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Sweeping of oil from ocean surface using adsorption techniques

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ABSTRACT

In the present scenario, most of our water bodies are polluted due to the leakage of liquid petroleum or hydrocarbon into the marine ecosystem, due to human activity, termed as "oil spill". Oil spills may be due to leakage of crude oil from tankers, spills of refined petroleum and refuse their by-products, heavier fuels which are used by large ships like bunker fuel, or the spill of any oily refuse. An oil spill occurs a fire hazard in short span of time. Spilled oil contaminates water and also causes severe damage to aquatic animals. In addition, oil spills are responsible for air pollution. And nowadays, many industries are facing severe problems to separate the water from oil and also oil from water due to leakage. So, we came up with a product which is cost effective when compared to existing solutions and this can "separate the oil from the water on ocean beds and water from oil in industries using adsorption techniques". Stainless steel mesh coated with microscopic particles like wax that repel oil but not water. Stainless steel mesh with silica nanoparticles that repel water but not oil. Where this product can be controlled using wireless remote control, automation and image processing.

Keywords: *Oil spill, Adsorption techniques, Microscopic and nanoscopic particles, Hazards*

1. INTRODUCTION

The oil spill is a leakage of liquid petroleum in the environment, especially the marine ecosystem due to human activity is a form of pollution. Oil spills create many problems throughout the world. Most of our water bodies are polluted due to the leakage of liquid petroleum or hydrocarbon into the marine ecosystem, due to human activity, termed as "oil spill". The quantity of oil spilled during accidents has ranged from a few hundred tons to several hundred thousand tons. The impact on the ecosystem in an area can be severe. Many plants and animals suffer or are killed within a short time after the spill occurs. [3]Oil spills can have **a** disastrous consequence for society, economically, environmentally and socially. As a result, oil spill accidents have initiated intense media attention and political uproar, bringing many together in a political struggle concerning government response to oil spills and what actions can best prevent them from happening.

2. PROBLEM STATEMENT

2.1 Human impact

An oil spill represents an immediate fire hazard [4]. The Kuwaiti oil fires produced air pollution that caused respiratory distress. The Deepwater Horizon explosion killed eleven oil rig workers. Spilled oil [5] can also contaminate drinking water supplies. Contamination can have an economic impact on tourism and marine resource extraction industries.

2.2 Environmental effects

In general, spilled oil can affect animals and plants in two ways: direct from the oil and from the response or cleanup process. [6][7]There is no clear relationship between the amount of oil in the aquatic environment and the likely impact on biodiversity. A smaller spill at the wrong time/wrong season and in a sensitive environment may prove much more harmful than a larger spill at another time of the year in another or even the same environment. Oil penetrates into the structure of the plumage of birds and the fur of mammals, reducing its insulating ability, and making them more vulnerable to temperature fluctuations and much less buoyant in the water.

2.3 How beaches and wetlands are damaged?

In the blog by Erika Kubowitsch [8] has written that World's water and food chain are being poisoned by this entire oil spill. The more the damage to the environment, the more natural calamities will occur. The oil which sticks to the rocks can be easily seen and removed, but it is difficult to remove the oil entirely from the wetland or marshland once it sinks into the land.

Fig. 1: Dead creatures due to the oil spill

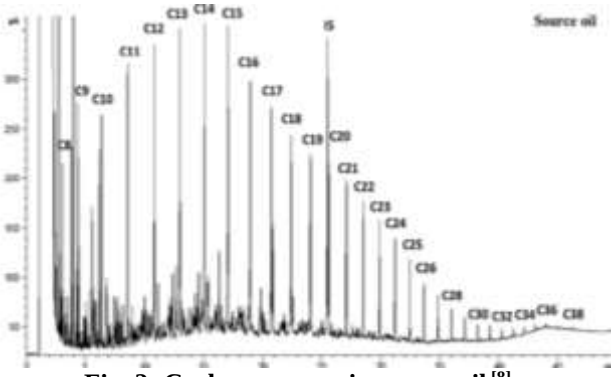

Fig. 2: Carbon content in source oil [8]

Yuling Han et al[9] has observed that long carbon chains in the spill sample decomposed into smaller carbon chains (after a few days from the day of the spill) which increases the reactivity of oil leads to a greater environmental issue.

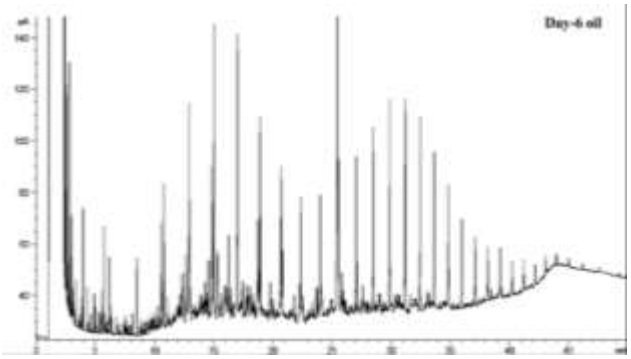

Fig. 3: Decomposition of longer carbon chains into smaller chains after 6 days of oil spill sample. [8]

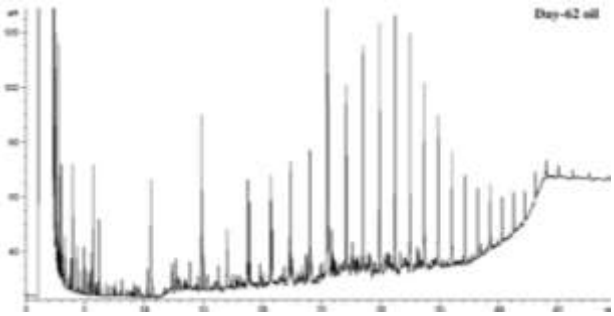

Fig. 4: Heavy decomposition of carbon chains after 62 days of oil spill sample. [8]

3. EXISTING SOLUTIONS

3.1 Burning In-situ

[10]It means burning of oil on the site where the spillage has occurred. The burning has to be done quite promptly before the oil spill can spread to a larger area. But the most important disadvantage of such an on-site burning is that the exhaust that is released contains toxic particles that can cause damage to the oceanic air in addition to the marine life-forms.

3.2 Using hot water and huge force

In this method, a huge force of hot water is used to push the oil split back into the water [11]. Then with the help of skimming tools and equipment, the oil spill cleanup operation takes place.

3.3 Using manual labor

[12]People in the coastal areas and beaches can help to accelerate the oil spill cleanup operation. By using simple tools like spades and shovels, removing and isolating the area affected by oil spillage is possible.

3.4 Using buoys

Davide Moroni et.al[13], have presented a novel system for cleaning up of all the hydrocarbon spills present in the surface of the water using sensorized buoy for oil spill early detection and pollutant detection by E-Nose.

4. SOURCES AND RATE OF OCCURRENCE

Oil tankers are just one of the many sources of oil spills. According to the United States Coast Guard, 35.7% of the volume of oil spilled in the United States from 1991 to 2004 came from tank vessels (ships/barges), 27.6% from facilities and other non-vessels, 19.9% from non-tank vessels, and 9.3% from pipelines; 7.4% from mystery spills. On the other hand, only 5% of the actual spills came from oil tankers, while 51.8% came from other kinds of vessels [14]. The International Tanker Owners Pollution Federation has tracked 9,351 accidental spills that have occurred since 1974. According to this study, most spills result from routine operations such as loading cargo, discharging cargo, and taking on fuel oil. 91% of the operational oil spills are small, resulting in less than 7 metric tons per spill. On the other hand, spills resulting from accidents like collisions, groundings, hull failures, and explosions are much larger, with 84% of these involving losses of over 700 metric tons.

5. CLEANUPAND RECOVERY

Cleanup and recovery from an oil spill is difficult and depends upon many factors, including the type of oil spilled, the temperature of the water (affecting evaporation and biodegradation), and the types of shorelines and beaches involved. [15]

5.1 Methods for cleaning up include

5.1.1 Biodegradation: Use of microorganisms or biological agents to break down or remove oil; such as the bacteria.

5.1.2 Controlled burning: Controlled burning can effectively reduce the amount of oil in water if done properly. But it can only be done in low wind and can cause air pollution.

5.1.3 Dredging: for oils dispersed with detergents and other oils denser than water.

5.1.4 Skimming: Requires calm waters at all times during the process.

5.1.5 Solidifying: Solidifiers are composed of tiny, floating, dry ice pellets, and hydrophobic polymers that both adsorb and absorb.

They clean up oil spills by changing the physical state of spilled oil from liquid to a solid, semi-solid or a rubber-like material that floats on water. Solidifiers are insoluble in water, therefore the removal of the solidified oil is easy and the oil will not leach out.

6. PROPOSED SOLUTION & DISCUSSION

We came up with a product which will separate the oil present in water and store it in a container. As hydrophobic material has the capability of attracting oil particles are used for oil removal from water, the management of oil spills and chemical separation processes to remove nonpolar substances from polar compounds.

This product contains a series of wheels over an axial rod which will be coated with a hydrophobic material and these wheels are clamped with clamps, followed by an oil-collecting pipe, such that the oil absorbed on wheels is collected and allowed to pass through the pipe and finally stored the

container. This is the technique used to separate the oil from water. And this product we can use in the oil industries too, to separate the water from oil in which when the same wheels are coated with the hydrophilic material. We can use some sensors like CSIM11-L Ph Probe and find out the ph-value and conductivity of water.

6.1 Advantages

1. This is the cheapest process compared to all the existing solutions.
2. It will save water from being contaminated.
3. Easily portable.
4. Less weight and compact shape.
5. It can save marine life.
6. Reduces manpower.
7. Can use as a buoy in a marine system.

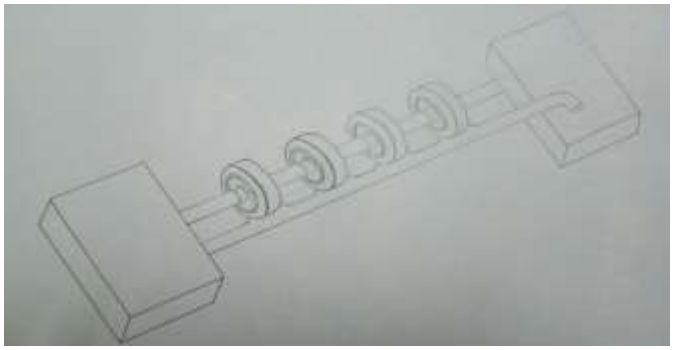

Fig. 5: Diagrammatic representation of oil sweeper

7. CONCLUSION

Hereby we conclude that with the help of this setup we can easily separate the oil layer on the water surface in oceans and seas. Also, we can separate the water present in oil in oil industries. The same setup can be used as Buoys. And also we can use this as a coastal guard in the oceans. By this, we can calculate the cosmic waves as well as ph and conductivity of water in different zones. By the help of this setup using image processing, we can know what is happening in the oceans and seas. By this, we can give signals and indicate directions to the ships present in the oceans.

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