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Impact of ship wrecks on sea and its mitigation measures

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Abstract : Due to ship wrecks there is a danger of release of crude oil into sea water. Oil spills can seriously affect the marine environment both as a result of physical smothering and toxic effects. The severity of impact typically depends on the quantity and types of oil spills, the ambient conditions and the sensitivity of the affected organisms and their habitats to the oil .Some of which leads to its removal from sea surface whilst others cause it to persist. Although spilled oil is eventually assimilated by the marine environment, the time involved depends upon factors such as amount of oil spilled , its initial physical and chemical characteristics, the prevailing climatic and sea conditions and whether the oil remains at sea or its washed ashore. Some surfactants such as poly propanal.Norsorex and synthetic polypropylene are used as de-emulsifiers for destabilization of emulsions of crude petroleum. Ours is a study of effect of oil spill and its remedial measures. The effect of chemical agents on crude oil and how it is reduced is been studied.
Keywords : Crude oil, habitat, spills, de-emusifiers, destabilization.

Introduction

Crude oil exploration and production is a major aspect of the global economy because of the enormous revenues generated from its activities. Nonetheless, despite the many benefits emanating from the industry, the negative impacts that the exploration and production process can exert on the environment remains a major concern for the industry. Oil spill is one of the known sources of direct and indirect marine pollution. Although oil spills account for about 5 to 12 percent of oil contaminations, the high oil concentration deposited could cause great damage to affected areas. Oil spills can occur as a result of explosions, during transfer, accidents due to a collision, or leakages from pipelines or vessels.

Oil spill recovery after a spill is usually challenging, costly and often a difficult task. Various methods are applied in the clean up process including chemical, physical and biological methods. Use of sorbents is one of the physical methods and has been applied in the industry for several years. Commercial sorbents are extensively used in oil spill clean- up. The most commonly applied are synthetic sorbents like polystyrene, polypropylene, and polyester foams. They have high hydrophobic and oleophilic properties and can sorb up to 70 times their weight in oil. They can also be used several times after recovery in some instances .

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Properties of oil

Crude oils of different origin vary widely in their physical and chemical properties, whereas many refined products tend to have well-defined properties irrespective of the crude oil from which they are derived. *Distillation characteristics* of an oil describe its volatility. As the temperature of an oil is raised, different components reach their boiling point one after another and evaporate, i.e. are distilled. The distillation characteristics are expressed as the proportions of the parent oil which distil within given temperature ranges. *Viscosity* of an oil is its resistance to flow. High viscosity oils do not flow as easily as those with lower viscosity. All oils become more viscous (i.e. flow less readily) as their temperature falls.

Spreading

- As soon as oil is spilled, it starts to spread over the sea surface, the speed at which this takes place depends to a great extent on the viscosity of the oil and the volume spilled.
- Low viscosity oils spread more quickly than those with a high viscosity. Liquid oils initially spread as a coherent slick but quickly begin to break up.
- Solid or highly viscous oils fragment rather than spreading to thin layers.
- The rate at which oil spreads or fragments is also affected by tidal streams and currents - the stronger the combined forces, the faster the process.
- It should also be appreciated that, except in the case of small spills of low viscosity oils, spreading is not uniform and large variations of oil thickness from less than micrometer to several millimeters can occur .

Evaporation

- The more volatile components of an oil will evaporate to the atmosphere. The rate of evaporation will depend on ambient temperatures and wind speed.
- In general, those oil components with a boiling point below 200°C will evaporate within a period of 24 hours in temperate conditions. The greater the proportion of components with low boiling points, the greater the degree of evaporation.
- The initial spreading rate of the oil affects evaporation since the larger the surface area, the faster light components will evaporate.
- Rough seas, high wind speeds and warm temperature will also increase the rate of evaporation.
- Any residue of oil remaining after evaporation will have an increased density and viscosity, which affects subsequent weathering processes and the effectiveness of clean-up techniques.

Dispersion

- Waves and turbulence at the sea surface can cause all or part of a slick to break up into droplets of varying sizes which become mixed into the upper layers of the water column.
- Droplets which are small enough are kept in suspension by the turbulent motion of the sea, which mixes the oil into ever greater volumes of sea water thereby reducing its concentration.
- The increased surface area presented by dispersed oil can promote processes such as biodegradation, dissolution and sedimentation.
- The rate of dispersion is largely dependent upon the nature of the oil and the sea state, proceeding most rapidly with low viscosity oils in the presence of breaking waves.

Emulsification

- In moderate to rough seas, most oils will take up water droplets and form water-in-oil emulsions under the turbulent action of waves on the sea surface.
- Very viscous oils tend to take up water more slowly than more liquid oils. As the amount of water absorbed increases, thedensity of the emulsion approaches that of sea water.
- Stable emulsions may contain as much as 70% - 80% water and are often semi-solid and have a strong red/brown, orange or yellow colour.
- They are highly persistent and may remain emulsified indefinitely. Less stable emulsions may separate out into oil and water if heated by sunlight under calm conditionsor when stranded on shorelinesseabed.

- When oil droplets in the water column adhere to very fine sediment particles or particles of organic matter they can form flocculates, which may be widely dispersed by currents or turbulence.
- This process, sometimes referred to as clay-oil flocculation, can result over a period of time in the removal of oil from beaches.

Biodegradation

- Sea water contains a range of marine micro-organisms capable of metabolizing oil compounds. They include bacteria, moulds, yeasts, fungi, unicellular algae and protozoa which can utilize oil as a source of carbon and energy.
- Each type of microorganism involved in the process tends to degrade a specific group of hydrocarbons and thus a wide range of microorganisms, acting together or in succession, are needed for degradation to occur.
- As degradation proceeds, a complex community of micro-organisms develops.
- Because the micro-organisms live in the water, from which they obtain oxygen and essential nutrients, biodegradation can only take place at an oil/water interface.

Viscosity of an oil is its resistance to flow. High viscosity oils do not flow as easily as those with lower viscosity. All oilsbecome more viscous (i.e. flow less readily) as their temperature falls, some more than others depending on their composition. Since sea temperatures are often lower than cargo or bunker temperatures on board a vessel, viscosity-dependent clean-up operations such as skimming and pumping generally become more difficult as the spilled oil cools. In this paper, units of kinematic viscosity, expressed as centistokes (cSt) areused.

Pour point is the temperature below which an oil will not flow. The pour point is a function of the wax and asphaltene content of the oil. As an oil cools, it will reach a temperature, the so- called 'cloud point', at which the wax components begin to form crystalline structures. This increasingly hinders flow of the oil until it eventually changes from liquid to semi-solid at the pour point. An example of this behaviour. For this oil, as it cools from a typical cargo temperature of >30°C, its viscosity rises slowly, but below 20°C it begins to thicken exponentially until at around 12°C the viscosity has increased so much that it will no longer flow. For the other two oils shown, the pour points and cloud points are below 0°C

Combined Processes

All come into play as soon as oil is spilled, although theirrelative importance varies with Spreading, evaporation, dispersion, emulsification and dissolution are most important during the early stages of a spill whilst oxidation, sedimentation and biodegradation are longer term processes which determine the ultimate fate of oil. An understanding of the way in which weathering processes interact is important when attempting to forecast the changing characteristics of an oil during the lifetime of a slick at sea. It should be appreciated that the movement of an oil slick on the sea surface is due to winds and surface currents, and may be influenced by the combined weathering processes. The actual mechanisms governing spill movement are complex, but experience shows that oil drift can be predicted from a simple vector calculation of wind and surface current direction, based on about 3% of the wind speed and 100% of the current velocity. Reliable prediction of slick movement is clearly dependent upon the availability of good wind and current data. Accurate current data are sometimes difficult to obtain. For some areas it is presented on charts or tidal stream atlases but often only general information is available. In shallow waters near the coast or among islands, currents may be complex and are often poorly understood, rendering accurate prediction of slick movement particularly difficult.

Materials and Methods

Materials required are glass trough, chemicals like Norsorex, Poly propanol, synthetic polypropylene. Chicken feathers, cattle and Human hair .

Methods: By taking sample from sea water mixed with crude oil and adding the above materials the results were analysed.

Result and Discussion

1). Norsorex : Properties :

- **Flammability> 174˚ F.**

• General dust limit (DE-TRGS 900): 3 mg/m^3 (respirable dust fraction),10 mg/m^3 (inhalable dust fraction), short- term exposure value (TRGS 900,2.3) – excess factor.

• Maximum storage temperature : 45˚C / 113˚F

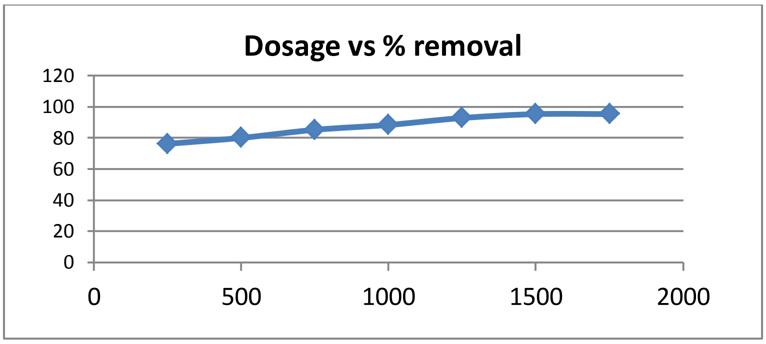
• Minimum storage temperature : -5˚C / 23˚F

• Optimum storage temperature : -5˚ to 30˚C / 23˚F to 86˚F

•The material changes from white to yellow and the absorption behavior decrease.

•To the sample taken from sea water norsorex was added in the following quantities as shown in the table below and % removal was calculated .

Sea water + crude oil sample (ml)	Dosage of Norsorex (ml)	% Removal
5000	250	76.19
5000	500	80
5000	750	85.21
5000	1000	88.33
5000	1250	92.8



2).Chicken feathers :Properties

•Although the chicken feathers barbs are coarser than wool, the strength, elongation and modulus of the barbs indicates that the fibers have tensile properties similar to that of

• However, the unique structure of chicken barbs and their low density makes them preferable for many applications.

• To the sample taken from sea water on addition of chicken feathers it was observed that the removal of oil particles were effective and its quantification process is going on.

3). Cattle and Human Hair :Properties :

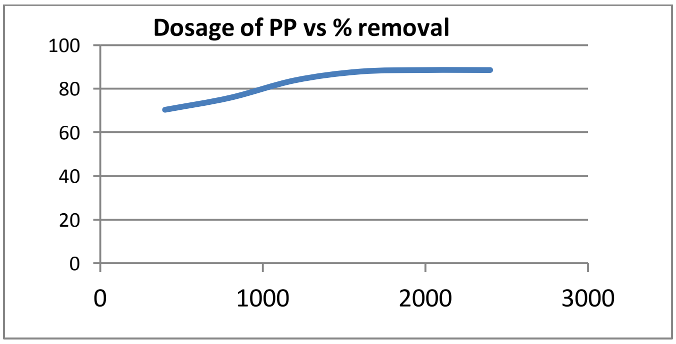
• Hair and hair – coat properties are significant because they are inputs to heat and mass transfer models of animals

• Properties of Hair (Hair length , hair diameter , density of hair coat , depth of hair coat and weight of hair coat).

• Optical properties (absorptivity , reflectivity , transmission.

• To the sample taken from sea water on additionof cattle and human hair it was observed that the removal of oil particles were effective and its quantification process is going on

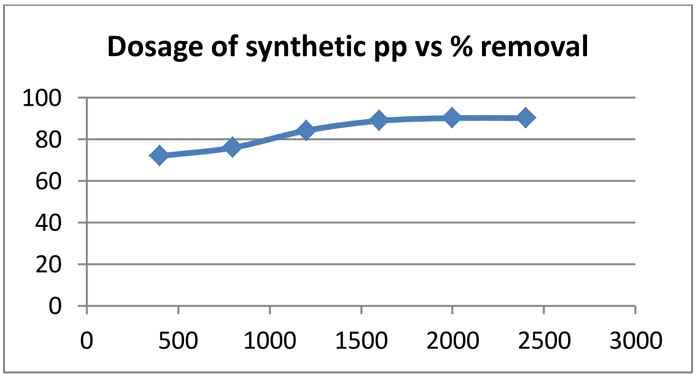
Crude + sea water sample (ml)	Dosage of poly propanol (ml)	% removal
5000	400	70.3
5000	800	75.8
5000	1200	83.8
5000	1600	87.8
5000	2000	88.5
5000	2400	88.5



5). Synthetic poly propylene :Properties :

- Polypropylene is in many aspects similar to polyethylene especially in solution behavior and electrical properties.
- The additionally present methyl group improves mechanical properties and thermal resistance, while the chemical resistance decreases.
- The properties of polypropylene depend on the molecular weight and molecular weight distribution, crystallinity, type and proportion of co monomer, isotaticity.

Crude oil + sea water mixed (ml)	Dosage of synthetic pol propylene (ml)	% removal
5000	400	72
5000	800	76
5000	1200	84.2
5000	1600	88.9
5000	2000	90.2
5000	2400	90.2



Conclusion

The mixture of crude oil with sea water is endangering the habitat of species and in turn affects the ecosystem. So in our study we have tried to reduce the impact of crude oil on sea water by use of 1. Norsorex 2.chicken feathers 3.cattle and human hair 4.poly propanol 5.Synthetic poly propylene. From the above three chemical addition it was observed that the percentage removal of oil spill was more with addition of Norsorex dosage, when compared with poly propanol and Synthetic poly propylene. The percentage removal for the above said chemicals against their dosage was depicted in graphs.

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