ISSN 2350-1030

International Journal of Recent Research in Physics and Chemical Sciences (IJRRPCS)
Vol. 10, Issue 2, pp: (48-53), Month: October 2023 – March 2024, Available at: www.paperpublications.org

Hydrocarbon Profile of bitumen deposit-Impacted Sediment in Ondo State, Nigeria

Olubunmi E. Olufunmilayo Fagbote (PhD)

Department of Chemical Sciences, School of Pure and Applied Sciences,
Bamidele Olumilua University of Education, Science and Technology, Ikere-Ekiti, Nigeria.

DOI: https://doi.org/10.5281/zenodo.10494984

Published Date: 12-January-2024

Abstract: **Total hydrocarbon content concentrations were determined in sediments collected from River Oluwa at Agbabu, Western Nigeria, in the dry season and rainy season. Samples were analyzed using the UV-vis spectrophotometer (HACH 2400). The average concentrations of total hydrocarbon content in sediment in the stations in the in the two seasons ranged from 1.26 ppm to 15.05 ppm. These values are higher than the WHO permissible level of 0.001µg/g for seafood in inland waters. The average hydrocarbon content in sediment collected during the dry season were significantly higher than the average concentration of total hydrocarbon content during the rainy season. The statistical analysis of the correlation coefficients of the values of THC at the sampling points are significant at 0.01, implying the hydrocarbons originated from biogenic sources due to the bitumen deposit in the environment and anthropogenic sources. High concentrations of total hydrocarbon observed is dangerous to the health of the rural dwellers at Agbabu because the total hydrocarbon can bioaccumulate and biomagnify and enter into River Oluwa and affect the biota through food chain. Therefore, seafood products from River Oluwa at Agbabu are unsafe, and should be consumed with caution.**

Keywords: **sediment, concentration, hydrocarbon, season, bitumen.**

I. INTRODUCTION

Pollution of rivers with contaminants has become one of the most critical environmental problems of the century. Pollutants such as mineral hydrocarbons could get into aquatic environment from a wide range of natural and anthropogenic point and nonpoint sources [1], [2]. Environmental concerns relative to the health and vitality of aquatic ecosystems have become an emerging issue in Nigeria [3]. The principal reason for this is that many toxic compounds such as mineral hydrocarbons from a large number of input sources can accumulate to elevated concentrations in sediments [4]. This also contributes to pollution problems in the aquatic environment. Hydrocarbons penetrate to the underlying sediments and consequently bring a change in desirable water characteristics and impaired growth of marine organisms [5].

Total hydrocarbon content is used to describe the quantity of the measured hydrocarbon impurities present [6], [7]. Usually expressed as methane equivalents. Hydrocarbons are a class of chemicals that contain only carbon and hydrogen atoms [8]. Polycyclic Aromatic Hydrocarbons contain hydrogen with rings of carbon atoms. Hydrocarbons and PAHs can be found in crude oil and bitumen [9]. The four categories of total hydrocarbon content are aliphatic saturates, aromatics, resins, and asphaltenes [10].

The Total Hydrocarbon Burdens in Stubbs Creek, a tributary of Qua Ibo Estuary, Nigeria in Nigeria has been investigated and it was reported total hydrocarbon content are higher in the sediments than the overlying water [1]. Total Hydrocarbon Concentrations (THC) in sediments from Otamiri River, Rivers State, Nigeria, has been investigated [11]. It was discovered that the concentrations in two out of the five locations were more than the limit set by WHO [12]. Total hydrocarbon content of water and sediments from major River Estuaries within the Niger Delta Region of Nigeria has been assessed [13]. The results obtained revealed the mean THC in sediments were higher than their recommended limits. The hydrocarbon profile of oil-spill-impacted soils from Ogoni in Rivers State, Nigeria has been studied [14]. The study showed that the sediments may be contaminated with THC and which may reduce plant growth in the study area and may lead to deleterious health effects on the exposed populace.

ISSN 2350-1030

International Journal of Recent Research in Physics and Chemical Sciences (IJRRPCS)
Vol. 10, Issue 2, pp: (48-53), Month: October 2023 – March 2024, Available at: www.paperpublications.org

Water bodies contain sediments which accumulate high levels of contaminants [13, [15]. The contamination and subsequent pollution of sediments is a serious environmental problem because aquatic plants and animals may bioaccumulate these pollutants and pass them to human body [16], [16], [18]. Consequently, this research was aimed at assessing the status of THC pollution of the sediments of the bitumen deposit impacted area of River Oluwa, Western Nigeria.

II. MATERIALS AND METHOD

Sample Collection:

Samples of sediments were collected from faive sampling points on River Oluwa at Agbabu. Samples were also collected for the Control Stations at Ovena (80km away). Samples were collected in the dry and rainy seasons. Sampling points were geo-located with Geographical Position System (GPS) to ensure consistency.

Quality Assurance:

Reagent blanks were used in all analyses to check reagent impurities and other environmental contaminations during analyses. Analytical grade reagents were used for all analyses. All reagents were standardized against primary standards to determine their actual concentrations. All glass wares used were washed with detergent and rinsed with water before use. Instruments were calibrated before use. Quality checks were also performed on the instruments. Tools and work surfaces were carefully cleaned for each sample. Minimum of triplicate readings were taken to check precision of the analytical method and instrument

Concentration Measurement:

5g of sample was weighed and enough sodium sulphate anhydrous was added to remove any trace of water. 25ml of chloroform was added to this mixture and stirred. The extracted hydrocarbon was then filtered into clean dry 100ml standard volumetric flask. The extraction was done three times and the combined extract was made up to mark.The concentration of hydrocarbon in the extract was then measured on a UV-vis spectrophotometer (HACH 2400) at a wavelength of 450nm [19].

III. RESULTS AND DISCUSSION

TABLE I: CONCENTRATION OF THC IN SEDIMENT – DRY SEASON

S/N	Sample Id	THC Concentration (ppm)			Ave. THC Conc. (ppm) - Dry Season	Std. Dev
1	OLSW-1 (SED)	12.56	11.67	12.52	12.25	0.50
2	OLSW-2 (SED)	11.84	10.66	10.79	11.10	0.65
3	OLSW-3 (SED)	15.26	14.88	15	15.05	0.19
4	OLSW-4 (SED)	1.14	1.28	1.35	1.26	0.11
5	OLSW-5 (M2) (SED)	12.66	12.42	13.45	12.84	0.54
6	OW-CTRL (SED)	7.58	8.61	7.22	7.80	0.72

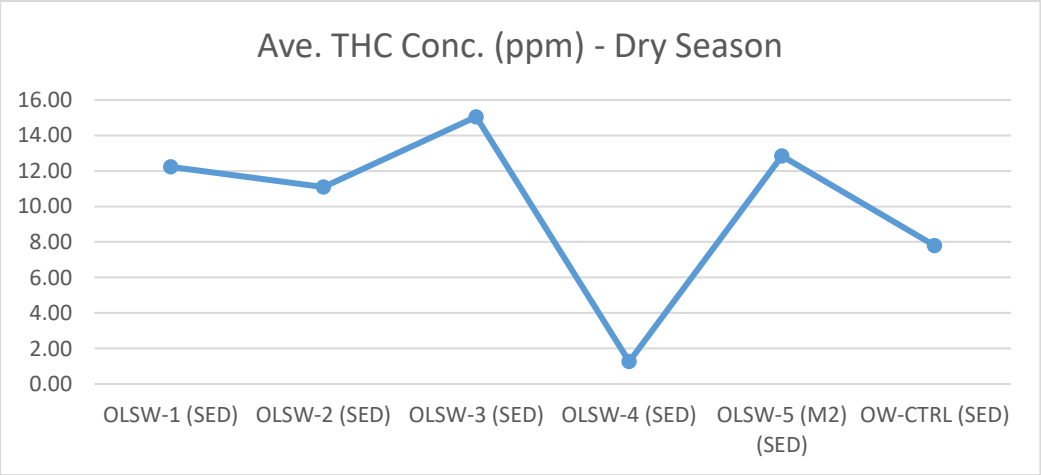

Fig. 1: Concentration of THC in Sediment – Dry Season

ISSN 2350-1030

International Journal of Recent Research in Physics and Chemical Sciences (IJRRPCS)
Vol. 10, Issue 2, pp: (48-53), Month: October 2023 – March 2024, Available at: www.paperpublications.org

TABLE II: CONCENTRATION OF THC IN SEDIMENT – RAINY SEASON

S/N	Sample Id	THC Concentration (ppm)			Ave. THC Conc. (ppm) - Rainy Season	Std. Dev
1	OLSW-1 (SED)	2.86	2.45	3.11	2.81	0.33
2	OLSW-2 (SED)	3.77	3.68	3.12	3.52	0.35
3	OLSW-3 (SED)	3.20	3.58	4.05	3.61	0.43
4	OLSW-4 (SED)	3.20	1.55	1.28	2.01	1.04
5	OLSW-5 (M2) (SED)	1.55	1.28	0.96	1.26	0.30
6	OW-CTRL (SED)	13.14	12.66	12.72	12.84	0.26

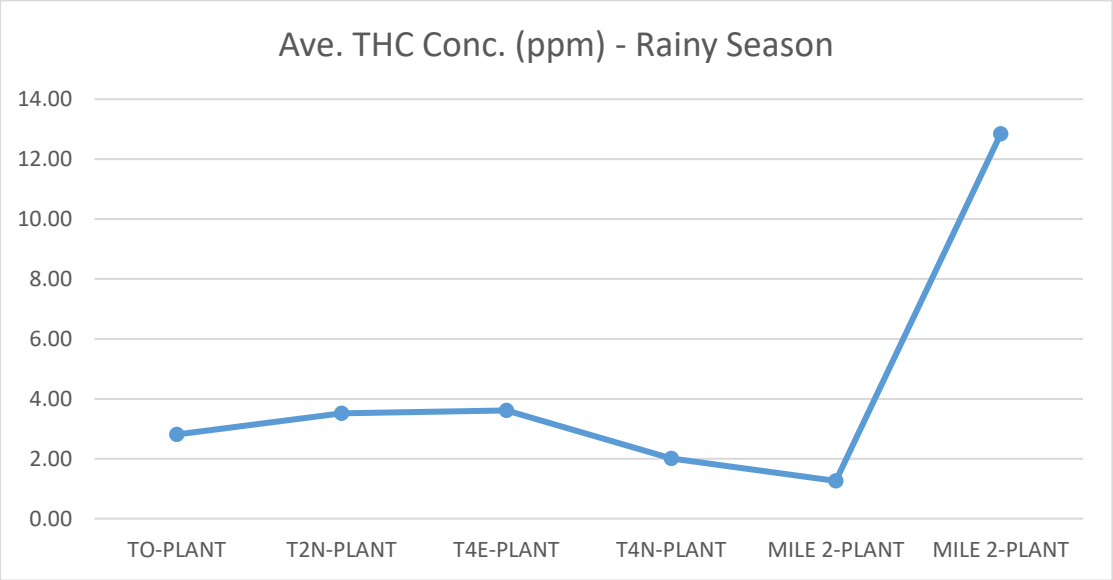

Figure 2: Concentration of THC in Sediment – Rainy Season

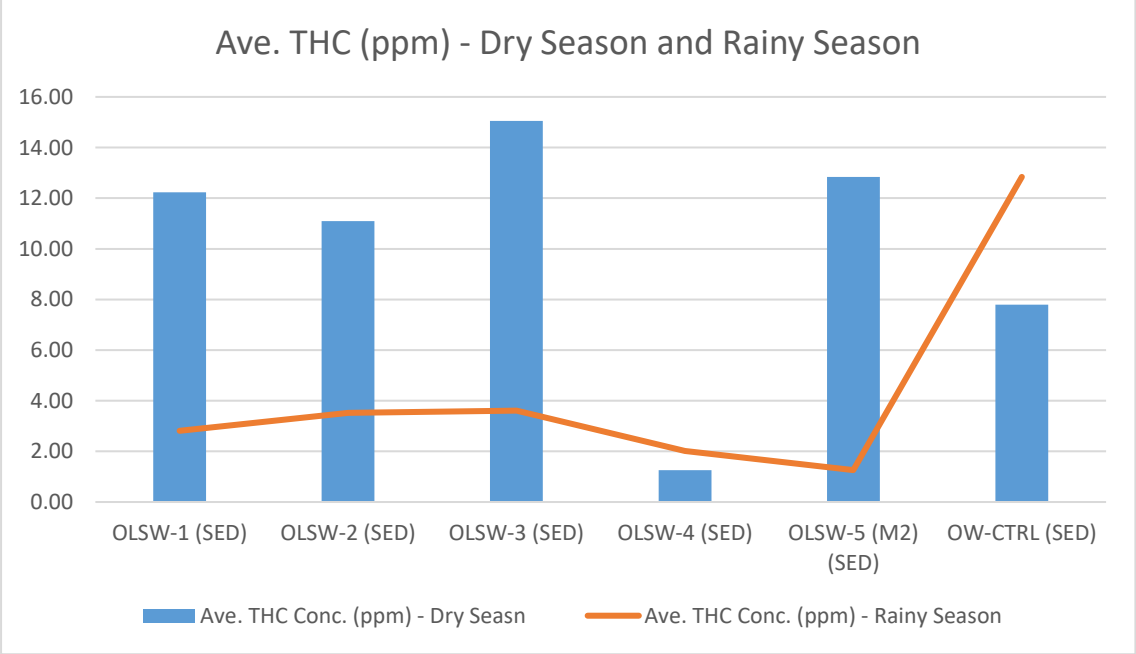

Figure 3: Average Concentration of THC in Sediment – Dry and Rainy Season

ISSN 2350-1030

International Journal of Recent Research in Physics and Chemical Sciences (IJRRPCS)
Vol. 10, Issue 2, pp: (48-53), Month: October 2023 – March 2024, Available at: www.paperpublications.org

Correlations							
		OLSW1	OLSW2	OLSW3	OLSW4	OLSW5	OWCTR
OLSW1	Pearson Correlation	1	1.000**	1.000**	-1.000**	1.000**	-1.000**
	Sig. (2-tailed)		.	.	.	.	.
	N	2	2	2	2	2	2
OLSW2	Pearson Correlation	1.000**	1	1.000**	-1.000**	1.000**	-1.000**
	Sig. (2-tailed)	.		.	.	.	.
	N	2	2	2	2	2	2
OLSW3	Pearson Correlation	1.000**	1.000**	1	-1.000**	1.000**	-1.000**
	Sig. (2-tailed)	.	.		.	.	.
	N	2	2	2	2	2	2
OLSW4	Pearson Correlation	-1.000**	-1.000**	-1.000**	1	-1.000**	1.000**
	Sig. (2-tailed)	.	.	.		.	.
	N	2	2	2	2	2	2
OLSW5	Pearson Correlation	1.000**	1.000**	1.000**	-1.000**	1	-1.000**
	Sig. (2-tailed)	.	.	.	.		.
	N	2	2	2	2	2	2
OWCTR	Pearson Correlation	-1.000**	-1.000**	-1.000**	1.000**	-1.000**	1
	Sig. (2-tailed)	.	.	.	.	.	
	N	2	2	2	2	2	2
**. Correlation is significant at the 0.01 level (2-tailed).							

The average concentrations of THC in the bitumen impacted sediments in the dry season are shown in the TABLE I and Fig. 1. In the dry season, the lowest average total hydrocarbon content was 1.26 ppm at station OLSW-4 while the highest average total hydrocarbon content value was 15.05 ppm at OLSW-3. The trend of the average concentrations of the average total hydrocarbon content at the stations in the dry season was OLSW-4< OLSW-2< OLSW-1< OLSW-5>OLSW-3. The average concentration of hydrocarbon at the sampling point OLSW-3 was the highest probably due to high human activities close the sampling point. This indicates that the total hydrocarbon content in aquatic plant (*Ceratophyllum demersum*) in the environment came from both biogenic and anthropogenic sources.

The average concentrations of THC in the bitumen impacted sediments in the dry season are shown in the TABLE II and Fig. 2. In the dry season In the rainy season, the lowest average total hydrocarbon content was 1.26 ppm at station OLSW-5 while the highest average total hydrocarbon content value was 3.61 ppm at OLSW-3. The trend of the average concentrations of the average total hydrocarbon content at the stations in the dry season was OLSW-5< OLSW-4< OLSW-1< OLSW-2>OLSW-3. The average concentration of hydrocarbon at the sampling point OLSW-3 was the highest probably due to high human activities close the sampling point. The average concentration of total hydrocarbon content in sediments in the stations in the dry season was 10.5 ppm. This is higher than 7.80 ppm recorded at the control point at River Owena. This indicates that River Oluwa at Agbabu farm settlement is polluted by the bitumen deposit in the environment. The average concentration in the rainy season was 2.64 ppm. This is lower than 12.84 recorded at the control sampling point at River Owena probably due to human activities at the control point.

The average concentrations of total hydrocarbon content in the sediments of River Oluwa were higher in the dry season than the rainy season probably due to higher domestic activities along the river as shown Fig. 3.

The statistical analysis of the correlation coefficients of the values of total hydrocarbon content at the sampling points are significant at 0.01 significance level using the bivariate Pearson correlation of IBM SPSS 25.0. This implies that the hydrocarbons originated from the same source at all sampling points. These sources are biogenic sources due to the deposit bitumen in the environment and anthropogenic sources.

The national permissible limit of total hydrocarbon/oil grease for inland water is 10mg/l while the WHO permissible level of THC in seafood is 0.001µg/g [5]. The values of average total hydrocarbon content recorded in this study ranged from 1.26 ppm to 15.05 ppm. These values are higher than the WHO permissible level of 0.001µg/g for seafood in inland waters. This indicates the sediment of River Oluwa was contaminated with total hydrocarbon. This is dangerous for the health of the rural dwellers at Agbabu because the total hydrocarbon can bioaccumulate and biomagnify and enter into River Oluwa and affect the biota through food chain. Therefore, seafood products from River Oluwa at Agbabu are unsafe, and should be consumed with caution.

IV. CONCLUSION

Total hydrocarbon in the sediments of River Oluwa at Agbabu originated from both biogenic and anthropogenic sources. Average concentration of THC of measured in the dry season were higher than rainy season. However, the highest concentration of 15.05 ppm measured in the dry and rainy seasons was lower than the concentrations reported by Edori et al. [20] in Total Hydrocarbon Content in Water and Sediment at Effluent Discharge Points into the New Calabar River, Rivers State, Niger Delta, Nigeria, and Owoh-Etete et al. [21], in Evaluation of Total Hydrocarbon in Marine Organisms and Sediment of Mgboshimili Creek,Niger Delta,Port-Harcourt, Nigeria. The sediment of River Oluwa at Agbabu has been slightly polluted with THC because the average concentrations measured in the dry season and rainy season were higher than the recommended value from WHO. The results from the study revealed that sediment of River Oluwa at Agbabu was polluted with hydrocarbon. Therefore, sea foods from River Oluwa at Agbabu should be consumed with caution.

REFERENCES

[1] D. U. Essien, U. B. Nsikak, and J. P. Essien, 2007. Trends in Heavy Metals and Total Hydrocarbon Burdens in Stubbs Creek, a Tributary of Qua Iboe Estuary, Nigeria. Trends in Applied Sciences Research, 2: 312-319, 2007

[2] O. E. Fagbote and E. O. Olanipekun, "Evaluation of the Status of Heavy Metal Pollution of Sediment of Agbabu Bitumen Deposit Area, Nigeria", European Journal of Scientific Research, 41:3 pp 373-382, ISSN 1450-216X, 2010.

[3] I. C. Howard, A. O. Briggs, and N. I. Uzomba, "Total hydrocarbon level of surface sediment and water from the upper reaches of sobreiro river, Niger Delta, Nigeria", Journal of Nigeria Environmental Society7(3), 16-22, 2012

[4] M. C. Asagbra, A. S. Adebayo, C. I. Anumudu, and A. A. Ugwumba, (2015). Polycyclic aromatic hydrocarbon in water, sediment and fish from the Warri River at Ubeji, Niger Delta, Nigeria. Afr. J. of Aquatic Sci. 40(2), 1-7, 2015

[5] H. I. Clinton, G. U. Ujagwung, and M. Horsfall, "Evaluation of Total Hydrocarbon levels in some aquatic media in an oil polluted mangrove wetland in the Niger Delta", Applied Ecology and Environmental Research, 7(2): 111-120, 2009

[6] P. Obinna, H. Akide, and I. Sokari, "An evaluation of lead and Total Hydrocarbon in bitter leaf and pumpkin collected along roadsides in Port Harcourt Nigeria", African Journal of Wood Science and Forestry (ISSN 23750979) Vol. 3 (3), pp. 122-127, 2014.

[7] P. Samuel, O. Elechi, and N. E. Julius, "Total Hydrocarbon Contents: Spatial Variations in Aquatic Environment of Oyigbo Communities, Rivers State", International Journal of Environmental Protection and Policy 10(1), 1-5. https://doi.org/10.11648/j.ijepp.20221001.11. 2022.

[8] O. A. F. Wokoma, "Levels of Total Hydrocarbon in Water and Sediment of a Polluted Tidal Creek, Bonny River, Niger Delta, Nigeria", International Journal of Scientific & Technology Research 3(12), 351-354, 2015.

[9] T. J. K. Ideriah, E. A. Emerhi, S. A. Abere, and W. Trinya, "Levels of Total Hydrocarbon contents in Plants Along Selected Roadsides in Port Harcourt Metropolis, Nigeria", Journal of Agriculture and Biological Sciences, 2(3)(3):65-70, 2011.

[10] I. C. Ossai, Ahmed A. A. Hassan, and F. S. Hamid, "Remediation of Soil and Water Contaminated with Petroleum Hydrocarbon: A Review", Environ. Technol. Innov. https://doi.org/10.1016/j.eti.2019.100526, 2019

[11] J. D. Nwineewii, and K. Azuonwo, Total Hydrocarbon Concentrations (THC) in surface water, sediments and biota from Otamiri River, Rivers State, Nigeria", International Journal of Chemical Studies, 6(3): 2743-2748, 2018

[12] World Health Organization (WHO) & International Programme on Chemical Safety. Guidelines for drinking-water quality. Vol. 2, Health criteria and other supporting information, 2nd ed. World Health Organization. https://apps.who.int/iris/handle/10665/38551, 1996

[13] G. A. Ebong and R. C. John, "Physicochemical properties, total hydrocarbon content, and trace metals of water and sediments from major River Estuaries within the Niger Delta Region of Nigeria", World Journal of Advanced Research and Reviews, 12(02), 587–597. DOI: https://doi.org/10.30574/wjarr.2021.12.2.0650, 2021

[14] N. A. Menkiti, L. C. Osuji, and M. C. and M. C. Onojake, "Hydrocarbon Profile of Oil-Spill-Impacted Soils from Ogoni in Rivers State", Nigeria, Asian J. Appl. Chem. Res., vol. 13, no. 2, pp. 1-15 DOI: 10.9734/AJACR/2023/v13i2238, 2023

[15] A. A. Adesuyi, M. O. Ngwoke, M. O. Akinola, K. L. Njoku, and A. O. Jolaoso, "Assessment of Physicochemical Characteristics of Sediment from Nwaja Creek,Niger Delta, Nigeria", Journal of Geoscience and Environment Protection 4(1), 16-27, 2016

[16] F. G. Olaifa, A. K. Olaifa, and T. E. Onwude, Lethal and sublethal effects of copper to the African Cat fish (Clarias gariepnus). Afr. J. Biomed. Res., 7: 65-70, 2004

[17] A. H. Gijo, A. I. Hart, and E. I. Seiyaboh, "Bioaccumulation of Aromatic Hydrocarbons on the blue crabs (CallinectesAmnicola)", International Journal of Environmental Biology6(2), 49-52, 2016

[18] V. Ighariemu, D. C. Belonwu, and M. O. Wegwu, "Level of Petroleum Hydrocarbons in Water and Sediments of Ikoli Creek Bayelsa State Nigeria", Toxicology and Environmental Health Sciences 11, 114-119.https://doi.org/10.1007/s13530-019-0395-3, 2019

[19] ASTM (2003) Method D3921. Standard Test Method for Oil and Grease and Petroleum Hydrocarbons in Water, ASTM International.

[20] O. S. Edori, K. E. Okpara, and E. I. Edeh, "Total Hydrocarbon Content in Water and Sediment at Effluent Discharge Points into the New Calabar River, Rivers State, Niger Delta, Nigeria", J. Sci. and Engineering Res., 8(5):1-6, 2021

[21] U. Owoh-Etete, O. J. Ogunbiyi, E. K. Oni,H. E. Iyare, and K. Brotoboh, "Evaluation of Total Hydrocarbon in Marine Organisms and Sediment of Mgboshimili Creek,Niger Delta,Port-Harcourt, Nigeria", African Journal of Environmental Sciences & Renewable Energ, 10 (1): 14-21, 2023