Gravimetric Analysis of Oil pollution of Tigris River

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Abstract: Environmental Pollution has become the first threat to humanity nowadays. Water pollution with petroleum products occupies the largest space because of its impact on the environment and waste of money. Oil is still one of the most important sources of energy currently used in the world. The aim of this research is to monitor and measure the intensity of the oil pollution caused by the oil spill leaks to the Tigris river and to treatment this leakage by oil booms. Six stations for remote sensing were distributed along the Tigris river to record oil concentrations. Each station consists of a sensor and a data reader that receives the digital data from the handsets and stores in the form of tables. Gravimetric analysis has been used to measure oil concentration. An organic solvent, hexane, was used to extract oil from the water. Oil booms have been used to collect spilled oil, preventing oil from spreading and changing flow direction for the purpose of collection. The process of scraping oil above the surface of water was done using oil scrapers.

1. Introduction

The oil spill to the water rivers or seas is one of the most environmental accidents lead to destroy the environment system and economics of countries. Risks of spill oil to the seas and water rivers have increased with increasing oil production [1]. The pollution of the rivers and seas in the oil representing real disasters it cannot be controlled because some of its dangerous effects do not appear until several years later. Dangerous petroleum compounds have a significant effect, which is also transmitted to humans through the food chain where they are stored in the livers and fats of marine animals. In the Arab world, the problem of pollution of rivers and seas has become a constant threat to human and economic activity because more than half of the Arab population lives along coastal areas of rivers and seas [2]. Oil is characterized by its high ability to interact and diffuse in several forms and access to fresh water for rivers and the seas. There are many forms of oil spread in rivers and seas such as spreading, natural dispersion, water in oil emulsification, dissolution, evaporation, oxidation, sedimentation and biodegradation [3].

Oil spills have negative impacts on the humans as a result of the direct exposure such as breathing contaminated air and contact with the skin, or due to the indirect exposure to oil spills by bathing in contaminated water or eating contaminated food. Oil spill pollution also effects on the economics of countries where it leads to economic stagnation and reluctance to tourism in contaminated places in addition
to the high costs to remove this pollution. The cost of removable of oil spill depending on the different factors such as location and type of oil spill, it’s between (2$ – 200 $) for each litter [2].

The spread of oil in water affects all vital activities in living organisms where it contributes to blocking the sun's rays and influence the process of photovoltaic construction, Prevents the exit of gases and reduces the amount of dissolved oxygen in the water, it adheres to aquatic organisms and birds, leading to its destruction and the great destruction of the coasts and the killing of useful plants found in the shallow waters located near these oil spots [4].

Oil pollution occurs as a result sinking of oil tankers, leakage due to the explosion of oil wells in the rivers or seas, dumping of petroleum industry waste into water and maintenance of power stations. The danger of oil spills into water bodies is the rapid spread of large oil spots (one ton of oil can be covers 12 km²).

There are different method to measure amount of oil in the water depending on the location of the test in situ or in the laboratory. Gravimetric analysis, Colorimetric analysis and Infrared spectrometry are used in the laboratory while UV Fluorescence technique is a common analysis used in situ. Gravimetric analysis has been used to investigate oil concentration in this study.

2. Methods of treatment of oil pollution

Due to the lightness of the oil, it forms a thin layer above the surface of the water and is therefore an insulator for gases and lighting. The process of combating oil spill on the water surface is affected by several factors such as quality and quantity of oil spilled, weather and place of spill. There are several ways to combat oil spill in the water [3,4]:

2.1 Mechanical approach

It is done by using oil booms to protect water outlets, prevent oil from spreading and Change the direction of the oil for the purpose of assembly. Oil skimmers are used to scrape the oil over the surface of the water. In this method a large of oil that are collected must be transport from the site [4].

2.2 Chemical approach

It is done by spray the oil with chemicals materials called dispersants to help distribute the spilled oil molecules. It used to minimize environmental damage and their use depends on certain places and not always. The treatment with this method requires long period [5].

2.3 Burning the oil spot

It is done by collect the oil spot and surround it with fireproof barriers and then burn the spot in place. The advantage of burning technique is removing large amounts of oil in less time than other techniques. The burning can be used in different weather and its usually the last control solution [6]. During some oil spill, the oil is naturally degraded by wave movement or by tides. This is used after studying the effects of the spilled oil and the area in which it is located and the feasibility of the control operations.

The mechanical method is consider the best way to remove the oil from water surface. Booms are used to stop the movement of oil on water and designed to move up and down with the waves. Booms are manufactured and designed to resist the failures due to the high waves ‘figure 1’ [7]. While skimmers are used to remove the oil from the water surface and designed according to the area where they are used ‘figure 2’ [8].
Combat the oil spot in this study has been done in Tigris river by mechanical technique due to provide the equipment and easy collect the spot of oil in one place.

3. Factors affecting on the treatment of oil spill

The cost of the treatment of oil spill is effected by the condition of the weather [9]. There are different weather condition significant on the treatment of oil spill, but the important those are wind speed, state of the waves, temperature and visibility. During treatment of oil spill, speed wind must not more than 15 m/s, wave steepness not more than 2 m, temperature not less than -3 °C and visibility not less than 0.4 day light [10]. Waves are affected by wind speed and can be cause change in behavior of the oil [11]. The energy of the wave is different from the sea to the river according to the speed of wind. At sea we can find different types of wave such as breaking waves and nonbreaking waves. The weather condition also effect on the burning in situ where its significant on the ability of ignite.

4. Materials and methods

4.1 Exploration of the oil spills in Tigris river

The oil spot was located near the Zubaidiyah power station in Wasit province. This leakage was the result of the maintenance of the power power station, waste disposal plant was discharged in the Tigris river. Emulsified oil sensor in the remote sensing station located in the Tigris River basin in the Zubaidiyah area observed amount of oil more than the natural value in the waters of the river.

4.2 Remote sensing project

Remote sensing project for monitoring water quality in Wasit Province consist of eight stations, six are distributed along Tigris river (Essaouira - Zubaydiyah - Nu'maniyah - Kut before Sada - Kut after the dam / station Bridge Karama - Sheikh Saad). The seventh station installed on the Al-Gharraf river in the Al-Hay district. These (7) station are connected with the eighth station (central station) which is installed in Environment Directorate of Wasit Governorate ‘figure 3’. Several sensors were used in the project, Dissolved oxygen sensor, Turbidity sensor, Acid function sensor. Chlorophyll sensor, Blue-green Algae
Allergy. Emulsions of the emulsified fat. The last type has been used to study concentration oil in the water Tigris river.

The float-type sensors are used in all the control stations. The principle of work of these sensors depends on the direct contact with the float material (oil). The sensor’s electrodes are made of titanium and insulated with spacers of ceramic.

Each station consists of a sensor and a data reader that receives the digital data from the mobile devices and stores it in its internal memory in the form of tables. This device instructs all the devices connected to it to take readings every 15 minutes and transfer this data from the remote station to the central station “figure 1”. The data are transferred through the central station data (CSD) message service where the results of the substations are viewed at the central station and the results and follow-up are reviewed periodically.

5. Al-Zubaidiyah power station

The Zubaidiyah power station is one of the projects that have significant environmental impacts on the quality of water. The plant was established in 2012 on the right side of the Tigris River on an area of 800 dunums. The cooling water of the plant and the operational water of the station will be withdrawn from the Tigris River by underground pipes. The temperature of the effluent will be higher than the influent. This leads to a change in water quality, especially in the areas between the station site and the city of Nu'maniyah. Al-Zubaidiyah power station needs to more than 160000 m³/day of water after refining and filtration to obtain water free of all impurities.

Although the maximum concentrations of carbon dioxide for 24 hours is 126.7 μg / m (the main pollutant of the plant) is emitted into the atmosphere, however, water pollution remains the most important effect due to its negative impacts on the humans.
6. Experimental work

In this study Gravimetric analysis has been used to investigate oil concentration in the water of Tigers river. Gravimetric analysis method depends on the extracting the oil from the water by using a solvent (EPA method 1664). An organic solvent, hexane, was used to extract oil from the water. This method is used to determine of n-hexane extractable material (such as oil) in surface waters and industrial aqueous wastes. This method is not suitable for materials that volatilize at temperatures below 85°C [12], [13].

Three samples from different positions were collected (middle of the river, before the barrier and after barrier). 500 ml of the each sample has been taken in a separating funnel, then add 2 ml of HCL 1:1 and 15 ml of hexane with good shaking. The sample is left to stagnate, hexane layer is separated and filtered through the NaSO₄ anhydrous filter paper to absorb the moisture. The sample extracted for three times and the value of the hexane is depends on the amount of the oil in the sample ‘figure 5’. The extracted sample is evaporated on a water bath and placed in an oven with a temperature of 70 °C for 15 minutes and then cooled and weighed ‘figure 6’. The amount of the oil can be expressed by the equation below:

\[ EO = \left( \frac{FM - IM}{V} \right) \]

Where:

- **EO**: Extracted oil [mg/l]
- **FM**: Final mass [mg]
- **IM**: Initial mass [mg]
- **V**: Sample volume [l]

![Figure 5. Gravimetric analysis equipment](image1)

![Figure 6. Oven used in the experimental](image2)
To achieve acceptable accuracy, equation (2) used to calculate the standard deviation (s) of the percent recovery (x) [14] (Method 1664, Revision A: n-Hexane Extractable Material (HEM:Oil and Grease) and Silica Gel Treated n-Hexane Extractable Material, 2010).

$$s = \sqrt{\frac{\sum x^2 - (\sum x)^2}{n}}$$

(2)

Where:

n= Number of samples

X= % recovery in each sample

7. Results and Discussion

This study was carried out to investigate amount of oil in the Tiger river with Gravimetric analysis method. Three positions were studded (Essaouira, Zubaydiyah and Nu’maniah) to investigate the concentrated the oil after discovering an oil spot near Al-zubaidiyah power station. Essaouira site was the first position has been tested, eight samples were selected to measure concentration of oil in the water. The results of the analysis showed that the average amount of oil 0.023 mg/L was less than the standard limits [0.1 mg/L]. Second station showed, which is after the thermal power station in Al- zubaidiyah, the samples were taken with the same number of the first site to study water pollution in this region. The results showed high oil concentrations in this area near alzubaydiyah thermal power station. The results of the average amount of oil in water was 0.40 mg/L was more than the standard limits [0.1 mg/L]. The third site was Nu’maniah district which is fifty kilometers south of the alzubaydiyah thermal power station. The results of the test eight samples indicate that the oil content in the water was 0.22 mg/L. Table 1 shows concentrations of the oil amount determined by Gravimetric analysis for three stations (Essaouira, Zubaydiyah and Nu’maniah).

| site          | Concentration of oil in the water [mg/L] |
|--------------|------------------------------------------|
| Essaouira    | 0.030 0.025 0.020 0.025 0.025 0.020 0.015 0.025 |
| Zubaydiyah   | 0.500 0.550 0.400 0.350 0.450 0.300 0.300 0.350 |
| Nu’maniah    | 0.210 0.220 0.230 0.190 0.180 0.240 0.260 0.230 |

Note that concentrations of the first position (Essaouira) is less than the standard limits according to Iraqi Standard No. 25 of 1967 (figure 7), this is because the site of first position (Essaouira) was located north of the thermal power station and the flow of the river from north to south. The concentration of second station in the table 1 was more than the standard limits [0.1 mg/L] due to the Oil spill near the thermal power station. As for the third site (Nu’maniah), which is south of the thermal power station, we notice that the concentration is still higher than the standard, but less than the second site due to the rapid flow of water that helps disperse the oil slick.
8. Treatment of oil spot

The oil spot has been treated by using the booms and the basin tankers for availability in the site with cooperation with Oil Ministry and Environment Directorate of Wasit Governorate. The booms have been installed near one of the bridges to prevent the oil spill from spreading. The basin tankers was beside the river to pull the collected oil from the surface of the water. There is other method has been used to collect the oil from the surface of the water by using storage boat. The pump is put under the oil spill then pull the oil to the out of water.

9. Conclusion

Tigris River is supplies water to a large area of Waist province and its considers one of the most important rivers in the southern of Iraq. During the last years, pollution reached the highest level in the Tigris River, especially after the establishment of thermal power plants near it (Zubaidiyah power station) as an example. There should be a feasibility study on the establishment of thermal power plants near the important rivers to maintain them, especially in the current conditions of water scarcity.

The environmental assessments were not carried out for most of the energy projects, including the Zubaidiyah power station. Despite the importance of this station at the present time, but the wastes which are disposed of in the Tigris Rivers after the maintenance is considered an environmental disaster must be addressed.

Gravimetric analysis has been used to investigate amount of oil in the waters of Tigris rivers. The results of the average amount of oil in water was more than the standard limits near Al- Zubaidiyah power station because of oil pollution in this region.

There are many method for removing the oil from the water rivers. Selection of the method depends on the type of oil, its depth, location and amount of oil. In this study the mechanical technique has been used to collect the oil spot from the water. This technique is very suitable for pollution of rivers especially in Iraq.
The booms are available in all the ministries but we need to provide the skimmer where it is not available. Now, the basin tanker and storage boat have been used to collect the oil spot from the river instead of skimmers.

After treatment and removing the oil from the surface of the water by using the mechanical technique, the amount of oil has been examined and was at a normal level.

10. References

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