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Mycoremediation of Oil Spill Using Human Hair as a Sorbent Material

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ABSTRACT: Numerous methods exist for cleaning up oil spills along with their after effect as well as large financial burden. Oil exploration has large economic benefits; however these benefits are associated with environmental issues arising from oil spills. Hence, the shift to methods that are environmentally friendly and cost effective is important. This paper investigates the analysis of adsorption capacity of human hair. Hence, human hair can be altered into boom to clean up oil spills. After the adsorption of oil on hair booms, these booms can be utilized in cultivating the mushrooms as mushrooms require oil for their growth. Hence the adsorbed oil can be restored by cultivating mushroom.

KEYWORDS : Oil spills, hair booms, recuperation, mycoremediation, mushroom cultivation

I. INTRODUCTION

The world is now more and more dependent on oil based products, derived from petroleum. These oil based products are used to fuel automobiles, heat homes, produce energy, and are used for machinery in various industries. The products that come from petroleum are gasoline, diesel, motor oil, kerosene, jet oil, heating oil, asphalt, and plastics. Oil is first stored and transported in large volumes via tankers because populous countries use large quantities of oils, and it is more cost effective to transport oil this way. However, while in storage or in transport, oils may get spilled onto land or into waterways. Oil spills are caused due to various reasons: tanker accidents, offshore platforms, drilling rigs, fuel leaks from large ships, which release crude oil or refined petroleum products or waste oil into the ocean^[2]. Potential oil spill volumes have been categorized by the National Oil Spill Contingency Plan, where they are broken down into three categories: a Minor Spill which is a discharge of oil less than 10,000 gallons, a Moderate Spill which is a discharge of oil of 10,000 to 100,000 gallons, and a Major Spill defined by a discharge of oil of more than 100,000 gallons. Oil spill is

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the contamination of the environment, due to the supply of liquid petroleum hydrocarbon. Oil spills have been a major complication from so many years. They pose a threat to the environment, causing harmful irreversible changes, physically, chemically and biologically^[2].

II. EFFECTS OF OIL SPILLS

Effects on Animal Life: Oil spill affects the living beings in the sea (birds, fishes, mammals) and exposes them to risks. Because of its floating nature, oil does not allow the sunlight and the oxygen to enter into the ocean, as it is important for the fishes and sea turtles to survive. Oil coats the fur of sea otters and seals and other mammals, which reduces their insulating effect and leads to fluctuations in body temperature, leading to hypothermia^[2].

Effects on Local Businesses: Due to oil spills fishing, tourism, sailing processes are affected and fishermen undergo immense losses as the fishes die due to oil spill. Boats and machines used for fishing and navigation are affected due to oil slicks present on the top of the water surface^[2].

Effects on Human Health: Inhalation of oil vapour, touching oil slicks, and consuming oil contaminated seafood is injurious to health of human beings. Exposure to heavy oils sometimes cause neurological, acute toxic effects and also problems in respiratory systems. People in the locality, near an oil spill zone, may suffer nausea, throat infection, eye irritation along with migraines and headaches. Oil spills contain harmful elements that are carcinogenic to human beings, causing cancer^[2].

Dissolution of soluble oil compounds: Although oil stays on the surface of the water, but some of the oil compounds may dissolve in the water which leads to change in pH and other salts composition. Because of the property of immiscibility, oil slicks are formed whenever oil spillage takes place on the water. Fishes surviving in the area will ingest the oil that has been spilled. Further these fishes may be fed by larger fishes, or other sea animals and they may be harmed too^[2].

III. NEED TO PREVENT

These oily wastes are one of the significant pollutants of the aquatic environment. Separation of oil from water is necessary due to following reason: Oil slick on surface of water prevents oxygen transfer from atmosphere to water and lead to over low dissolved oxygen level due to microbial & oxidative attack on the hydrocarbon molecules. It is necessary to remove oil because it can hinder the process. Oil in boiler feed causes foaming & so treatment is necessary; oil & waxes solidify at low temperature that cause clogging in pipes & sewer line; oil slick is reason for the death of birds; the oil penetrates in their feathers there by affecting their insulation & buoyancy; birds become colder & more vulnerable to diseases & experience difficulty in floating & flying.^[6]

Consumption of oil contaminated water will result in health hazards such as eye irritation, increased blood pressure, headache, loss of appetite, poor coordination, difficulty in concentrating, kidney damage, human cancer and decrease in the ability of blood clotting.

Oil layer in wastewater reduces the efficiency of wastewater plant and sometimes inhibits the overall process of the plant by reducing the oxygen dissolving which is very essential to aerobic bacteria.

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The oily water badly affects to the wildlife and marine life and because of that it unbalances ecosystem process. As example, oil can affect respiration of fish by adhering oil on the gills and oil destroys the algae and planting.

The penetrated oil from water to earth may initiate long term problems by making a barren ground. Oily water surface affects to aesthetic appearance of the environment.

IV. METHODS OF OIL SPILL CLEAN UP

Any damage caused needs a remedy, and oil spill clean-up is an important issue. Oil spills are very difficult to remove. It may take months and even years to treat an oil spill. New methods, equipments are innovated to aid in oil spill clean-up, leading to better results. Since protecting and saving the environment is our responsibility, this approached target is an effective and economical oil spill recovery. We intend to formulate new, simple ways to remove oil spills from oceans, leading to positive results^[2]. Spill containment technology methods which are used currently to clean up oil in coastal environments are: the use of booms, hard booms, sorbent booms, fire booms, skimmers, vacuum trucks, in situ burning, dispersants, and chemical cleaners. The different methodologies used for the purpose of cleaning up oil spills are:

Using sorbents: Sorbents are the materials that are placed on the surface of the water, where the oil is floating. These sorbents draw and absorb the oil from the surface of the water which leads to an oil spill cleanup. Even though this method of cleaning is a conventional technique, still many new sorbents can be discovered which absorb or adsorb the oil without leaving any traces in the water^[2].

On site burning: This is the process of burning up of the spillage on site, before its spreading, in order to remove or reduce the amount of oil slick on the water. But the drawback of such an on-site burning is that, the exhaust gas that is released, contains toxic particles which can lead to severe levels of contamination in the air. In addition, the marine life also gets affected^[2].

Using chemical dispensers: The dispersion of oil spillage, into smaller droplets, is carried out using fertilizers called as dispensers. It is the highly recommended oil spill cleanup methods. The fertilizers help to increase the growth of micro-organisms, which help to diffuse the components of the oil, spilt in the water. In simple words, dispensers are the catalysts, to speed up the reaction of degradation of the oil, by increasing the growth of micro-organisms^[2].

Bioremediation: Bioremediation is the use of fungi, bacteria or other microorganisms to eat up oil spill. These microorganisms break down oil into more simpler matter, thereby allowing biodegradation to take place. This method is less harmful to the environment, as it involves only biologically active material^[2].

Skimming: Skimming is the removal of the oil spillage, with the help of tools and equipments, from the surface of the water. Only lighter oils can be separated and removed from the water in this method of cleaning of up oil spills because, the density of spilled oil should be comparatively lower than the density of water. Only then, it will be easy to separate oil from water, using skimmers^[2].

Cleaning manually: People in the coastal areas, beach workers and public volunteers can help to hasten the oil spill cleanup operation. By using simple tools like spades, buckets and shovels, removing oil spillage can be done. This method is suitable only for minor oil spills. For the accidents which take place away from shore side, high and ultra high

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pressure pumps are used to remove the oil slicks. From this mixture of oil and water, oil can be separated easily using units like gravity oil separators or API separators^[2].

Natural decomposition: This is nothing but the process of allowing the spilled oil to decompose on its own, by the help of sun, oxygen and wind, naturally and the particles of the oil evaporate and disappear. This is the slowest method to clean up the oil spills. Since, it affects both the environment and marine ecosystem, this method is generally not advisable to perform^[2].

Using oil booms: Oil booming is a very common method of controlling the spread of oil spills. There are various kinds of oil booms that are designed for various needs, in different locations where the oil spill might occur, thus leading to a quite thorough oil spill cleanup. Simply, boom is floating barrier used temporarily, to contain an oil spill, preventing the oil from getting dispersed^[2].

Using hair booms: Hair booms are nothing but barriers to the movement of oil, preventing the oil from spreading, which otherwise has a higher chance of polluting the shoreline. They make clean-up process easier. Booms float on water, trapping oil into thicker layers. Compared to existing methods, the oil recovery process is low cost, effective, and used friendly. It uses waste products as compared to new ones and is able to recover a significant amount of spilled oil for reuse^[6].

V. EXPERIMENT WORK

The experimental work includes various steps:

- Step 1: Collection of waste hairs from various salons and barber shops, which they simply dump it into waste.
- Step2: After collection of hair, washing of hair was done. It was done in two phases, first the bigger dirt particles present in it was cleaned and then second phase included cleaning hair with mild shampoo so that no other impurities stays in it.
- Step 3: The hairs were kept to dry under sunlight to kill any kind of germs or pathogens present in it.
- Step 4: the dried hairs were collected and packed into bundles of booms, providing area for the adsorption of oil from the oil spill.
- Step 5: Synthetic spillage was done to test the effectiveness of the hair booms to adsorb. The synthetic spill was of 250 ml of motor oil into 2.5 liter of water. This was done both in used oil and unused oil.
- Step 6: After the synthetic oil spillage was done, the booms that were made to adsorb the oil in the plastic trough which ought to represent the mini ocean. After an hour, hair booms were rolled in spilled area, as hair has attraction towards oil rather than water, oil get adsorbs on hair booms.
- Step 7: After synthetic oil spill removal, mushroom cultivation is done. For that, mushroom seeds, straws, hair booms containing oil, plastic bag, etc are collected.
- Step 8: A plastic bag is taken and then a layer of straws is kept and above the layer of straws, booms containing hair is kept. On the booms, mushroom seeds are spread and the mouth of the bag is closed using a thread.
- Step 9: Holes are made in plastic bag and regular spraying of water is done to cultivate mushroom. Also, the temperature is maintained below 23° C for the proper growth of mushrooms.

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DETERMINATION OF OIL & GREASE:

Three methods by which oil and grease are estimated are (i) the partition-gravimetric method (ii) partition infrared method, and (iii) the solvent extraction method. Though method (i) does not provide needed precision, it is widely used for routine analysis of samples with high oil and grease contents because of its simplicity and no need of special instrumentation. In method (ii) adequate instrumentation allows for the measurements of as little as 0.2 mg oil and grease. Method (iii) is identical to gravimetric method but it is designed for the samples that might contain volatile hydrocarbons that otherwise would be lost in the solvent removal operation of gravimetric method.

In the Partition-Gravimetric method, dissolved or emulsified oil and grease is extracted from water by intimate contact with petroleum ether (40/60) or hexane.

Apparatus:

1. Beaker
2. Separating funnel
3. Distilling flask
4. Desiccators

Procedure:

1. Collect about 1 litre of sample and mark sample level in bottle for latter determination of sample volume. Acidity to pH 2 or lower; generally, 5 ml HCl is sufficient. Transfer to a separating funnel.
2. Preferably shake vigorously for 2 minute. However, if it is suspected for stable emulsion shakes gently 5 to 10 minute.
3. Let layer separate out, drain solvent layer through a funnel containing solvent– moistened filter paper into a clean, evacuated distilling flask. If a clear solvent layer cannot be obtained, add 1g Na₂SO₄, if necessary.
4. Extract twice more with 30 ml solvent each time but first rinse sample container with solvent. Combine extracts in evacuated distilling flask and mash filter paper with an additional 10 ml to 20 ml solvent.
5. Distill solvent from distilling flask in a water bath at 70°C. Place flask on water bath at 70°C for 15 minute and draw air through it with an applied vacuum for final 1 minute after the solvent has evaporated. If the residue contains visible water, add 2 ml acetone evaporates on a water bath and repeat the addition and evaporation until all visible water has been removed. Cool in a desiccators for 30 minute and weigh it.

Calculation:

The amount of oil and grease in the sample can be calculated as,

Oil and Grease (mg/L) = (A - B) 1000/volume of the sample

where,

A = mass of evacuated flask and residue (g)

B = mass of evacuated flask (g)

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VI. RESULTS

SR NO.	SAMPLE	INITIAL OIL & GREASE (mg/L)	OIL & GREASE REMOVED(mg/L)	% REMOVAL
01	Raw water + used motor oil	250	247.5	99
02	Raw water + unused motor oil	250	248	99.2
03	Raw water + used vegetable oil	250	247.5	99
04	Raw water + unused vegetable oil	250	247	98.8
05	Wastewater + used motor oil	250	246	98
06	Wastewater + unused motor oil	250	246.5	98.6
07	Wastewater + used vegetable oil	250	246.5	98.6
08	Wastewater + unused vegetable oil	250	247.5	99

VII. CONCLUSION

The uniqueness of this project is of focusing on the oil pollution subject, with a bio-friendly approach. The material for absorption of spilled oil is human hair, which degrades biologically, and thus the collected oil along with the hairs are used in mushroom cultivation. The question arises here why growing of mushroom? Since the oiled hairs cannot be thrown away like that instead it could be bioremediate, using the concept of mycoremediation. The mushroom breaks down the heavy hydrocarbons present in the crude oil/petroleum and using its carbohydrates and uses it for its food purpose. Mushrooms grown here are non-toxic and edible which is a plus point. What comes from nature shall return to it, in order to maintain the balance. The problem of oil pollution can be solved very effectively, economically and ecologically.

REFERENCES

- [1] Abdul Aziz Al-Majed, Abdulrauf Rasheed Adebayo, M. Enamul Hossain, "A sustainable approach to controlling oil spills", Journal of Environmental Management 113, 213-227, 2012.
- [2] Augustine Osamor Ifelebuegu and Zenebu Momoh, "An Evaluation of the Adsorptive Properties of Coconut Husk for Oil Spill Cleanup", Proc. of the Intl. Conf. on Advances in Applied science and Environmental Technology - ASET 2015.
- [3] A S Jadhav, M Y Naniwadekar, N H Shinde, S V Anekar, "STUDY OF ADSORPTION OF OIL FROM OILY WATER USING HUMAN HAIR", International Journal of Advanced Engineering Technology.
- [4] Balaji.N.S, Antonette Varshini.K, Monica.M, "Experimental Study On Oil Spill Recovery", International Journal of Innovative Research in Science, Engineering and Technology.
- [5] Carolyn Federici, Jonathon Mintz, "Oil Properties and Their Impact on Spill Response Options", CNA Analysis and Solutions
- [6] Heather R. Luckarift, Susan R. Sizemore, and Karen E. Farrington, Preston A. Fulmer and Justin C. Biffinger, Lloyd J. Nadeau and Glenn R. Johnson, "Biodegradation of Medium Chain Hydrocarbons by Acinetobacter venetianus 2AW Immobilized to Hair-Based Adsorbent Mats", Wiley Online Library.
- [7] Henry R. Walther III, "Clean Up Techniques Used for Coastal Oil Spills: An Analysis of Spills Occurring in Santa Barbara, California, Prince William Sound, Alaska, the Sea Of Japan, and the Gulf Coast", University of San Francisco.
- [8] Jamal A. Sweileh, "Sorption of trace metals on human hair and application for cadmium and lead pre-concentration with flame atomic absorption determination", Anal Bioanal Chem, 450-455, 2003.
- [9] Thomas James Azwell, "Oil Spill Remediation and Restoration: The Fate and Consequences of Oil in the Environment".
- [10] Peter Rowland Ukotije-Ikwut, Akpevwe Kelvin Idogun, Christopher Tubuyai Iriakuma, Abiye Aseminaso and Tamunotonjo Obomanu, "A Novel Method for Adsorption using Human Hair as a Natural Oil Spill Sorbent", International Journal of Scientific & Engineering Research, August-2016.
- [11] Shweta Kulshreshtha, Nupur Mathur and Pradeep Bhatnagar, "Mushroom as a product and their role in mycoremediation", AMB Express 2014, 4:29.
- [12] http://www.sololiya.fr/tout_sur_l_eau/planet_eau/blabla/freshwater/1_overview_of_freshwater_importance