

# AN EXPERIMENTAL ANALYSIS OF TREATMENT OF CRUDE OIL POLLUTED WATER

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**Abstract** - Oil spills in the sea and groundwater are one of the most dreadful hazards to the environment. Leakage from conduit, gusher, underground storage tanks of gas stations, imprudent disposal of petroleum wastes and stranded oil spills are the extensive sources of surface and groundwater contamination. The effects are even more harmful to people if the spill happens from an underground pipeline and contaminates ground water. A leak was observed from one of the pipelines that transport crude oil from Chennai Port to several refineries located in North Chennai. The crude oil in the ground water has to be removed from the water in a way to assure safe usage of groundwater by the residents of North Chennai. The main aspect is to analyze the treatment of crude oil mixed water by freezing method. The treatment of crude oil by fractional distillation methods are difficult and time consuming. By using the difference in density and freezing points of the water and oil, large amounts of oil content can be removed. The main goal of this project is analyze crude oil polluted water and to develop and design a prototype which depicts the procedure to treat crude oil contaminated ground water

**Key Words:** Crude oil, Leakage, Freezing Method, groundwater.

## 1. INTRODUCTION:

Water may be a constant gift of nature that defines peace in life. It remains a veritable endowment of nature necessary forever sustenance of plants and animals. Organic substances from oil spillage and rock oil merchandise disposed into water bodies considerably contaminate and degrade them and will probably elevate the concentration levels of significant metals. Water is continually in grips with the bottom within which it stagnates or circulates, so equilibrium develops between the composition of the soil and that of the water: i.e. water that circulates in a very sandy or granitic substrate is acidic and encompasses a few minerals. Water that circulates in limestone contains bicarbonates alkalinity. The average annual rainfall of the Chennai district is 1200 mm.

Ground water contamination by crude oil and other petroleum-based liquid is a boundless problem. An average of eighty three crude-oil spills occurred per annum throughout 1994-96 in the United States, each spilling an average of about 50,000 barrels of crude oil.

## 1.1 Water Quality:

Water quality is one decisive aspects of an aquatic setting. Water scrutiny consists of an assessment of the condition of water in respect to set goals. For example, water samples with shriveled electrical conduction activity indicate a decent live of purity.

## 1.2 Impact on Aquatic Life:

During spillage, water supply becomes critical. Toxic pollutants in water refer to a whole array of chemical which are leached into groundwater or which are discharged directly into rivers. Contamination of aquatic environment by crude oil and petroleum products constitute an additional source of stress to aquatic organisms and are of importance to wetland environment. Water pollutants can also include excessive amounts of heavy metals, radioactive isotopes, and faecal coli form bacteria, phosphorus, nitrogen, sodium and other useful elements as well as certain pathogenic bacteria and viruses. The water setting experiences several dynamic changes induced by numerous natural events like the spillage of harmful chemicals which will have vital impact on aquatic life.

## 2. CRUDE OIL:

Crude oil, or rock oil in its wild, is that the unprocessed fuel extracted from the bottom. Crude oil is straightforward to handle, transport and store, but it emits high levels of carbon gas into the atmosphere that presents safety hazards. It is an oily, poisonous, flammable, yellow-to-black liquid that generates naturally beneath the earth's surface. When an organism expires and is concealed by silt and sands over long span of time, the pressure and the heat from the surrounding domain turn the organism into oil and gas.

Crude oil, however, remains prominent as a supply of energy, primarily because it is quite easy to extract and transport. It's set nearer to the surface than coal, making it easier and more cost-effective than coal to excerpt. Crude oil may be a present, unrefined petroleum product composed of hydrocarbon deposits and other organic material. Crude Oil are often refined to supply usable merchandise like gasoline, diesel and numerous styles of petrochemicals.

### 2.1 Types of Crude Oil:

- ◆ Light crude oil
- ◆ Heavy crude oil
- ◆ Sweet crude oil
- ◆ Sour crude oil

### 2.2 Crude Oil Constituents:

Crude oil consists of several chemical elements that include carbon, nitrogen, sulphur, hydrogen, and oxygen along with other various metals. The chemical elements in crude oil are listed below:

**Table 1:** Composition of crude oil

Elements	Range(%Composition)
Carbon	83 - 87
Hydrogen	10 - 14
Nitrogen	0.1 - 2
Oxygen	0.1 - 1.5
Sulfur	0.5 - 6

### 2.3 Crude Oil and Health Hazards:

Exposure to crude oil in the atmosphere can be lethal and dicey to the human body. Respiration issues, headaches, nausea, dizziness, and brief confusion are some symptoms of exposure to crude oil. While oil spills also occur in countries that produce and export oil, there is often poor oil spill clean-up equipment maintenance. A person with respiratory illness or any metabolic process issues could expertise aspect effects of fossil oil toxins simply by transient exposure. Long-term effects could embrace metabolic process harm, liver, blood, and kidney damage, along with immune and nervous system damage. Exposure to crude oil can also be the cause of cancer and birth defects. The extent of reaction toward the toxins depends on the conditions of exposure and the other distinctive factors. Children are at a higher prospect of adverse side effects along with pregnant woman and their babies. In order to avoid exposure to these deadly toxins one must be aware of unusual odors, pollution alerts, air pollution, oil-ridden sand, oil-ridden animals, and oil- ridden plants. The people in study area complain that their ground water is fully contaminated and cannot be used for drinking or any other activities. The water sometimes burst into flames when it is ignited.

### 3. FREEZING METHODS:

There are various types of freezer available for freezing and freezer operators are often undecided about which type is best suited to their needs. Three factors may be first considered when choosing a freezer; economic, practical and feasibility. Some of them are:

- ◆ Sharp Freezing
- ◆ Air -Blast Freezing
- ◆ Fluidized - bed Freezing

## 4. MATERIALS AND METHODOLOGY

### 4.1 Study Area:

Four years after an oil pipeline leak contaminated the groundwater in North Chennai around Tondiarpet ,those affected by the contamination are on the brink of despair after repeated appeals to authorities hasn't led to a clean-up. Residents of Tondiarpet is part of RK Nagar, woke to black sludge coming out of their taps. That was oil that had leaked from one of the pipelines that transport crude from Chennai Port to several refineries located in North Chennai.

Several such pipelines cut through populated areas and the leaks, contaminated the groundwater that residents draw up with the help of bore wells and use for drinking, cooking and bathing.



**Fig. 4.1:** Crude oil leak

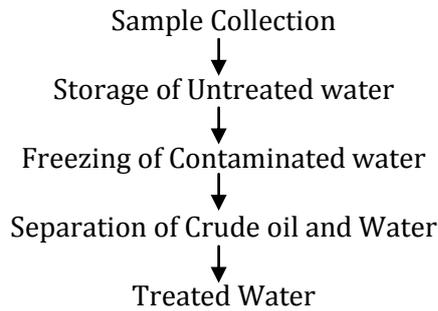
### 4.2 Sample:

Groundwater sample was obtained by the help of motors as the bore well connections were discarded due to pollution. It was collected in pre-sterilized 10 liter container from a housing board in Tondiarpet, North Chennai that has its water source from a borehole within the city.



**Fig. 4.2:** Sample contaminated Groundwater

### 4.3 Methodology:



The sample was stored in a container and then introduced into a freezing unit. This unit uses electrodes to freeze the crude oil polluted water. The crude oil polluted water freezes in a quick time as the freezing point for water is 0° C and the oil remains at the top like oil over a solid layer. The most part of the oil removed easily. Some of the oil was removed by using oil absorbents such as peat. Then this treated water is allowed to undergo removal of dissolved solids and impurities by Reverse osmosis method or any other removal techniques for more purity.

#### 4.3.1 Input Unit

This is the initial unit in which the contaminated groundwater is pumped up and stored in it. This groundwater contains lots of suspended particles such as dirt and waste particles from ground. In order to remove them a Rubber filter material is introduced in between the flow path of input unit and Freezing unit.

#### 4.3.2 Freezing Unit

This is the second unit in which the filtered contaminated groundwater is collected from the input unit through a valve attached to it. In this unit the main Freezing Process takes place. The Freezing process may be of any type as mentioned above. Here we use a normal electrical freezing unit. After freezing the oil will stays in semisolid state above the solid water cube. The oil is easily removed through mechanical ways, then the water cube is allowed to melt in room temperature.

#### 4.3.3 Output Unit

This is the final unit in which the melted water is collected with the help of another valve fixed along the freezing unit. The water may contain some fine particles within it; therefore a cloth material is placed in between the pathway of freezing unit and output unit. After this filtration water is drawn out through the outlet tap fixed at the end of output unit.

### Testing of sample in Freezer:

The difference between before and after freezing method is clearly shown by our mini experimental containers filled with contaminated groundwater sample as shown in the fig.



**BEFORE**



**AFTER**

**Fig. 4.3:** Testing of sample in ordinary Freezer

### 4.4 Filters Used

The filters used were rubber plastics filter and normal cloth filter. The rubber plastic filter is placed in the first slot which is before the freezing unit. This filter takes care of the clogged crude oil or foreign substances. Second filter is a normal cloth filter which filters the finer particles after freezing.



**Fig. 4.4:** Rubber Plastic Filter

**5. RESULTS:**

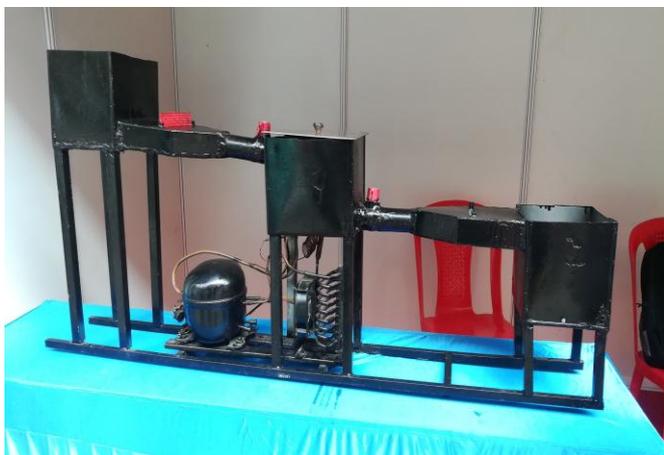
Parameter	Units	Untreated Water	Treated Water
pH @ 25°C	-	6.6	6.6
Chemical Oxygen Demand	mg/l	1238	216
Biological Oxygen Demand	mg/l	310	70
Total Dissolved Solids	mg/l	40468	32642
Total Suspended Solids	mg/l	1900	129

**6. CONCLUSION:**

There are several redress techniques out there to treat the oil-contaminated sites in offshore similarly as onshore; but, the removal potency of those strategies depends on the sort of oil, type of soil, weather, penetration depth, sensitivity of the situation and also the toxicity of the chemicals. When the contaminated water freezes, due to the differences in the densities and different freezing points the oil settles in the top. It resembles oil on a solid material. So, that oil can be removed easily. However, if oil spills or leakages occur, response ought to be taken right away to reduce the potential environmental consequences. The BOD and COD levels showed significant decrease. The suspended solids had a great decrease from 1900 to 129 in 1 liter sample. This method can be built in every resident and ground water can be purified with help of this method. This method can also be used in marine oil spills to a certain extent. If the water is cooled the oil can be easily removed. The percentage of treatment was found to be 90-95%. The treated water has less suspended solids. So that some other simple water treatment process such as reverse osmosis can be utilized for more purity.

**7. REFERENCES:**

- 1) **B. Novales, P. Papineau, A. Sire, M.A.V. Axelos,** Characterization of emulsions and suspensions by video image analysis, *Colloids Surfaces A, Physicochem. Eng. Aspects* 221 (2003) 81-89.
- 2) **G. He, G. Chen,** Separation of water and oil from water-in oil emulsion by freeze/thaw method, *Separation Purif. Technol.* 31 (2003) 83-89.
- 3) **Gray, N.F., (1997).** "Drinking water quality; problems and solutions" John Wiley and Sons
- 4) **I, Singaas, M. Reed, P.S. Daling 2000.** SPE Paper 61117, presented at the *SPE int.conf. On health, safety and the environment in oil and gas exploration and production, Stavanger, (Norway).*
- 5) **Macgill, (2000),** Macgill Environmental Research Laboratory (MERL)-Analysis Manual.
- 6) **Turner, S, (2000),** "Will There Be Enough Water in the Next Century?" *Encarta Yearbook, February 2000.*
- 7) **World Health Organization, (2010),** Guidelines for Drinking Water.
- 8) **Wagstaff, E.C. (1999).** In *Appropriate Technology for Oil Spill Management IUPAC.*
- 9) **Viswanathan, B.(2006).** "Petroleum". Introduction to Energy Sources. Retrieved
- 10) **17 ways to Clean up the Gulf Oil Spill.(n.d.)** Retrieved January 26, 2011, from [CNBC.com](http://CNBC.com)



**Fig. 7** Prototype