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Evaluation of Oil Spills in Sandy Soil Of Rumaila Oil Field Area in Basra, Southern Iraq.

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Abstract

The objective of this study is to evaluate the environmental impact of crude oil spills in soil in the Rumaila oil field, at Basra city, southern Iraq. Six soil samples were collected near oil spill sites in the current study. The results of the grain size analysis of the selected soil samples, generally are a silty sand containing a little clay. The concentrations of T.n.alkane compounds were measured to determine the total normal allkane content (TPH), the results showed a high concentration of total hydrocarbons in soil samples. Samples the carbon number for the Aliphatic compounds are ranged between (C41-C7) except for station (2), the sequence of carbon compounds started from (C18) and ended at (C34). The highest concentration reached (93.59) mg/g in the station (5), while the lowest concentration was (0.5) mg/g in the station (3). A detailed study was conducted to determine the concentrations for six heavy metals (Zn, Pb, Cd, Cu, Ni and Fe) were (10.69, 17.17, 0.92, 101.29, 39.24 and 1511.17) ppm, respectively, these values indicate that petroleum emissions are the main sources of these metals in soil. The concentration of (Zn, Fe, Ni, Cu) was high in all soil samples, it exceeded the international standard limits in the soil. For (Fe, Cu, Ni) (ppm).The results of Igeo, EF and CF indices showed high pollution levels for Cu, Fe and Ni, the index indicated that most metals caused low risk in all stations excepted Zn, Cd and Pb have a moderate risk in the study area.

Key words: total hydrocarbons, Rumaila oil field, crude oil, heavy metals, Iraq

1. Introduction

One of the major causes of environmental pollution that refers to the accidental leakage of crude oil or refined products onto land, as an effect of the process of the production and distribution of crude oil (Zwijnenburg, 2017). The demand for crude oil as a source of energy has caused a dramatic increase in its production, transportation and refinery, resulting in environmental pollution, causing serious hazards to the environment (Adesina, 2014). Topsoil is known as one of the main sinks of pollutants in environments (Padoan E, 2017). Where petroleum hydrocarbon pollution is one of the main environmental problems, not only because of the significant amounts emitted, but also due to their toxicity **(**Khwedim, 2016**) .** Pollution of heavy metals may originate from various types of anthropogenic sources such as petroleum, diesel and coal combustion, as well as industrial activities and natural geochemical processes such as weathering, the metals may be come from many different sources, including vehicle emissions, industrial discharges, weathered materials and various human activities (Shahab, 2017)**.**The importance of oil and natural gas in the modern world is well known. However, many locations within the oil industry are polluted due to the distinct activities of this business, for instance, oil exploration, production, refining and spillage of drilling fluids and crude oil. These activities have led to the release of many organic and inorganic pollutants in the soil, air and water, including trace elements, heavy metals and hydrocarbons around the oil fields, and these activities have an important role in the availability of these pollutants in the surface soil (Xianyuan, 2010)**.**The increasing of the heavy minerals in the soil in the oilfields has resulted from crude oil dispersion at the surface (Al-Hejuje, 2015)**.**

Oil spills are present in the region in the form of large oil ponds. These spills have been dating since 1992 after the destruction of the oil processing units of South Oil Company, which led to the dumping of oil production waste at the site. And the waste dumping process continued until the year 2014, when the treatment process of these sites resulted from spilled oil residues, and work is still underway to this day, by removing contaminated soils within three sites, namely, in the fifth gas separation plant (DS5) or the first general downstream area, and the area is gas isolation The fourth (DS4), the second region, contains a group of monitoring wells for groundwater (Monitoring Wells) in those operational stations (the current study area), and the third gas isolation plant / Russian pool (DS3) which is a site for temporary waste storage (the third region), where These oil spills cause the emission of toxic and highly flammable gases, which is clear evidence of environmental pollution due to the presence of these flammable oils and gases in the region (Figure 1), where we notice oil spills in rainwater pools and by the action of the winds they accumulate at the edges of surface water and they cause pollution Dangerous environmental pollution of the soil which poses a threat to plants that are as a an important food source**.**

The objective of this study is to investigate the environmental impact of oil spills and heavy metals in the soil and Total Petroleum Hydrocarbon (TPH), at the Rumaila oil field in southern Iraq. (Picture 2) illustrated the oil spills pools in the study area is which was accumulated since 1993 until now, it causes serious environmental pollution problem which poses a threat for various living from.

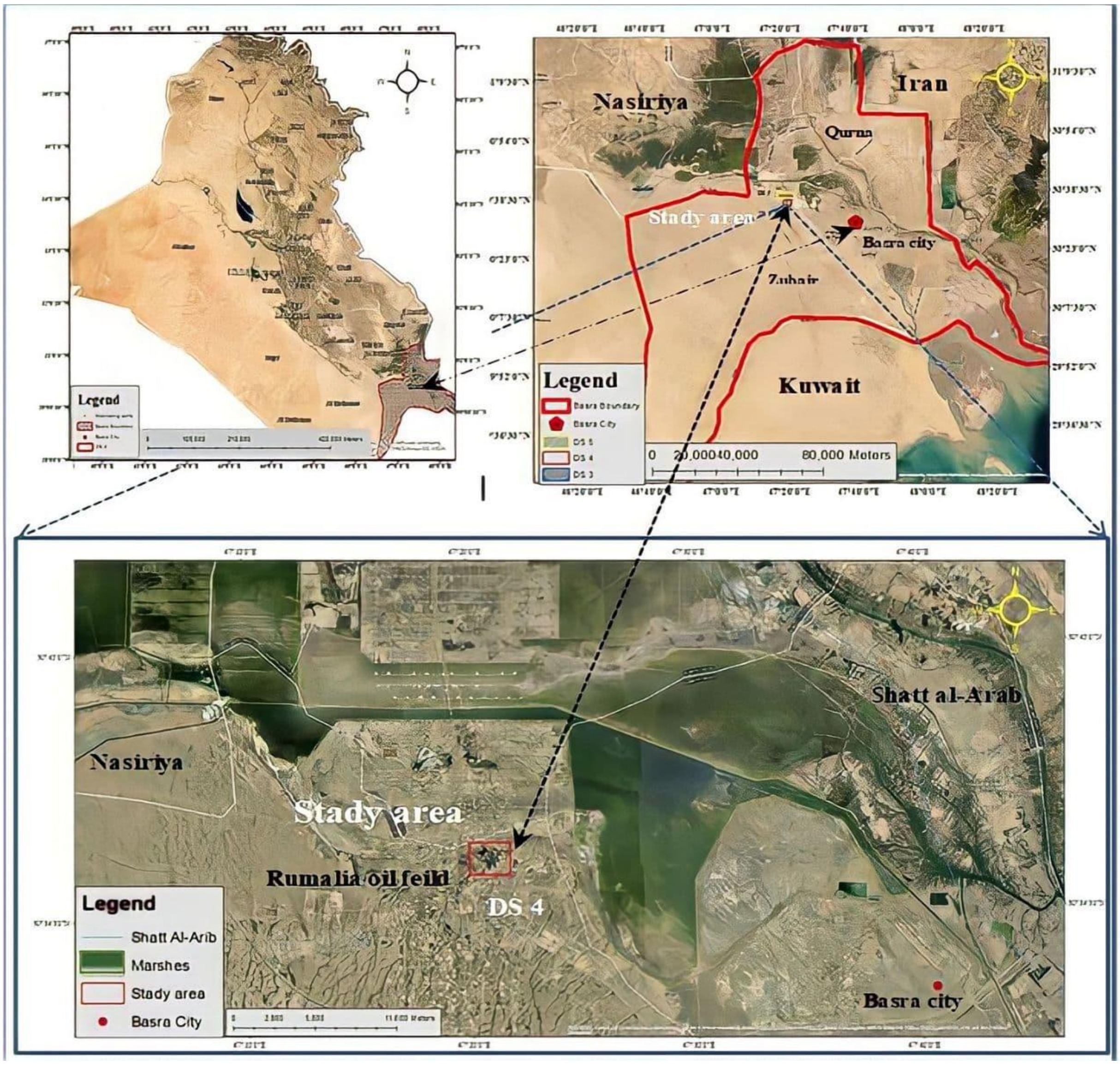


Figure (1) the study area location (North Rumaila field).

Picture (2) the environmental impacts in the study area

2. Study area

The study area is located in the eastern border of the Rumaila field is about (**30** km) west of Basra governarate. , the field extends from the Iraqi-Kuwaiti border in the south to the borders of the West Qurna field in the north.

The area of North Rumaila field with estimated around (1600) km^2 (Figure 1), which is relatively low above sea level, as for the study area DS4, ranging from (16-20) km^2 . The northern part of the Rumaila field was historically known as the Hammar marsh region, this marsh in which water was flowing from the Euphrates and Tigris rivers was drained from 1973 to 1984, in order to facilitate the development of the Rumaila field and many Other works, such as the construction of the waterway of the general estuary.

Geologically, The study area is located within the Zubair season area, which is located within the unstable shelf of Iraq according to subdivisions (Buday, 1987). The study area is mainly covered by the recent sediments and Dibdibba Formation (Upper Miocene-Pliocene-Pleistocene), in the southwestern part of the Basra Governorate in southern Iraq. The Dibdibba formation is part of the western desert of Iraq and extends over large areas in the southern part of Iraq.

3. Materials and Methods:

3.1 Sampling: Samples were collected from the sites that have been treated to find out the percentage of pollution therein, and a sample of sites that have not yet been treated, for surface soils at a depth of 30 cm from the Rumaila oil field area, collected in December 2019 (Figure 3). Then the soils samples were dried at room temperature, homogenized with a pestle and sieved all samples through a 2mm sieve, and were transferred to the laboratory for analysis.

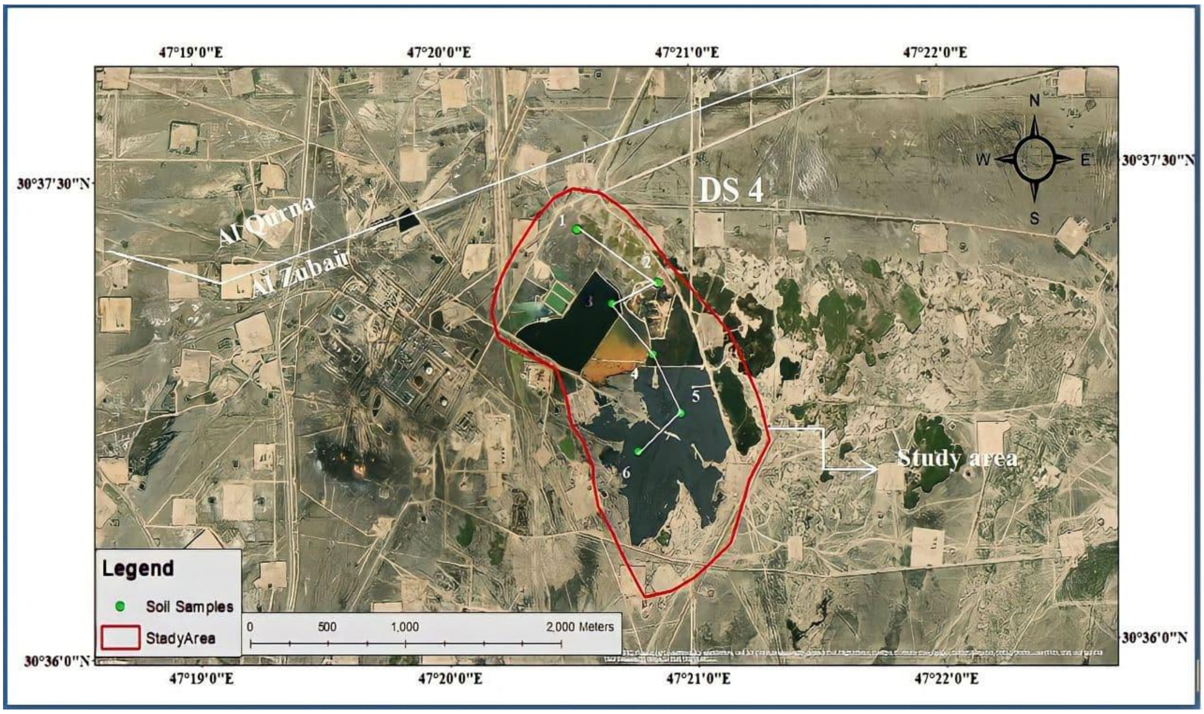


Figure (3) Location of soil samples

3.2 Grain size analysis: The grain size analysis of the study area was analyzed by wet sieving according to the Folk method (1974), at the laboratories of the Marine Sciences Center, Department of Marine Sediments- University of Basra. The texture class influences the contamination since earth, topsoil is characterized by permanent changes due to the human activities taking place above it, therefore topsoil is considered more vulnerable to natural and human changes compared to the normal soils with a thick section.

The sand ratio results were ranging between (22% - 92%), silt ranged from (7% - 74%), while, the percentage of clay was scarce compared to sand and silt, it only (1% - 11%). However, the soil of the study area represents sand and silty sand, with a little clay. As well as, the other soils that were analyzed are Silty Sand, Sandy Silt and Sand according to (Folk, 1974) method Table (3) and Figure (5).

Table (3) The results of grain size analysis in the study area

Sample number	Sand %	Silt %	Clay %	Texture
1	22	74	4	Sandy silt
2	68	21	11	Silty sand
3	85	7	8	Silty sand
4	84	13	3	Silty sand
5	91	8	1	Sand
6	92	7	1	Sand

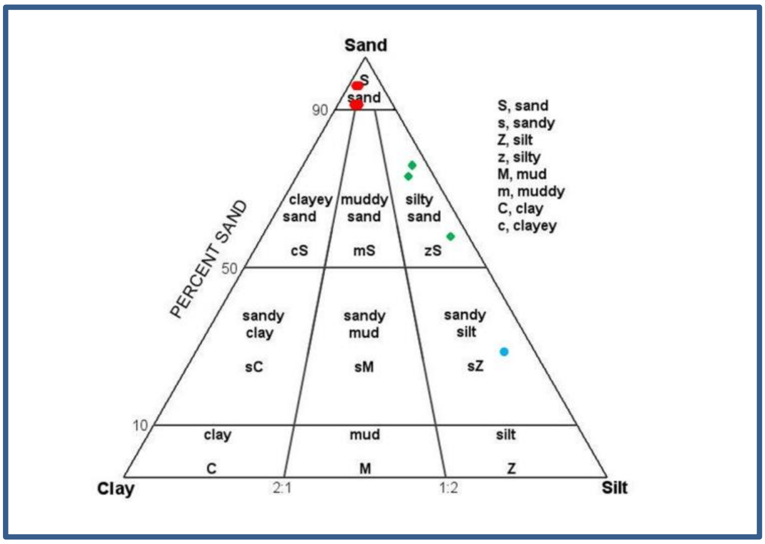


Figure (5) Texture classification of the studied soils according to (Folk, 1974)

3.3 Total Petroleum Hydrocarbons: Environmentally petroleum hydrocarbons are found in the form of organic compounds, they are an important and dangerous group of toxic environmental pollutants (Park, 2011)**.**The types and concentrations of Aliphatic compounds were measured in five samples from the soil of the study area with capillary gas chromatography (GC) device in the gas chromatography laboratory of the Basra Oil Company., which is equipped with an Ionization Detector, Flame (FID) to identify the total amount of hydrocarbons in the studied soil samples. Weight were taken (**80.14**)g and extracting values for (**S1**, Free hydrocarbons volatilized below **330 C°**) and (**S2**, Very heavy hydrocarbons > **C40** volatilize and nonvolatile organic compounds, crack at temperatures up to **550 C°**) and their total represents the TPH values for the sample. The recorded results showed that there is a gradation of total hydrocarbon petroleum concentrations (Table 4), (Figure 6). The results in the quality and concentrations of aliphatic compounds in the soil samples for the study areas showed that the carbon compounds of the aliphatic compounds ranged between (C7-C41) except for station (2). The sequence of carbon compounds started from (C18) and ended at (C34), (Table 5). As it reached the highest concentration (93.59 mg/g) in the sample (5), while the lowest concentration reached (0.5) mg/g in sample (3). These results are shown for the concentration of normal Alkanes and for the concentration of Aliphatic compounds in (mg/g). It's observed that all sample soils contain a high concentration of TPH. From the similar slopes obtained in the GC-FID analysis, for the TPH analysis, all sample soils contain high concentration of TPH, and a significant concentrations hydrocarbons was observed resulting in the higher of the peak curve in station samples 4 , 5 and 6 these results for sample soils with higher organic matter (Figure 7) shows these results for soil sample with higher organic matter.

Table (4) Evaluate TPH concentrations of soil samples using (GC-FID) analyzes.

Sample No.	)gm (Weight	)mg/g(TPH
Standard	80.12	12.77
2	80.08	0.53
3	80	0.5
4	80.05	47.49
5	80.11	93.59
6	80.14	0.59

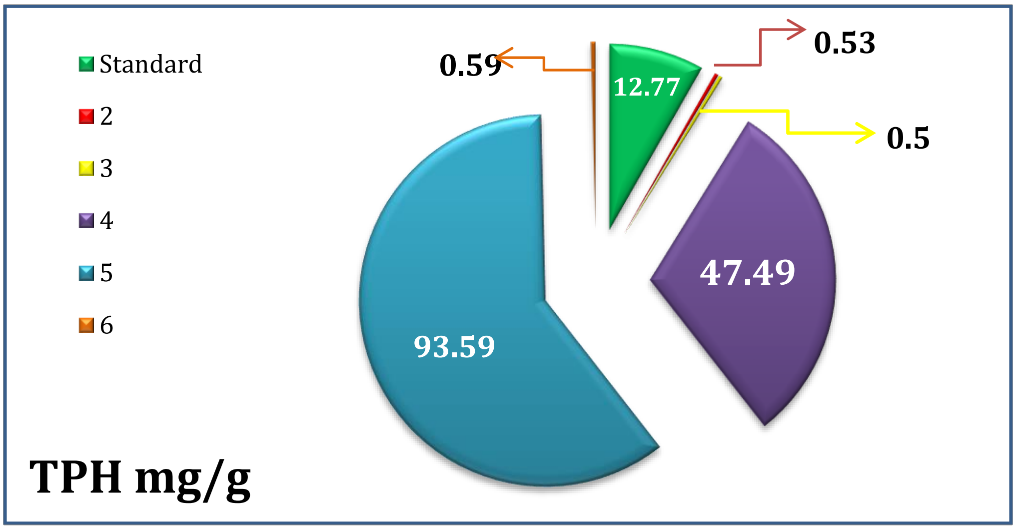
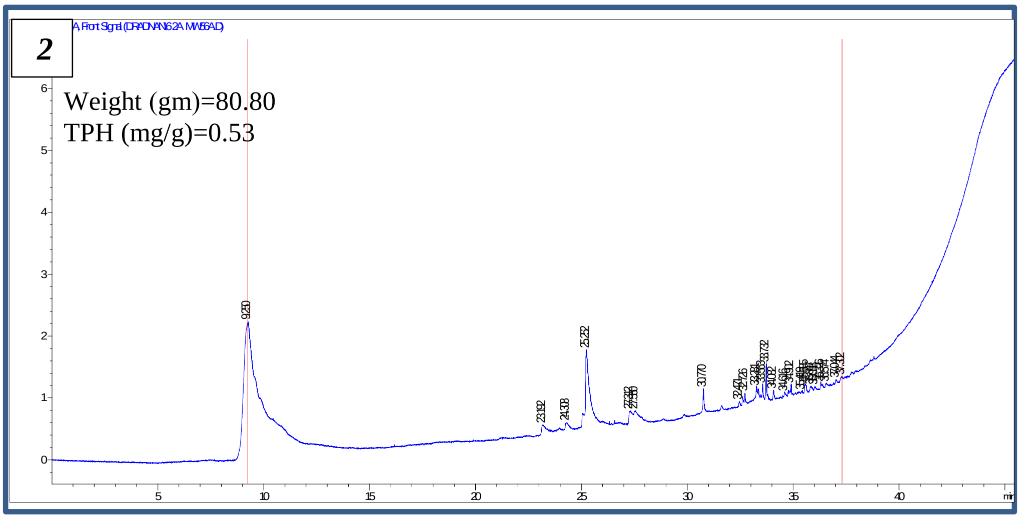
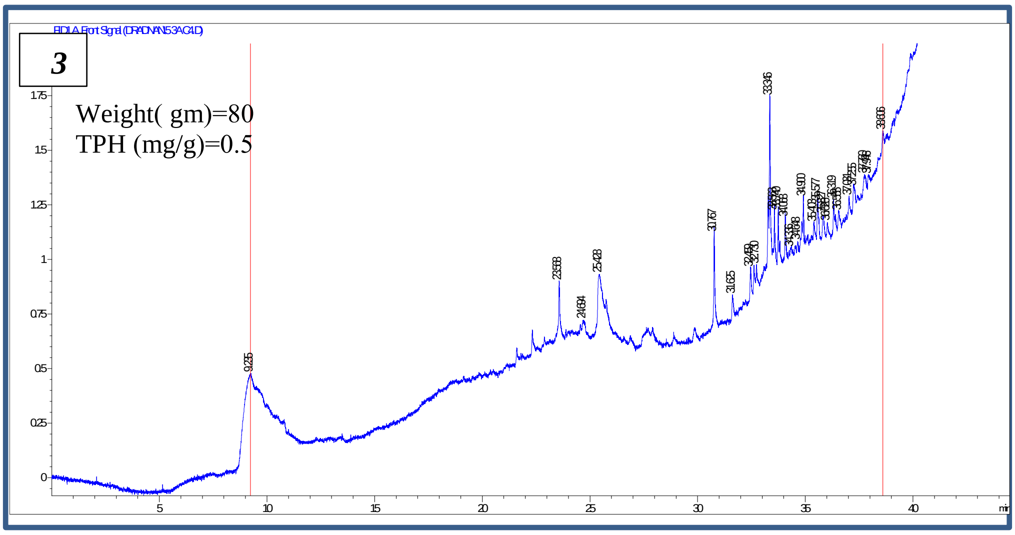
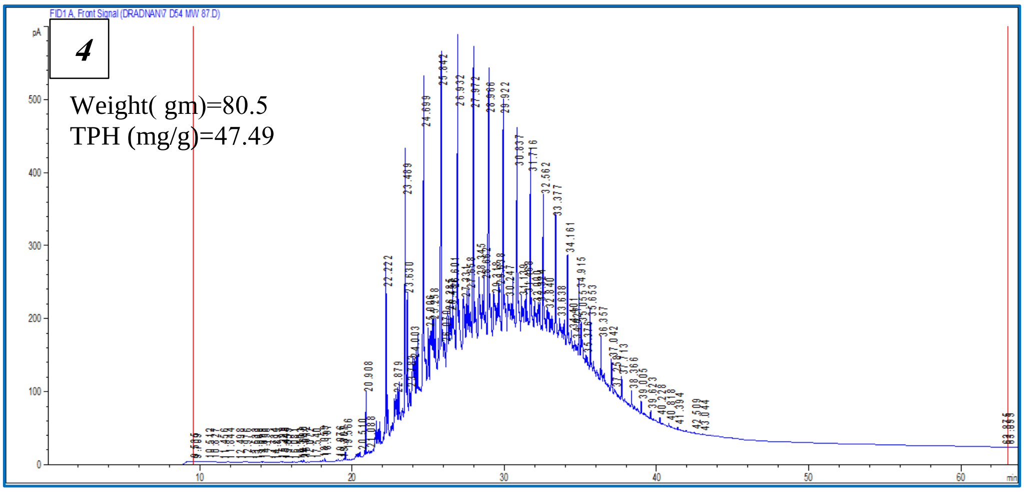


Figure (6) Total hydrocarbon concentrations in the study area


2
Weight (gm)=80.80
TPH (mg/g)=0.53


3
Weight(gm)=80
TPH (mg/g)=0.5


4
Weight(gm)=80.5
TPH (mg/g)=47.49

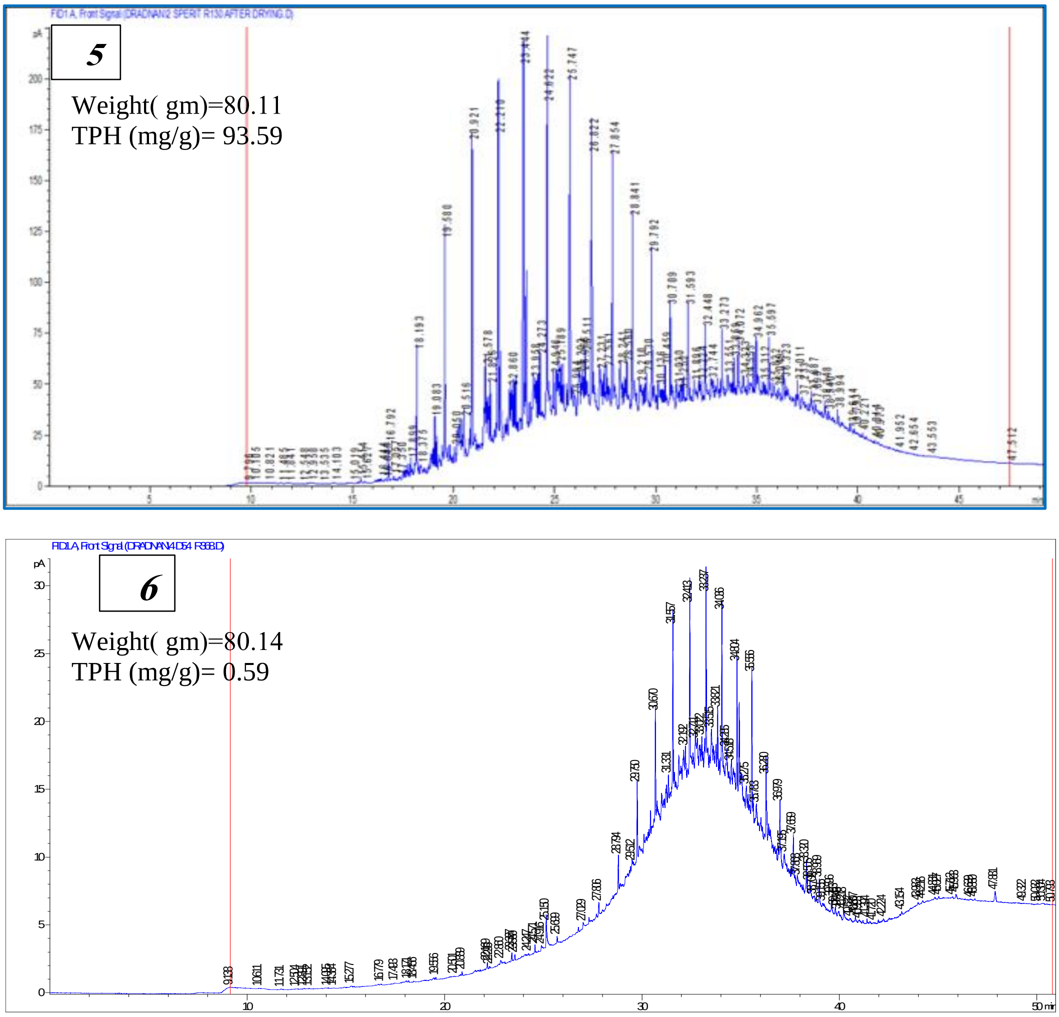


Figure (7) Concentration values of the usual Alkantine concentration in samples with a (GC-FID)

Table (5) the concentration values of Aliphatic compounds (mg /g) in the studied soil samples

Carbon No.	Station				
	2	3	4	5	6
C7	0	13.625	0	0	0.4
C8	0	0	0.32	0.26	0.195
C9	0	0	0.074	0.092	0.1
C10	0	0	0.025	0.04	0.185
C11	0	0	0.033	0.065	0.231
C12	0	0	0.036	0.097	0.297
C13	0	0	0.2	0.134	0.422
C14	0	0	0.876	0.206	0.553
C15	0	0	2.415	0.202	0.681
C16	0	0	3.429	0.423	0.829
C17	0	0	4.623	1.547	1.087
C18	2.509	0	5.644	2.617	1.228
C19	2.108	4.357	5.924	4.958	1.732
C20	18.765	5.115	5.978	5.353	2.31
C21	0	0	6.444	6.525	4.912
C22	5.416	0	5.479	6.031	3.404
C23	0	0	5.08	6.038	5.693
C24	0	0	4.658	5.775	5.778
C25	1.61	1.859	4.254	5.35	6.752
C26	0	2.113	4.125	5.09	7.634
C27	1.602	3.564	4.174	4.794	7.155
C28	8.067	9.112	3.733	4.021	7.394
C29	8.813	7.601	4.173	4.003	8.595
C30	9.694	5.56	5.253	3.04	3.685
C31	10.123	7.075	2.471	4.809	7.131
C32	12.547	9.828	5.189	2.205	1.413
C33	13.121	9.715	1.093	0.731	3.321
C34	5.625	3.664	2.614	2.719	2.594
C35	0	3.378	2.155	1.344	2.402
C36	0	13.434	2.939	1.156	2.008
C37	0	0	0.451	1.007	2.226
C38	0	0	1.939	0.89	1.273
C39	0	0	0.243	0.79	5.162
C40	0	0	3.307	17.073	1.219
C41	0	0	0.65	0.614	0
Total	100	100	100.001	99.999	100.001

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3.5 Heavy Metals: One of the negative effects of oil spills is transmitted of heavy metals to the surrounding environment. Contamination by heavy metals depends on the toxicity and concentration of each metal in the crude oil (Al-Khafaji, 2020). Heavy metals are accompanied by petroleum accumulation at an early stage in their formation from source rocks, mainly as organometallic complexes, which are very stable (Lewan, 1982). There are other sources of trace metals in crude oils, which include minerals leaked during migration and contamination during production (Ajayi, 2009). Heavy metals enter the soil primarily into the human body through inhalation, skin, and Ingestion contact, posing a threat to human health (Castro-Gonzalez, 2017). High concentrations of metals in soil can be deleterious, upsetting the delicate ecological balance and contaminating food sources (Hardaway, 2004). All heavy metals are deposited only under alkaline conditions in the form of oxide, hydroxide, phosphate and carbonate (Namieśnik, 2010).

Six heavy metals, these are: Cd, Cu, Fe, Ni, Pb & Zn, weighs (2 gm) on dry soil sample and put it in Pyrex heat-resistant tubes, add a mixture of HNO3 + HCl acid in a ratio of (1:1) and a volume of (3 ml) for each acid. The samples shall be placed on a hot plate at a temperature of (80 C0) to a degree close to drought. Leave the sample to cool at room temperature. Then the sample is removed from the hot plate and added (2ml) of (HClO4) Perucloric acid with (2ml) of (HF) acid Pyropholic acid in a ratio of (1:1) and then return again on the hot plate to a degree close to dehydration.The samples are raised and added (HCl) acid drops to (0.5 ml), then diluted with distilled water to (50 ml). Then are extracted and measured a (Flam) Atomic Absorption Spectrophotometer in the laboratories of the Marine Sciences Center / University of Basra.

The heavy metals in this study were identified in different proportions and their content in soil samples is given in (Table 6). The results show high concentrations of some heavy metals Figure (8). Fe is varied value from (821 - 2450 ppm) with a mean of (1511.7) ppm (Figure 9). Cu, Ni and Zn vary from (122.75, 79.7 and 31.75 ppm) with a mean of (101.29, 39.24 and 10.69) respectively, the concentration rates Cu, Ni, Zn were less than the recorded rates for some Iraq soils. Also Pb and Cd are varied from (24.45 and 1.63 ppm) with a mean of 17.17 and 0.92 respectively.

All selected soil samples in the studied area exhibited significantly higher contents, particularly (Cu, Ni, Pb, Fe and Zn) due to the petroleum industries and drilling processes in Basra Governorate (Khwedim, 2013). And due to their large concentration in crude oil compared with the concentration of the same metals according to international classifications and within the limits of previous local studies in southern Iraq (Table 7).

Concentration of heavy elements in the study area (ppm) Table (6)

Sample No.	***Zn***	***Pb***	***Cd***	***Cu***	***Ni***	***Fe***
1	318.6	811.1	1.63	119	79.7	1759.00
2	3.45	28.45	80.9	121	336.2	2450.00
3	3.45	7.45	0.65	110	828.9	968.50
4	34.8	18.65	0.65	122.75	828.9	821.50
5	31.75	18.65	1.63	52.5	57.95	1309.00
6	2.05	18.65	0	82.5	3.6	1759.00
Average	10.69	17.17	0.92	101.29	39.24	1511.17

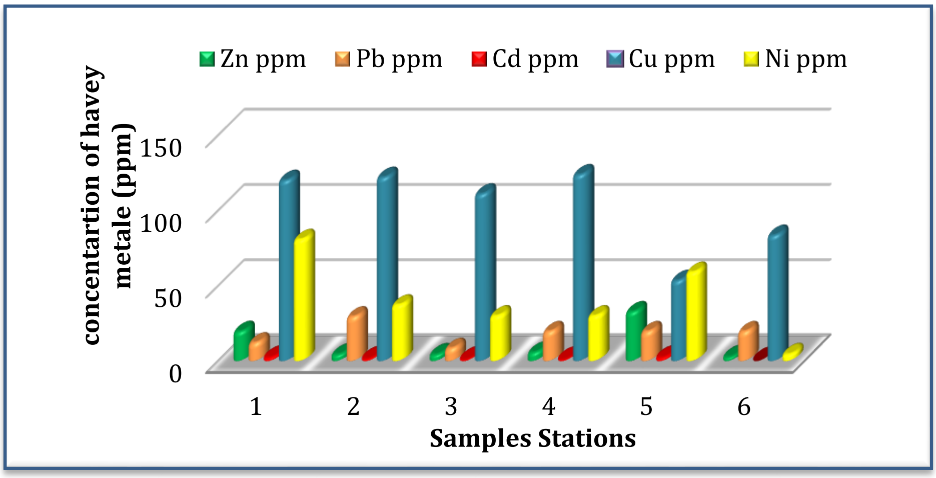

Figure (8) The concentration values of heavy metals in the study area soil samples

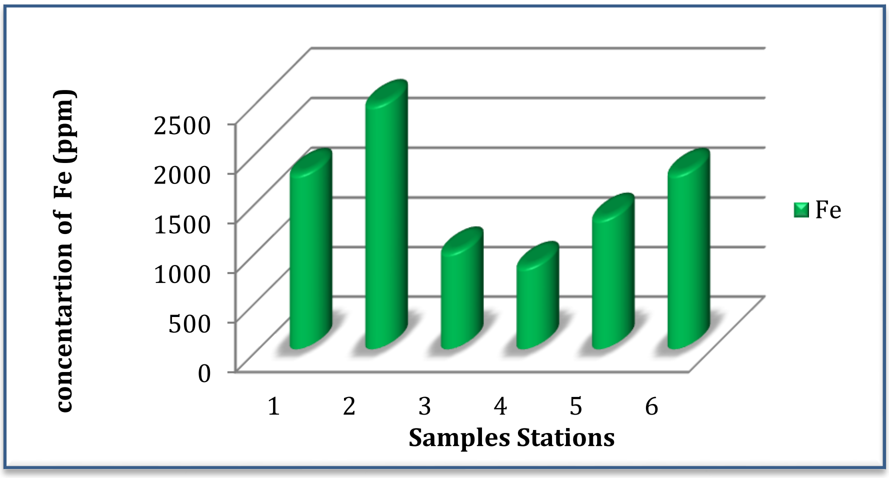

Figure (9) The concentrations of Iron elements in the study area

4. Pollution assessment methods for heavy metals: Heavy metal contamination of soil has behaved a serious global issue considering their persistence in the environment and the non-biodegradable nature leading to their accumulation to toxic levels, it is necessary to select suitable indices to diagnose heavy metal pollution (Tang, 2019) .

4.1 Geoaccumulation Index (Igeo): It is the most common indicator used to assess pollution (Welch, 1980). It is defined by the following formula:

$$\mathbf{Igeo = \log_2 (Cn / 1.5\ Bn)..........(1)}$$

Whereas, Cn is a concentration of heavy metals in soil, Bn is geochemical background reference value in soil. The background values (1.5) were used to reduce the variance (Müller, 1979) (Table 8) show classification of Igeo. The standard classes of Igeo for heavy metals are given according to (Kabata-Pendias, 2011) listed in Table (9).

Table (7) Comparing the standard limits for the concentration of heavy elements in the soil of the study area (ppm) with different standards and previous studies

Heavy Metals Ref	Zn	Pb	Cd	Cu	Ni	Fe	Studied Area
(ASTM, 2007)	**230**	**530**	**12**	**190**	**210**	**220**	**International Soil**
(Kapata–Pendias, 2011)	**66**	**15**	**1.05**	**26**	**20**	**500000**	
(Chiroma, 2014)	**300**	**100**	**3**	**100**	**50**	**-**	**International Soil**
(European Union, 2006)	**-**	**100**	**3**	**-**	**50**	**-**	
(USEPA, 1997)	**200**	**300**	**3**	**50**	**50**	**-**	**International Soil**
(Vodyanitskii, 2013)	**16**	**55**	**0.76**	**3.5**	**2.6**	**-**	
(Mohammed, 2015)	**-**	**178.00-10.1**	**3.80-0.1**	**-**	**38.60-1.5**	**-**	**Basra city- Al-Zubair highway area Roadside Baghdad city**
(Al-Obaidy, 2010)	**-**	**117.83 - 83.70**	**0.50-0.56**	**-**	**78.89 - 78.66**	**-**	
(Al-Hassen, 2011)	**-**	**97.4 -41.5**	**-**	**49.5-36.4**	**-70.9 152.1**	**-4694 5130.0**	**Basra city**
(Raheem, 2009)	**-**	**-**	**19.65 -9.79**	**14.42-6.18**	**-59.23 207.3**	**-**	**North Basra**
(Al-Sabah, 2013)	**7.10**	**7.06**	**-**	**5.79**	**-**	**2465**	**Southern Iraq**
Present study	**10.69**	**17.17**	**0.92**	**101.29**	**39.24**	**1511.17**	**North Rumaila field**

Table (8) Classification of Igeo according to (Müller, 1979)

Igeo value	Soils pollution case
Igeo ≤ 0	*Practically unpolluted*
0 ≤Igeo≤ 1	*to moderately Unpolluted*
1 ≤Igeo≤ 2	*Unpolluted to moderately polluted*
2 ≤Igeo≤ 3	*Moderately polluted to polluted*
3 ≤Igeo≤ 4	*Strongly polluted*
4 ≤Igeo≤ 5	*Strongly to extremely polluted*
Igeo≥ 5	*Extremely polluted*

Table (9) Geoaccumulation index of heavy metals in the study area (Müller, 1979)

Geoaccumulation Index (Igeo)			
Elements	Range (Igeo)	Mean (Igeo)	Pollution level
Zn	3.17-7.13	4.82	Strongly to extremely polluted
Pb	2.90-4.83	3.98	Strongly polluted
Cd	-4.45-0.00	-3.17	Practically unpolluted
Cu	6.51-7.73	7.40	Extremely polluted
Ni	2.26-6.73	5.23	Extremely polluted
Fe	14.74-16.32	15.52	Extremely polluted

4.2 Enrichment Factor (EF): It is defined as the minimum factor by which the weight percent of mineral in an ore body is greater than the average occurrence of that mineral in the Earth's crust.

EF = [(CM / CFe) sample] / [(CM / CFe) Earth's crust]……. (2)

Whereas, (CM/CFe) sample is the ratio of the concentration of the element of concern(CM) to that of Fe (CFe) in the soil sample (ppm) and (CM/CFe) Earth's crust is the same ratio in an unpolluted reference sample. According to (Müller, 1979); (Rule, 1986) proposes a system of six categories to describe the level of pollution (Table 10). The standard classes of EF for heavy metals are given listed in (Table 11).

Table (10) Classification of EF, according to (Müller, 1979); (Rule, 1986)

Enrichment factor	Enrichment degree
EF<1	*No enrichment*
1 ≤ EF < 2	*The least possible enrichment*
2 ≤ EF < 5	*Moderately enrichment*
5 ≤ EF < 20	*Significant percentage of enrichment*
20 ≤ EF < 40	*Very high enrichment*
EF ≥ 40	*Extremely enrichment*

Table (11). Enrichment factor index of heavy metals in the study area (Müller, 1979); (Rule, 1986)

Enrichment Factor (EF)			
Elements	Range (EF)	Mean (EF)	Pollution level
Zn	0.01-0.18	0.06	No enrichment
Pb	0.21-0.76	0.04	No enrichment
Cd	0-0.59	0.32	No enrichment
Cu	0.77-2.87	1.50	The least possible enrichmen
Ni	0.05-1.13	0.72	No enrichment
Fe	0. 4-1.0	1	The least possible enrichmen

4.3 Contamination Factor (CF): It is a single indicator is considered to be a simple and effective tool in monitoring heavy metal contamination (Hakanson, 1980) as given in Table (12), CF is calculated using the following equation.

CF=CM Sample /CM Background………(3)

Where (CM) sample the concentration of the heavy elements in the sample (ppm) while CM Background is its concentration in the reference sample. The results of polluted soil samples in the current study are explained in Table (13) according to the pollution factor CF.

Table (14) shows the result values of pollution parameters for heavy elements in the study area Figure (10). Observed the CF > Igo > EF contamination of the Cu and Fe more than Compared to other metals Zn, Pb, Ni and Cd, respectively, by using the Igeo Geoaccumulation Index proposed (Müller, 1979) and the Evolution Factor (EF) Enrichment Factor approved by (Tang, 2019); (Hakanson, 1980) and the pollution factor index. (CF) Contamination Factor approved (Savvides, 1995) and (Pekey, 2004).

Table (12) Classification of sediments according to the pollution factor (Hakanson, 1980)

Contamination factor	Contamination degree
CF <1	*Low contamination*
1 ≤CF≤3	*Moderately contamination*
3< CF≤6	*High contamination*
CF >6	*Extremely contamination*

Table (13) The results of CF for the studied soil samples (Hakanson, 1980)

Contamination Factor (CF)			
Elements	Range (CF)	Mean (CF)	Pollution level
Zn	0.03-0.48	0.16	Low contamination
Pb	0.49-1.89	1.14	Moderately contamination
Cd	0.0-1.55	0.88	Low contamination
Cu	2.01-4.72	3.89	High contamination
Ni	0.18-3.99	1.96	Moderately contamination
Fe	4.9-1.6	3.02	High contamination

Table (14) represents the pollution indexes in the study area soils

Soil Contamination Factors (Igeo), (EF), (CF)			
Sample soil	**Igeo**	**EF**	**CF**
Zn	4.82	0.059	0.162
Pb	3.98	0.42	1.14
Cd	-3.17	0.32	0.88
Cu	7.395	1.49	3.89
Ni	5.23	0.715	1.96
Fe	15.52	1.00	3.02

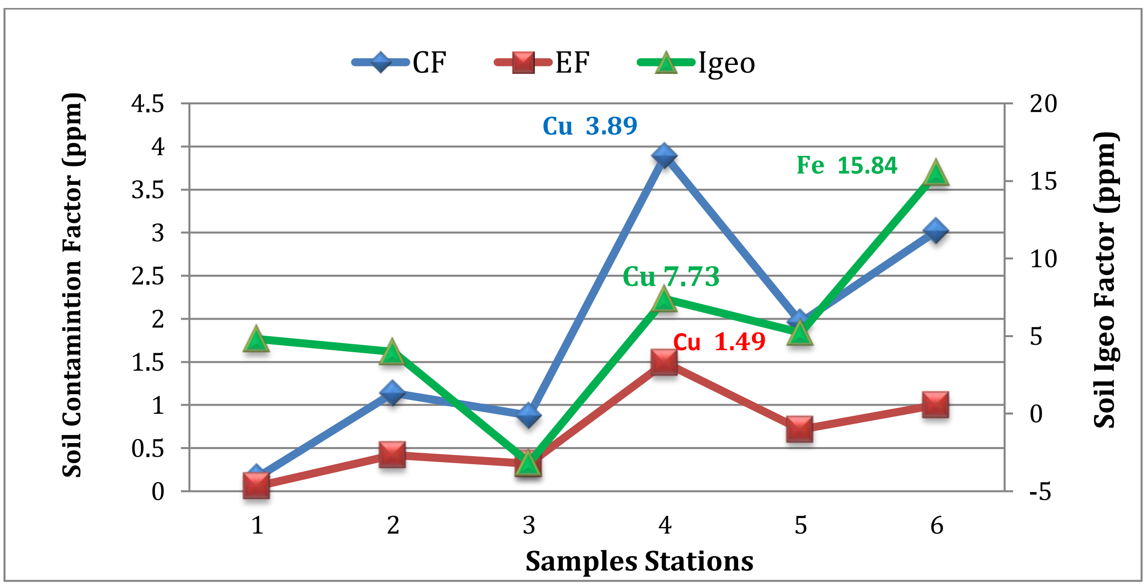

Figure (10) The graphic distribution of pollution factors in the study area

5. Conclusion

The results of grain size analysis revealed the sand, sandy silt to silty sand. Observed that all sample soils contain a high concentration of TPH Also, evidence that pollution of soils with petroleum hydrocarbon compounds has a negative impact on various aspects of life.

The presence of high concentrations of heavy metals in the soil due to the sandy soil texture with high permeability is due to the washing of these minerals down in the lower earth layers, particularly (Cu, Ni, Pb, Fe and Zn) because of the petroleum industries and drilling processes in the Basra Governorate. Their large concentration in crude oil compared with the concentration of the same metals are according to international classifications and within the limits of previous local studies in southern Iraq.

According to (Igeo) values, (EF) and (CF), Zn falls into Strongly to extremely polluted, the pollution levels of Pb Strongly polluted, and Cu, Ni and Fe in all stations were higher than Cd, is falling into extremely polluted, this pollution in the study area indicating that in the studied area polluted by petroleum emissions are the main source.

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تقييم الأنسكابات النفطية في التربة الرملية بمنطقة حقل الرميلة النفطي – البصرة، جنوب العراق

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المستخلص

الهدف من هذه الدراسة هو تقييم الأثر البيئي لانسكاب النفط الخام على التربة في حقل الرميلة النفطي في مدينة البصرة جنوب العراق. تم جمع ست عينات من التربة بالقرب من مواقع الانسكابات النفطية. أظهرت نتائج التحليل الحجمي لعينات التربة المختارة, نتائج تحليل الحجمي للحبيبات التربة في منطقة الدراسة تعد تربة رملية غرينيه تحتوي على القليل من الطين.

تم قياس تراكيز المركبات الأليفاتية لتحديد محتوى الهيدروكربون الكلي (TPH) ، وأظهرت النتائج وجود تركيز عالي من الهيدروكربونات الكلية في عينات تربة منطقة الدراسة. تراوحت مركبات الكربون للمركبات الأليفاتية بين (C41-C7) باستثناء نموذج (2) ، إوضح تسلسل مركبات الكربون يبدأ من (C18) وينتهي عند (C34) حيث بلغ أعلى تركيز (93.59) ملجم / لتر بالنموذج (5) بينما كان أقل تركيز (0.5) ملجم / لتر بالنموذج (3).

أجريت دراسة تفصيلية لتحديد تراكيز ست عناصر ثقيلة (الزنك والرصاص والكادميوم والنحاس والنيكل والحديد), سجلت تراكيزها (10.69 ، 17.17 ، 0.92 ، 101.29 ، 39.24 و 1511.17) جزء في المليون على التوالي. لوحظ وجود تركيز عالي من (الزنك ، الحديد ، النيكل ، النحاس) في جميع عينات التربة تجاوز الحدود القياسية العالمية في التربة، تشير إلى ان التلوث النفطي هو من المصادر الرئيسية لهذه العناصر في تربة منطقة الدراسة الحالية

أظهرت نتائج مؤشرات تقييم التلوث Igeo و EF و CF مستويات تلوث عالية لكل من Cu و Fe و Ni ، وأشار المؤشر إلى أن معظم تلك العناصر تسببت في مخاطر بيئية منخفضة في جميع مواقع النمذجة باستثناء Zn و Cd و Pb والتي كان لها مخاطر معتدلة في منطقة الدراسة.