International Journal of ChemTech Research
CODEN (USA): IJCRGG, ISSN: 0974-4290, ISSN(Online):2455-9555
Vol.10 No.2, pp 789-795, 2017

The Evaluation of Crude oil leakage effect on Water quality

Wameedh A.K. AL-Yasari, Ayad M.J. Al-mamoori, Zainab Imran AL-Rifaie, Shaymaa Obayes Hussein Al-Mamoori

Department of Biology, College of Science, University of Babylon, Iraq

Abstract : This investigation was designed to evaluate the effect of crude oil leakage from Electricity station in Karbala City, Iraq on water quality parameters of Amholia stream, therefore two sites were chosen, the first one before the leakage point and the second after this point, the results according to statistical analysis indicate that some water quality parameters have affected by this leakage such as pH, E.C., T.D.S, Chloride, acidity , Total hardness, Mg, Nitrate, phosphate with fluctuation through study period, only Fe concentration increased after leakage point, we concluded that crude oil leakage effects on water quality has related with many factors.
Keywords : crude oil leakage, water quality, stream, heavy metals.

Introduction:

Water quality is one of valuable factor of an aquatic environment. Pollution of aquatic environment by crude oil represents real stress to aquatic organisms and causes fluctuation in Water quality parameters

Crude oil is a complex mixture of thousands of hydrocarbons and non- hydrocarbon compounds, including heavy metals [1].

It's found through the study of the Effects of a crude oil spill on water quality and macrobenthos of a southeast Texas stream that crude oil effect on water quality especially by decreased dissolved oxygen and increased carbon dioxide concentrations, while Responses of the benthic macroinvertebrate community related with an increase in density of oligochaetes, decrease in numbers and taxa diversity. [2]

Effect of Crude Oil Pollution on Soil and Proximate Composition of was studied Ukwa West Local Government Area of Abia State, Nigeria, This work detected the concentration of Total Hydrocarbon Content (THC), trace metals, physicochemical properties ofthe soil sample of Owaza shell location, also they found The valuable effect of crude oil

pollution on soil and plants[3]

[4] found that crude oil contamination negatively and valuable affect the productivity of the Nsukka soil ipso facto the production of Zea mays in Nigeria .

Other study was designed to show Effects of Dispersed Bonny Light CrudeOil on Water Quality Parameters in Tanks Containing Oreochromis niloticus , they found that some parameters of water quality such as temperature, pH, Do, TDS, Conductivity , and Redox potential effect by crude oil through media containing fish Oreochromis niloticus[5]

Materials & Methods

The study was included two sites on ,the first site is located before crude oil leakage as control , second sites is located 2km after crude oil leakage point, Water samples water collected over 12 months from February 2014 till January 2015withmeasured some of the water quality parameters such as (pH, Temperature, E.C. ,T.D.S.) by multimeter 350i Germany, and (T.S.S.Alkalinity, Acidity,chlorids, total hardness,Calcium, Magnesium, Nitrite, Nitrate, phosphorus, and Silicate) according to methods described by [6], Triplicate samples were collected monthly from each site and transported quickly with cool box to the laboratory for analysis. Samples were filtered immediately upon arrival to the laboratory, One liter of each sample was filtratedthrough 0.45 µm polycarbonate filter. The filtrate was used to determine dissolved heavy metals (Cd, pb, Fe, Zn) concentration, whereas the filters were used to determine the concentration of particulate heavymetals by Flame Atomic absorption spectrophotometer Shimadzu 7000A (Japan) in Biology Dept., College of science, Babylon University. Dissolved heavy metal concentration was calculated according to the equation [7] which was clarified by [8] while particulate heavy metals according to [9].

Water quality index was measured for all sites according to on line water quality index supported by Water Research Center (U.S), and according to below classification of water quality index.

Table 1 : Water quality index value.

Range	Quality
90-100	Excellent
70-90	Good
50-70	Medium
25-50	Bad
0-25	Very Bad

Statistical Analysis:

SPSS 17.0 programs used for least significance differences (LSD $\leq$ 0.05), Analysis of variance test(ANOVA) between sites and different Studies parameters.

Results and Discussion

Water quality changes, other than the presence of oil, were not evident until six months after the spill when stream flow ceased and water temperature increased many of the toxic aromatic components probably evaporated.

Through this study some parameters of water quality effected by leakage of crude oil in Site 2 such pH which have increasing through January, February, march months, electrical conductivity showed increasing in most of study period especially in January 2014 with value (9194 µ.S/cm) , also Total dissolved solids increased through the first three months of study period with the highest increasing (4457 mg/l) in March 2014, chloride recorded the increasing though all studied months with highest value (9428 mg/l) in June 2014, acidity of water showed increasing only in January 2014 in site 2 while total hardness effected in January and February 2014 with highest value (1933, 970 mg/l) respectively, magnesium has elevated values thorough the first four months with highest value (334 mg/l) in January 2014, Nitrate increased in first two months April 2014 and the last months with highest value (336µg/l) while phosphate increase in site 2 only in first month (14.3 µg/l) (Table 1and 2).

The constituents of crude oil are complex. It contains aliphatic, alicyclic, polyaromatic hydrocarbons, oxygen, nitrogen and Sulphur containing substances[10] these mixture plays important roles in fluctuation in water quality parameters.

Table 2:monthly variations of physicochemical parameters of site 1. (Mean ±S.D)

Months / Parameters	January 2014	February	March	April	May	Jun
Air temp. (C˚)	14.6 ± 0.5	19 ± **1**	20 ± **1**	25 ± 1.1	32 ± **0.5**	**35** ± **0.5**
Water temp. (C˚)	11.3 ± 0.5	**16.3** ± **0.5**	**16.6** ± **1.1**	**21.3** ± **0.5**	**27** ± **1.7**	**30** ± **0.5**
pH	8.1 ± **0.1**	7.9 ± **0.2**	**7.1** ± **0.2**	**7.5** ± **0.4**	**7.1** ± **0.1**	**7.2** ± **0.3**
E.C (µ.S/cm)	4316.6 ± 299.1	3989 ± 199.2	4568.3 ± 389.1	3712 ± 85.7	6924 ± 1300.8	5553 ± 290.1
TDS mg/L	1976 ± 282.3	2124.3 ± 93.2	2222.3 ± 125.2	2184.6 ± 450.3	3450 ± 37.8	1969.3 ± 282.3
TSS mg/L	0.09 ± 0.02	0.1 ± 0.04	0.02 ± 0.02	0.09 ± 0.07	**0.2** ± 0.02	**0.08** ± 0.006
Chloride mg/L	5060.2 ± 370.9	4146.2 ± 174.6	4661.6 ± 325.8	3334.1 ± 371.4	4851.3 ± 142.2	4879.8 ± 218.0
Alkalinity mg/L	42.1 ± 3.7	49.1 ± 1.5	46 ± 2.6	51.8 ± 1.2	51 ± 1	50.3 ± 3.2
Acidity mg/L	33.1 ± 1.7	36.2 ± **0.4**	39 ± **1**	42.2 ± **0.6**	49.7 ± **4.7**	40.9 ± **0.7**
Total Hardness mg/L	900 ± 87.1	806 ± 35.1	656.6 ± 37.8	793.3 ± 23.1	1237 ± 305.3	850 ± 34.6
Calcium mg/L	239.8 ± 40.5	221 ± 13.1	205.1 ± 30.5	190.5 ± 19.8	215.7 ± 7.7	199.5 ± 8.5
Magnesium mg/L	80.1 ± 40.4	61.1 ± 15.8	32.6 ± 8.2	76.8 ± 6.2	196.2 ± 80.8	85.7 ± 13.8
Nitrite µg/l	3.1 ± 0.9	2.8 ± 0.3	3.2 ± 0.2	4.1 ± **0.2**	3.3 ± **0.6**	3.4 ± **0.3**
Nitrate µg/l	267.1 ± 67.6	265.2 ± 20.3	272.5 ± 9.8	280.4 ± 13.6	236 ± 4.3	242.4 ± 28.5
Phosphate µg/l	9.9 ±	15.6 ±	13.5 ±	16.1 ±	13.8 ±	14.4 ±

	1.1	2.3	0.4	1.8	3.1	1.9
Sulphate µg/l	209.7± 7.7	173.7± 10.1	139± 0.5	212.7± 18.5	75.7± 9.2	94.1± 1.6

p≤0.05

Table 3:monthly variations of physicochemical parameters of site 2. (Mean ±S.D)

Months / Parameters	January 2014	February	March	April	May	Jun
Air temp. (C°)	15.3 ± **0.5**	19.5 ± **0.8**	20.6 ± 1.1	27.5 ± 1.3	34.1 ± 1.8	36.6 ± **0.5**
Water temp. (C°)	11.3 ± 0.5	17 ± 01.0	16.8 ± 1.4	21.5 ± 0.5	28.6 ± 2.3	31 ± 01.0
pH	6.6 ± 0.5	6.9 ± 0.6	6.2 ± 0.2	7.2 ± 0.3	7 ± 0.1	7.1 ± 2.0
E.C µ.S/cm)(	9194.6 ± 1110.8	7327.3 ± 765.2	8971 ± 1619.4	5730 ± 445.7	7873.3 ± 470.5	6765 ± 386.2
TDS mg/L	4235.6 ± 111.4	3813 ± 292.7	4457.6 ± 560	3076 ± 119.5	2371.6 ± 232.3	2365 ± 268.4
TSS mg/L	0.1 ± 0.01	0.1 ± 0.02	0.3 ± 0.03	0.2 ± 0.01	0.05 ± 0.004	0.09 ± 0.001
Chloride mg/L	8693.9 ± 7621.5	8380.2 ± 233.5	8162.2 ± 666.6	69367 ± 523.7	16731.4 ± 969.5	9428.2 ± 187.4
Alkalinity mg/L	47.3 ± 4.6	59 ± 1.7	33.4 ± 6	53.8 ± 2.02	106.4 ± 23.4	72 ± 3.4
Acidity mg/L	62.5 ± 12.8	58.4 ± 14.01	77.1 ± 4.9	47.6 ± 1.2	35.9 ± 23.4	51.1 ± 1.7
Total Hardness mg/L	1933.3 ± 461.8	970 ± 34.6	626.6 ± 132.7	836.3 ± 90.6	496.6 ± 40.4	633.3 ± 75.1
Calcium mg/L	221.9 ± 31.5	185.1 ± 58.8	60.3 ± 21.3	99.6 ± 12.5	131.1 ± 5.1	159.7 ± 10.1
Magnesium mg/L	334.5 ± 92.8	123.04 ± 44.3	115.7 ± 19.1	125.5 ± 34.1	40.9 ± 12.7	57.3 ± 23.9
Nitrite µg/l	2.9 ± 0.2	2.6 ± 0.5	2.3 ± 0.1	4.1 ± 0.2	4.9 ± 0.2	3.9 ± 0.6
Nitrate µg/l	336.7 ±	274.7 ±	221.5 ±	324.6 ±	211.7 ±	259.6 ±

	11.5	16.1	14.2	4.1	60.1	39.2
Phosphate µg/l	14.3 ± 1.8	15.7 ± 1.1	18.1 ± 1.3	17 ± 2.01	19.8 ± 0.3	22.3 ± 2.02
Sulphate µg/l	163.5 ± 9.1	180.5 ± 4.3	131.6 ± 4.8	155.9 ± 11.4	201.3 ± 13.2	210.9 ± 13.7

p≤0.05

Some of water quality parameters were not affected due to the degradation of Crude oil as a result of the activities of weathering by plant root, the climate, waterand micro-organisms[4], moreover, the water quality index was high in site 1 than site 2 according to water index value classification which indicated that not a high effect of oil leakage on water quality.

Table 4: Water Quality index for site 1.

Parameter	Tested Value	Weighting Factor	Q-Value Water Quality index
pH	6.8	0.11	80
Water Temperature C^0	21.1	0.10	39
Total Phosphate (µg /L)	17.8	0.10	7
Nitrates (µg /L)	271.5	0.10	1
Total Dissolved solids (mg/l)	3386	0.07	20
Total			31

Parameter	Tested Value	Weighting Factor	Q-Value Water Quality index
pH	7.4	0.11	92
Water Temperature C^0	20.5	0.10	19
Total Phosphate (µg /L)	13.9	0.10	2
Nitrates (µg /L)	260.6	0.10	1
Total Dissolved solids (mg/l)	2321	0.07	20
Total			29

Regarding heavy metals, only iron effected by crude oil leakage through increasing in their concentration in January and June 2015 with concentration (4.6, 7.8 ppm) respectively (Figure 1 and 2)

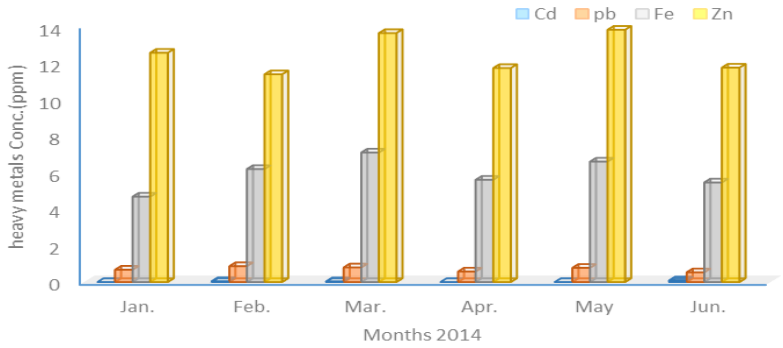

Figure 1: monthly variations of heavy metals for site 1.

The fluctuations and non-increasing in metals pointed to that various types of aquatic organisms have different strategies to heavy metal uptake and exposure.[11]

Low concentration of heavy metals due high adsorption ability, organic complex formation, and its easily absorption from sediments particles, also The relatively high intensity of the rain event lead to elevated suspended solids which effect on water quality and heavy metals concentrations.[12]

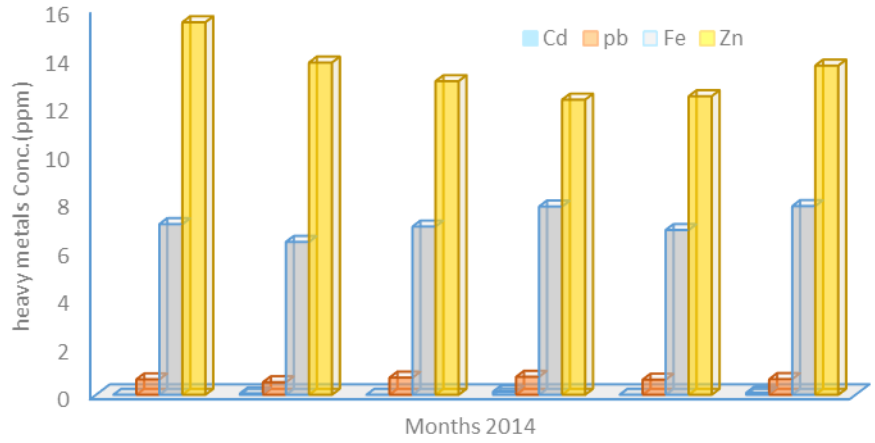

Figure 2: monthly variations of heavy metals for site 2.

Crude oil have impact of water quality due to its content from variable quantities of non-hydrocarbon organic compounds which comprises functional group like N,S and O[13.]

Conclusion

We conclude that many factors participate in the effect of crude oil leakage on water quality such as the content of crude oil, amount of leakage, evaporation, dilution and degradation of crude oil by aquatic organisms.

References

1. Salhi,N., Souici,S andANNOU , H (2016) the effect of crude oil contamination on seed germination and the growth of some crop plants, DOI: 10.13140/RG.2.2.28435.68640 ICIEM 2016 - International Conference on Integrated Environmental Management for Sustainable Development.poster.
2. Harrel, R.C.(1985) Effects of a crude oil spill on water quality and macrobenthos of a southeast Texas stream, Hydrobiologia,124(3): 223–228.
3. Ifemeje, J.C.& Egbuna, C.(2016) Effect of Crude Oil Pollution on Soil and Proximate Composition of Cassava from Owaza in Ukwa West Local Government Area of Abia State, Nigeria, International Journal of Innovation and Applied Studies,15(1): 72-79.4.
4. Ezeonu, C.S., Sindama,A., Ezeonu, N.C.& Onwurah, I.N.E.(2016) effect of crude oil and soluble metal salt contaminated soil on Zea mays plant growth indices, FUW Trends in Science & Technology Journal, 1(1): 243-247.
5. Enodiana, O.L.(2014) Effects of Dispersed Bonny Light Crude Oil on Water Quality Parameters in Tanks Containing Oreochromis niloticus, Trends in Applied Sciences Research,9(9):540-544.
6. APHA, 2005. (American public health association) Standard methods for examination of water and wastewater. 21the Ed. Washington, D.C., U.S.A.
7. United Nations Educational, Scientific and Cultural Organization, UNESCO, 1992. In: Al-Taee, M.M.S. (1999). Trace elements in water, sediments, fish & plants of shatt Al-Hilla river. Ph.D. thesis, Babylon univ. (in Arabic).
8. Al-taei, M.M.S., (1999) Trace elements in water, sediments, fish & plants of shatt AlHilla river. Ph.D. thesis, Babylon univ. (in Arabic).
9. Sturgeon, R.E., J.A. Desaulincrs, S.S. Berman,D.S. Russell, (1982) Determination of trace metals inestuarine sediment by graphite fernace atomic absorption spectrophotometry. Anal. Chem. Acta.,134: 288-291.
10. Khabakhsh, E., Jamili,sh., Motalebi, A., Moradi, A.M.& Saravi, H.N.(2014) Histopathological effects of water soluble–fraction of crude oil onliver tissue of fingerling beluga , Huso huso Linnaeus, 1754, Caspian J. Env. Sci, 12(1): pp. 63-72
11. Terry, P.A., W. Stone, (2002) Biosorption ofcadmium and copper contaminated water by Scenedesmus abundans, Chemosphere, 47: 249–255.
12. Rule, K.L., S.D.W. Comber, D. Ross, D.Thornton, C.K. Markopoulos, R. Rautiu, (2006) Diffuse sources of heavy metals entering an urbanwastewater catchment, Chemosphere, 63: 64–72.
13. Lundegard.P.& Knott, J.R.(2014) Polar Organics in Crude Oil and Their PotentialImpacts on Water Quality, Conference paper

*****