Environmental Study for the Oil Pollutants Treatment of Wadi Al Naft Water/Kirkuk

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Abstract

Wadi Al Naft is a narrow valley originates from the confluence of two tributaries within the industrial region of (BaBa GurGur). The valley is being used to discharge the oily wastewater from the North Oil Company (NOC) premises in addition to the natural oil seepages within the industrial region. The oily wastewater is a polluting source to the agricultural lands at Hawija district and further lands. The study included (111) samples of oily wastewater from (13) sampling stations (9 on the first tributary and 3 on the second tributary) along the course of Wadi Al Naft and its tributaries. The sampling procedure was performed for a continuous period of seven months (Jan.2007-May2007), in addition at selective seasonal periods during April and July. It was found that the oil concentration plays a major role in polluting the wastewater discharged to the channel; which was (44%) above the permissible standard.

Keywords: Wadi Al Naft, BaBa GurGur, natural seepages, oily wastewater.

الدراسة البيئية لمعالجة الملوثات النفطية في مياه وادي النفط/كركوك

الخلاصة

وادي النفط هو وادي ضيق يتألف من ملتقى رافدين ضمن المنطقة الصناعية (بابا كركر). الوادي يستخدم لطرح مياه الفضلات النفطية من اقسام شركة نفط الشمال بالاضافة الي النضوحات النفطية الطبيعية ضمن المنطقة الصناعية. مياه الفضلات النفطية هي مصدر لتلوث الاراضي الزراعية في قضاء الحويجة واراضي أبعد. تضمنت الدراسة (111) نموذج لمياه الفضلات النفطية تم **جمعها** من (13) محطة (9 منها تقع على الرافد الاول و3 على الرافد الثاني) على طول مجرى الوادي وروافده. استمرت اجراءات جمع العينات مدة سبعة أشهر (كانون الثاني 2007- تموز2007)، اضافة الى اختيار فترات فصلية خلال شهري نيسان وتموز. وجد ان تركيز النفط يلعب دورا كبيرا في تلويث مياه الفضلات المطروحة الى القناة، حيث تجاوز بنسبة (44%) المحددات المسموح بها.

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Introduction

Wadi Al Naft is a narrow valley lies to the north west of Kirkuk city with a length of about 130 Km passes through agricultural lands, starts from the lower Faris Mountains in the industrial region (BaBa GurGur) behind the old processing plant of the North Oil pany and ends at Al Adhaim River. The main channel of Wadi Al Naft is composed from the conjunction of two tributaries within the industrial region, as shown in Figure (1):-

• **The first tributary** consists from two sources which are inside the industrial region as follows:

Natural Seepages: These occur as springs with crude oil seepages. The sources of these springs are ground water, surface runoff like rain water and the crude oil seepages from the

bottom trap at the industrial region about(300-400) m from the natural seepages region.

Industrial wastewater: This wastewater flows from the old processing plant of the North Oil Company inside the industrial region.

• **The second tributary** includes the flow of the industrial wastewater from the central workshops and the flow from the oil products store inside the industrial region.

Objective of the Study

The main objective of this study is to investigate Wadi Al Naft channel pollution inside the industrial region in Kirkuk through studying the sources of pollution that may affect the environment and measurements of oil in water resulting from different sources of pollution (natural and industrial).

Pollution

Pollution-the word brings to mind a variety of abuses that man has perpetrated on his fellow man. He has fouled the air, polluted streams and lakes, and made vast dumping grounds out of once scenic areas. Water is impossible to destroy. Eventually, all water evaporates and later returns to the earth as rain or snow in a relatively pure state. Through this never-ending cycle there is just as much water now as there ever was, but the amount of water does not increase, (Sam, 1970).

In areas where oil and gas development is prevalent, air, water and soil resources can become contaminated with oil and gas wastes and byproducts, (Earthworks, 2003).

Oil and Grease

Oil and grease, measured in mg/L, can cause many problems in decentralized wastewater systems. They tend to coat equipment and living organisms and clog soils (Matassa et al., 2003). Fats are among the more stable of organic compounds and are not easily decomposed by bacteria. The oil and grease (O and G) is a very important test used to determine the hydrocarbon content of industrial wastewaters. Free O and G can be removed by flotation and skimming using gravity oil separator (GOS) (Self Monitoring Manual, 2003).

Oil and Grease in Oil Processing Wastewaters

The most important pollutants in the oil processing wastewaters are conventional pollutants such as oil and grease, suspended solids, and nonconventional pollutants such as phenolic compounds, COD, sulfide and ammonia. Among these pollutants, oil and grease is one of the most complicated to remove. Wastewater from oil field operations may contain drilling muds, brine, free and emulsified oil, tank-bottom sludge and natural gas. Many oil-bearing strata have brine-bearing formations. Oil and gas must then be separated from the wastewater; this wastewater is typically a brine waste containing some oil contamination and must be disposed (Rhee et al, 1983). The type of oil-water mixture may be classified as oil and grease present as free oil, dispersed oil, emulsified oil or dissolved oil. Free oil is usually characterized by an oil-water mixture

with droplets greater than or equal to 150 microns in size while a dispersed oil mixture has a droplet size range between 20 and 150 microns, and an emulsified oil mixture will have droplet sizes smaller than 20 microns (Manning and Eric, 1983). A wastewater with oil-water mixture where the oil is said to be soluble is a liquid where oil is not present in the form of droplets (the oil particle size would be typically less than 5 microns) (Patterson, 1985).

Field Work

The field work started at the industrial region (BaBa GurGur) down till Hawija circle outside the industrial region (Fig. 1). The industrial region lies to the north west of Kirkuk city; many of the North Oil Company premises are located within the industrial region. Therefore, many of them are regarded as industrially polluting sources of Wadi Al Naft channel. All the tests were carried in the laboratories of the North Oil Company at Arafa region at a distance about (6) Km from the industrial region.

Sampling Stations

Thirteen stations were selected along Wadi Al Naft channel and on its tributaries. Many factors were considered in selecting the sampling stations. Hydraulically the reach at each station should be relatively straight. Geometrically, should be distinct with clear section. Also for the selection of the stations it was considered to have over looked the pollution situation problem and the pollutant concentrations effect. In addition to all mentioned considerations, the possibility of reaching these stations due to the rough topography of Wadi Al Naft region was the most practically problem. At many locations, the side slope of the channel was relatively steep, so it was difficult to reach for any measuring purposes. That was from one hand, but on the other hand the security situation in the region made it impossible to reach some locations. Table (1) shows the geometric details of each sampling station.

Experimental Tests

Evaporation method was used for determining oil and grease concentrations. Dissolved or emulsified oil was extracted from water using chloroform as a solvent and then separating water and solvent by a separating funnel. Then the solvent was filtered into a glass dish through a funnel containing solvent moistened filter paper (No.1PS). After evaporating the solvent, the glass dish was weighed to determine oil concentration, as stated by (Alley 2000, and ASTM 1988). The floating oil was measured in a (100) mL cylinder.

Analysis of Oily Wastewater

For Period from Jan.-May

The oil in water data, are shown in figures 2 and 3. The high level of concentration at station No.3 which reached a maximum value of (1069) mg/L due to the oily wastewater which is discharged from the old processing plant while the minimum value is in the natural seepages region as shown in figure (2). The lagoon of the industrial region was found to have a high removal efficiency of 99% for the oily wastewater which discharged from the old processing plant of the North Oil Company. That is the reason for the decreasing of oil level in water at station No.4. Figure (3) shows a maximum level of oil in water at station No.10 while figure (5) shows oil discharge. The results showed a dilution process for the oil in water content along the path of Wadi Al Naft course due to the presence of reeds adjacent to the channel. Oil in water concentration ranged between (3-1069) mg/L with a mean value of (193.96) mg/L, which is above the Iraqi Standard Specifications (Abbawi and Hasan, 1990) of (10) mg/L and the EPA Specifications (EPA, 1994) of (15) mg/L.

For the Period April and July

Figure (4) shows the variation of oil at different stations. High levels of oil in water during April and July were at station No.3 with maximum values of

(10,283) mg/L and (32,693) mg/L respectively, while the minimum values during April and July were exhibited at station No.4. The lagoon of the industrial region has a high removal efficiency of 99% for the oily wastewater which discharged from the old processing plant of the North Oil Company. That is the reason for the decreasing of oil level in water at station No.4. The figure shows a different attitude behavior of oil concentration at the natural seepages region (station No.1). This behavior was believed to be due to the injection of excess crude oil in the nearby oil wells, which operated occasionally. The ranges of oil in water were (22-10283) mg/L and (20-32693) mg/L at April and July respectively with mean values of (1518.57) mg/L and (5521.33) mg/L at April and July respectively. These values are above the Iraqi Standard Specifications and the EPA Specifications.

Conclusions

1. The concentrations of oil pollutant in the first tributary of the channel were found to be more affective as compared to the second tributary of the channel.
2. The maximum levels of oil (1069, 10283, and 32693) mg/L for each period were found to be at station No.3, where this station receives oily wastewater from the old processing plant of the NOC.
3. The hydrocarbon entrapment efficiencies of the lagoon of the industrial region and Bajwan trap were found to be (99) %.
4. Oil in water concentration for all data was above the permissible Iraqi by about (44%).

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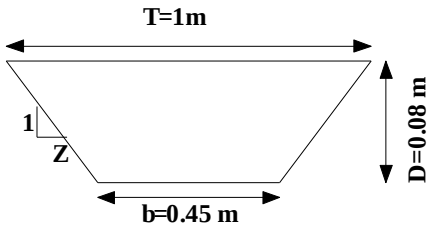
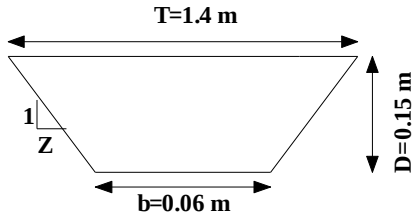
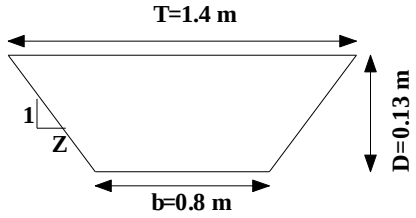
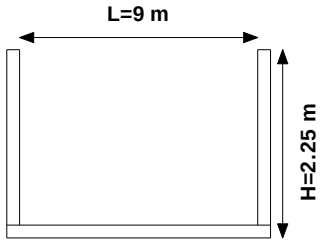
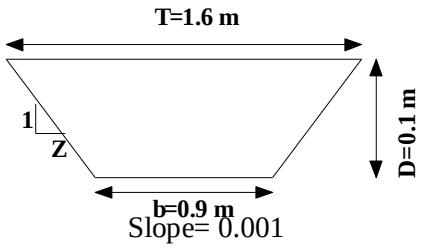
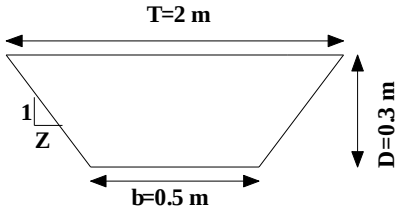
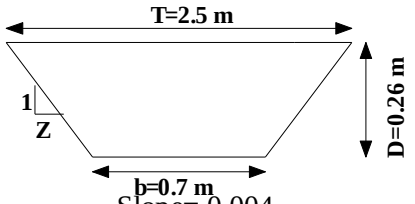
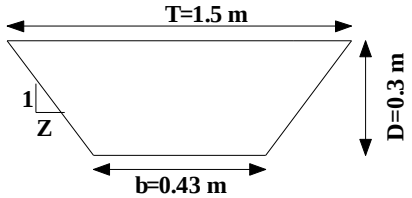
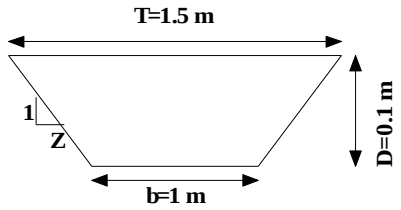
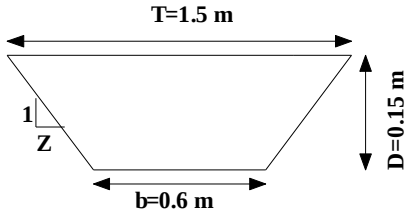
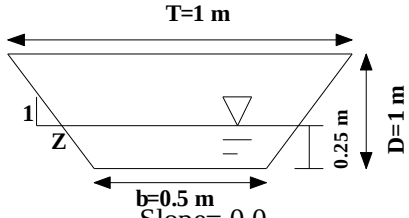
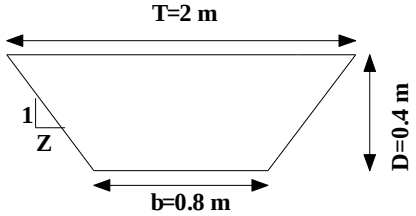
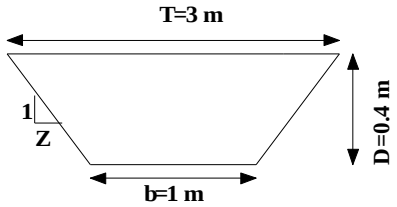
Table (1) Wadi Al Naft Channel Stations and Cross Sections

Station No.	Description	Hydraulic features
1	The source of natural seepages of pollutants within the industrial region at the 1st tributary of the channel	 Slope= 0.016 Area= 0.058 m² Velocity= 0.031 m/s Flow rate= 0.002 m³/s
2	The natural seepages and industrial oily wastewater from the old processing plant within the industrial region at the 1st tributary	 Slope= 0.013 Area= 0.11 m² Velocity= 0.142 m/s Flow rate= 0.017 m³/s
3	The source of industrial oily wastewater from the old processing plant before the lagoon of the industrial region at the 1st tributary	 Slope= 0.009 Area= 0.143 m² Velocity= 0.281 m/s Flow rate= 0.04 m³/s
4	The industrial oily wastewater from the old processing plant after the lagoon of the industrial region at the 1st tributary	 Flow rate= 101.15 m³/s

Station No.	Description	Hydraulic features
5	The meeting point between the natural seepages and the industrial oily wastewater from the old processing plant after the lagoon of the industrial region at the 1st tributary	 Slope= 0.001 Area= 0.125 m² Velocity= 0.425 m/s Flow rate= 0.0531 m³/s
6	The 1st tributary behind the stores department of the north oil company within the industrial region	 Slope= 0.001 Area= 0.375 m² Velocity= 0.34 m/s Flow rate= 0.128 m³/s
7	The 1st tributary behind K1tanks within the industrial region	 Slope= 0.004 Area= 0.42 m² Velocity= 0.71 m/s Flow rate= 0.298 m³/s
8	The 1st tributary of channel near from K1 trap outside the industrial region	 Slope= 0.003 Area= 0.285 m² Velocity= 0.17 m/s Flow rate= 0.0485 m³/s

Station No.	Description	Hydraulic features
9	The 1st tributary at Kisliar village outside the industrial region	 Slope= 0.002 Area= 0.125 m² Velocity= 0.34 m/s Flow rate= 0.0425 m³/s
10	The industrial oily wastewater source of the 2nd tributary from the central workshops of the transports department of the north oil company before Bajwan trap within the industrial region	 Slope= 0.001 Area= 0.158 m² Velocity= 0.17 m/s Flow rate= 0.03 m³/s
11	The industrial oily wastewater source of the 2nd tributary from the oil products store before Bajwan trap within the industrial region	 Slope= 0.0 Area= 0.141 m² Velocity= 0.0283 m/s Flow rate= 0.004 m³/s
12	The industrial oily wastewater after Bajwan trap at the 2nd tributary within the industrial region	 Slope= 0.012 Area= 0.56 m² Velocity= 0.243 m/s Flow rate= 0.136 m³/s

Station No.	Description	Hydraulic features
13	The meeting point of the two tributaries of at Hawija circle outside the industrial region. Also the point of effluent discharge from the new processing plant	 Slope= 0.004 Area= 0.8 m² Velocity= 0.85 m/s Flow rate= 0.68 m³/s

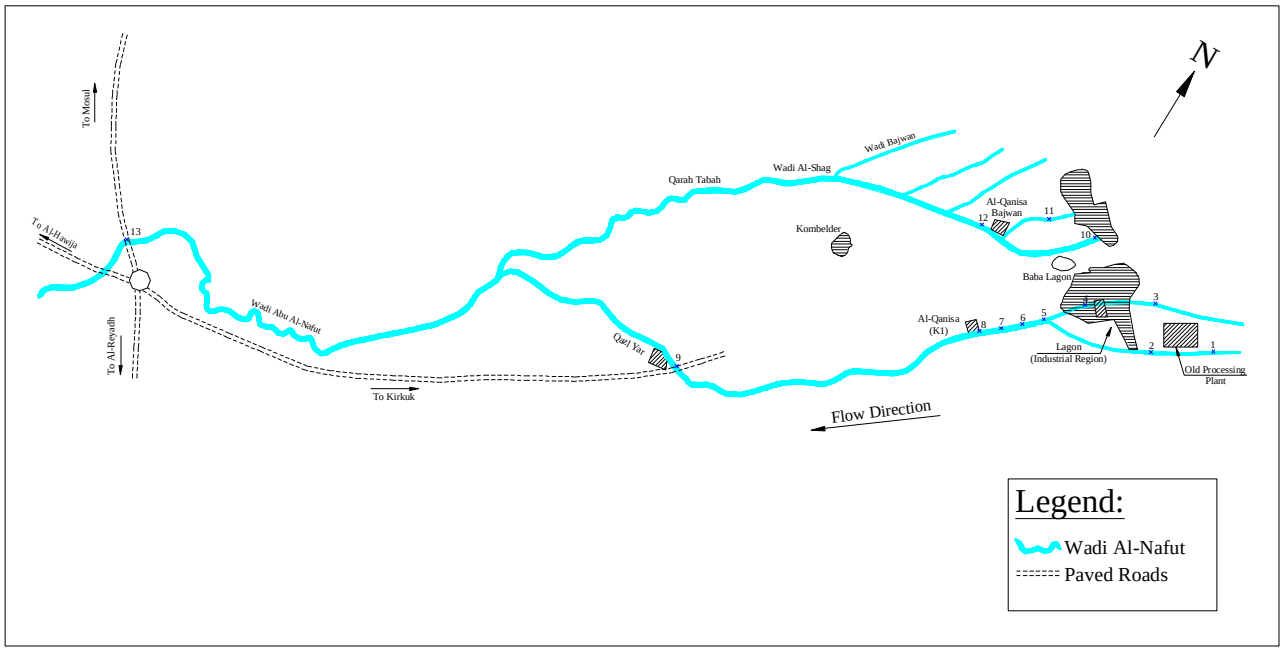


Figure (1) Wadi Al-Naft Map

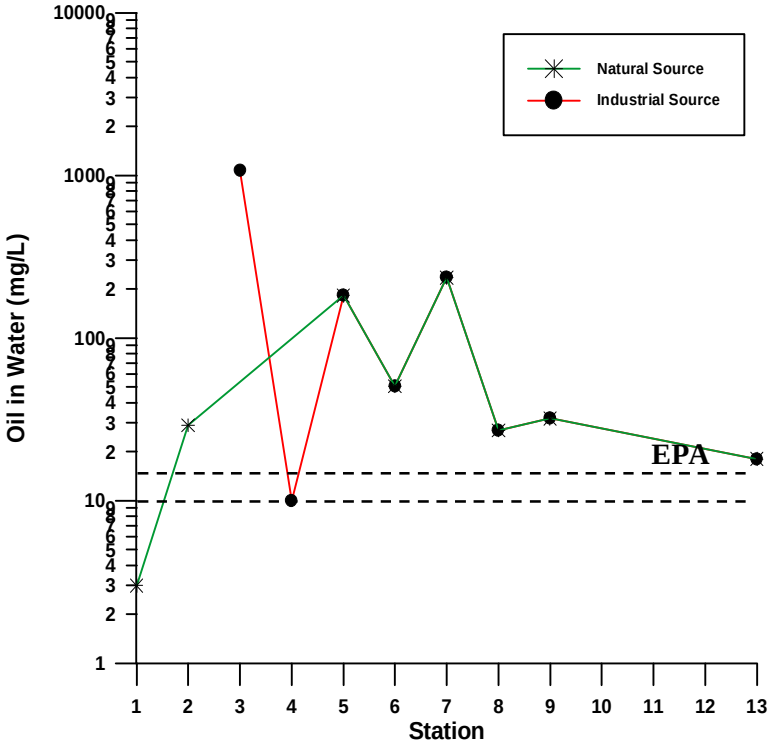


Figure (2) Monthly Average Oil in Water of Oily Wastewater Data , During Jan.-May (1st-tributary)

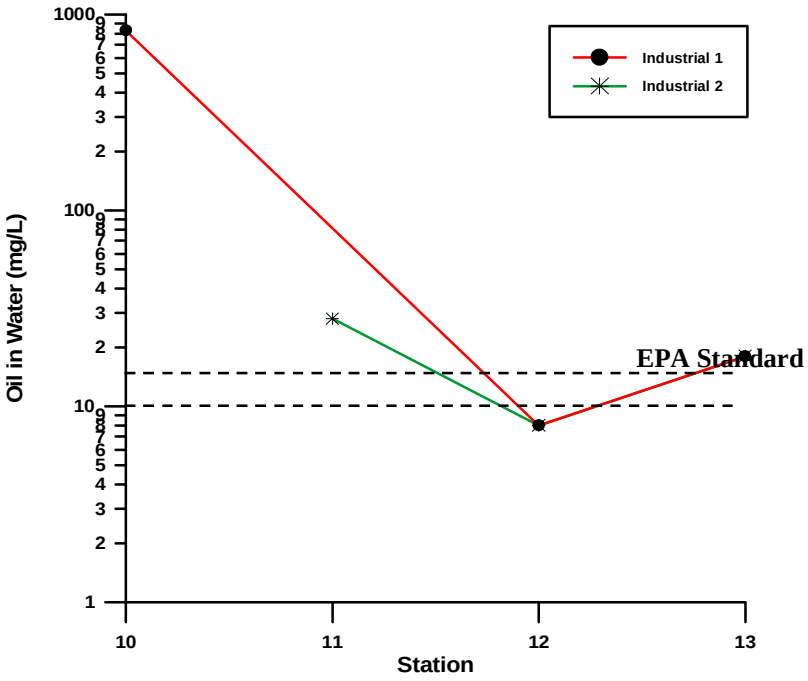


Figure (3) Monthly Average Oil in Water of Oily Wastewater Data During Jan.-May (2nd-Tributary)

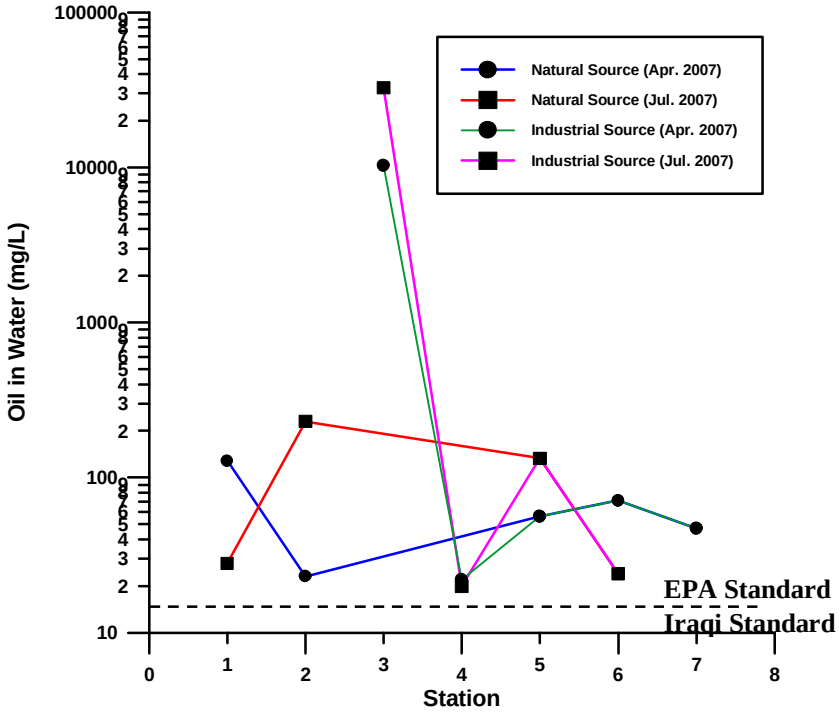


Figure (4) Weekly Average Oil in Water of Oily Wastewater Data During April & July

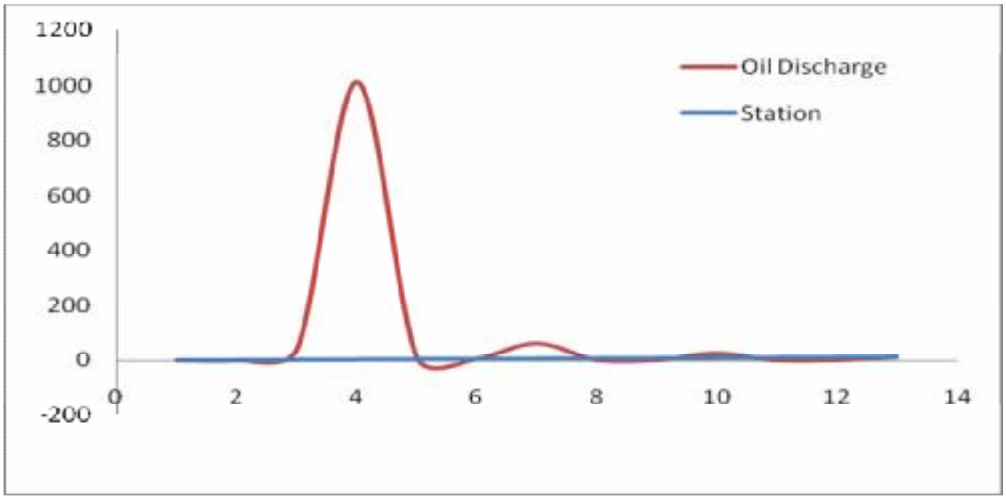


Figure (5) Oil Discharge during Jan.-May