD (Al-Haddad, 2007), and in

developing countries of the world, wastewater is treated by a skimming process and an aeration ditch, followed by a dilution.

The results obtained from the laboratory analysis on the application of *Moringa oleifera* powder are shown in Table 1.

TABLE 1: Refinery Wastewater before and after the application of *Moringa oleifera* powder for treatment

Mixing Duration(minutes)	Raw-refinery wastewater (0mg/l)	Dosages of *Moringa Oleifera* powder			
		50 mg/l	140mg/l	80 mg/l	110mg/l
	Turbidity Concentration Levels (NTU)				
5	80.02	51.54	12.45	10.21	12.22
10	81.99	51.05	13.84	10.10	12.95
15	80.01	50.45	12.56	10.42	11.45
Total : 30	Mean: 80.67	56.01	12.95	10.24	12.54

Source : Laboratory analysis, 2011.

From Table 1, the results indicated that the mean turbidity level of the raw refinery wastewater recorded 80.67 NTU when 50 mg/l was of the *Moringa oleifera* powder was added to raw wastewater and shocked between 5 – 15 minutes, reduction between the range of 50.45 – 51.54 NTU, with the mean reduction of 56.01 NTU. There was further reduction in turbidity concentration from mean reduction of 56.01 NTU to the mean reduction 12.95 NTU when 140 mg/l *Moringa oleifera* was mixed. However, there was a slight increase in the turbidity level from 10.24 – 12.54 NTU between dosage 80 – 110 mg/l of powder mixture to raw refinery wastewater. This indicates that the optimum dosages for maximum reduction of turbidity in raw refinery wastewater. On the whole, the results shown that *Moringa oleifera* seed powder is effective for the treatment of refinery waste water between the dosage ranging between 80 – 140mg/l. The results fall below 30 NTU recommended Federal Environmental Protection Agency (1992) and Food and Agricultural Organization (FAO) (1992) for irrigation and effluent discharge into surface water bodies in Nigeria, and the 25 NTU recommended by Newcombe and Jenson (1996) for fisheries and aquaculture operation.

TABLE 2: The pH level of Raw Refinery Wastewater at different Dosages of *Moringa oleifera* Seed Powder

Mixing Duration (minutes)	Dosage of Moringa oleifera Seed Powder				
	RR wastewater (0 mg/l)	50 mg/l	80 mg/l	110 mg/l	140 mg/l
	pH values at various Dosages				
5	7.2	7.2	7.2	7.2	7.2
10	7.2	7.2	7.2	7.2	7.2
15	7.2	7.2	7.2	7.2	7.2

The results of pH concentration in raw refinery wastewater shows that at various dosages of *Moringa oleifera* powder application as indicated in Table 2, there was no variation in the values of pH before and after the treatments at different duration of mixture. This implies that, originally raw refinery wastewater is neutral event at the application of the powder. The result is consistent with the findings of Anselem and Nerasiah (1998) , Folkard et al (1993; 1996), who reports that pH value of wastewater discharged into surface water always remained neutral above the 6.5 – 8.5 WHO STD for clean water.

TABLE 3. The ANOVA for Turbidity values of dosages and mixing of *Moringa oleifera* powder in raw refinery wastewater

Source	DF	SS	MS	FCAL	Ftabα =0.05
Trial	14	11,809.86896			
Treatment	4	11,803.60676	2,950.90169	6,842.75	3.84
Block	2	2.54028	1.27014	2.75	4.46
Error		3.72195	0.46524		

The result subjected to statistical analysis using randomized completely block design (RCBD) shown reduction of turbidity raw refinery wastewater at the various dosages of *Moringa oleifera* seed powder were found to be significant: (F =6, 342.75) at 95% Alpha level (Table 3). However, the different time duration for the shaking and mixing of the *Moringa oleifera* powder with the raw refinery raw wastewater was highly insignificance on the reduction of turbidity concentration.

SUMMARY AND CONCLUSION

From the results of the study, it is observed that *Moringa oliefera* seed powder is effective as a coagulation aid in removing turbidity from refinery wastewater before discharging into the environment which the dosage fall within the range of 50 – 140 mg/l, with 110 mg/l having the greater impact and 50 mg/l having lesser impact on purification of raw refinery wastewater respectively. Also, pH of raw refinery wastewater recorded 7.2 during and after coagulation indicating neutrality of refinery wastewater.

RECOMMENDATIONS

From the results observed, the following recommendations are made :

1. Since *Moringa oliefera* seed powder is cost effective in wastewater treatment, oil companies in Nigeria are advised to used it for the treatment of raw refinery waste water
2. Government and private individuals are advised to adopt *Moringa oliefera* seed powder for the treatment of effluent generated from any source in order to maintain environmental qualities.

REFERENCES

Al-Haddad, E. Chmielewska and Al-Radwan, S. (2007) A Brief Comparable Lab Examination for Oil Refinery Wastewater Treatment Using the Zeolitic and Carbonaceous Adsorbents. *Petroleum and Gas* ISSN 1335 – 7027, 49 (1) 21 -26.

Akinwore, A.O and Jok, I. I. (2006) An investigation of the Potentials of *Moringa Oleifera* Seed as a Coagulation and for Suspended Solids in Fish Culture Wastewater. The *Nigerian Journal of Forestry*, 31st Annual Conference ,Pg 26 -30.

Alhassan, O. (2008) *Federal Government Of Nigeria endorses Local Water Treatment Purification Initiative*, The Nation Newspaper: May 13th, pg 22.

Allen, J.R.L. (1965*) Late Quaternary Niger Delta and Adjacent Areas: Sedimentary Environment and Litho-facies* .Bull. AAPG 49, 547 -600.

Cunningham, W. P. and Cunningham, M.A. (2004) *Principles of Environmental Sciences. Environmental Health and Technology*, 2nd Eds.Published by McGraw Hill Higher Education, pg. 175.

Federal Environmental Protection Agency (FEPA) (1992) *National Environmental Protection (Effluent Limitation) regulations.*

Forkard , G. Sutherland , J. and Great, W. Y. (1993) Natural Coagulants at Pilot Scale, *Pickford, 21st WEDC Conference*.

Forkard , G. and Sutherland , J. (1996) Moringa Oleifera and Water Purification. *Conference Proceedings,* Dares Salaam, Tanzania, 10 – 14th March.

Food and Agricultural Organization (FAO) (1992) *Water Quality Recommendation Range for Agricultural Water Supply*, pg. 82

Ghbemichael, K. Gunaratna, K. R. Henrikisson, H. Bruner, H. and Dalhammer, G. (2005) A Simple Purification and Activity Assay of Coagulation Protein from Moringa Oleifera Seed. *Water Research Vol. 39*, NO.11. Pg. 2338 – 2344.

Global Health and Education Foundation (GHEF) (2007) Conventional Coagulation-Flocculation Sedimentation. Safe Drinking Water is Essential. *National Academy of Science*, Retrieval on 2007.

Meitzner, H. and Price (1996): *Amaratu to Zai Holes*: Ideas for Growing Food under difficult condition Echo.

Newcombe, C.P. and Jensen, J.O.T. (1996) Suspended Sediment and Fisheries: A Synthesis for Quantitative Assessment of Risk and Impact. *North American Fisheries Management,* 16: 693 – 727.

Ojuma, T.V. Bellow, O.O. Sonibara, J.A. and Solomon, B. O. (2005) Evaluation of Microbial System for Bioremediation of Petroleum Refinery Effluent in Nigeria. African *Journal of Biotechnology,* pg 31 – 35.

Olubaniyi, S.B. and Oluyemi, F.B. (2006) Characterization By Factor Analysis the Chemical Facies of Groundwater in the Deltaic Plain Sands Aquifer of Warri, Western Niger Delta, Nigeria. African *Journal of Science and Technology (AJST), Sciences and Engneering Series, Vol.7 No.*1. pp. 73-81.

Oluwalana, S. A. Bankole, W. Bolaji, G.D. Martus, D. and Alegbeleye, O. (2004) Domestic Water Purification Using Moringa Oleifera . *The Nigerian Journal of* Forestry , 29 (1): 28 – 32.

Raghuwanshi, P. K. Meindloi, M. J. Sharma, A.D. Malviya, H.S. and Chaudhiri, S. (2002) Improving Filtration Quality using Agrobased Materials as Coagulation Aid. *Water Quality Research of Canada* 37 (4) 745 – 756.

Reyment, R.A. 1965) *Aspect of Geology of Nigeria. Ibadan University Press.* 145p.

Short, K. C. and Stauble, A. J. (1967) *Outline of the Geology of the Niger Delta* .Bull. AAGP. 51. 761 – 779.

Weber, K.J. and Daukuro, E. (1975) Petroleum Geology of the Niger Delta. Proceedings. *9th Petroleum Congress*, Tokyo. P209-229.