WWJMRD 2019; 5(3): 24-28
www.wwjmrd.com
International Journal
Peer Reviewed Journal
Refereed Journal
Indexed Journal
Impact Factor MJIF: 4.25
E-ISSN: 2454-6615

Phuoc Quy Phong Nguyen
Ho Chi Minh City University of Transport, Vietnam

Xuan Phuong Nguyen
Ho Chi Minh City University of Transport, Vietnam

Correspondence:
Phuoc Quy Phong Nguyen
Ho Chi Minh City University of Transport, Vietnam

Introduction of physical methods for oil spill treatment

Phuoc Quy Phong Nguyen, Xuan Phuong Nguyen

Abstract
Oil spills can have disastrous consequences 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. Oil spills may be due to releases of crude oil from tankers, offshore platforms, drilling rigs and wells, as well as spills of refined petroleum products (such as gasoline, diesel) and their by-products, heavier fuels used by large ships such as bunker fuel, or the spill of any oily refuse or waste oil. Oil spills penetrate 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. 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. Oil spills are a very dangerous occurrence for the marine ecosystem is affected and the marine life-forms' existence gets unnecessarily threatened. Since exploration of oil from oceanic resources has become a must and oil spills end up occurring accidentally, as a result, it becomes important to employ various oil spill cleanup methods. With the help of these methods of oil spill cleanup, the task and its hugeness do not affect the optimism of the person. Just like one makes use of the broom, these methods are adapted to clean affected and problematic areas at a much higher level. However, it can be hoped that since many shipping companies are getting aware of the risks and problems caused to the oceanic atmosphere, the requirement of such oil spill cleanup methods will reduce in the days to come.

Keywords: oil spill, oil slick, recovery technology, marine environment protection

1. Introduction
The planet and earth, has large reserves of oil and gas trapped deep beneath its surface. Occasionally, these reserves develop cracks and some of the oil or gas seep out. However, this is a part of nature and rarely causes any major damage. On the other hand, there are times when the same problem is causes because of human interference and it can cause a great deal of damage to marine ecosystems. In the last thirty odd years, the issue of oil spills and their effects has taken on much importance. This is because when an oil spill occurs, it causes a multitude of problems for the environment and our lives. An oil spill happens when liquid petroleum is released into the environment by vehicle, vessel or pipeline. It happens on a large scale and is mostly seen in water bodies. It happens due to human negligence and is a major form of pollution. Oil spills and their effects can also be experienced with refined petroleum or even waste oil from large scale industries. What is common in all of them is that the damage caused by them is permanent and takes a long time to clean up. As oil spill, it floats on water and prevents sunlight to pass through it. The shiny substance that you see sometimes on top layer of water is nothing but oil which makes it difficult for plants and sea animals to survive; cleaning up of oil spill is no easy task. Many various factors need to be considered before carrying out operations. Some of them being amount of oil spilled temperature of water, type of beaches and many more [1].

Picture 1: An aerial image of an oil slick in the Gulf of Mexico

The impacts of spills have been studied and documented in the scientific and technical literature over several decades. Consequently, the effects of oil pollution are sufficiently well understood to allow for broad indications of the scale and duration of damage for a given incident. Ascientific appraisal of typical oil spill effects reveals that, while damage occurs and can be profound at the level of individual organisms, populations are more resilient. In time, natural recovery processes are capable of repairing damage and returning the system to its normal functions. The recovery process can be assisted by removal of the oil through well-conducted clean-up operations, and may sometimes be accelerated with carefully managed restoration measures. Long term damage has been recorded in a few instances. However, in most cases, even after the largest oil spills, the affected habitats and associated marine life can be expected to have broadly recovered within a few seasons [2].

In the world, the statistics showed that from 1900 to now, there were two to four large oil spills in the world each year. The most notable incidents included: The Amoco Cadiz spilled 231,000 tons of crude oil into Brittany Bay, Northwestern France, in 1978; In 1989, the Exxon Valdez ship spilled 40,000 tons of oil into Alaska (USA) offshore; In 2002, the Prestige ship spilled 77,000 tons of oil into the Northwestern Spain offshore; In 2007, the Hebei Spirit ship spilled 2.7 million gallons of oil into the South West Sea of Korea. Most of the oil spills have been catastrophic, with serious ecological, economical, and social losses. Thus, finding a solution to absorb oil spill and slick on the water surface is an urgent issue to protect the marine environment. This article presents the research results of using remediation techniques for recovering oil spill and slick. Based on those remediation techniques, this research shows the methods using cellulose prepared from straw, bagasse, sawdust and added on a polymer of urethane to increase the absorption of oil. This review article will present the physicochemical properties of oil spill and oil slick and propose the remedies. Depending on the oil spill level, suitable solutions will be chosen.

2. Properties of oil spill and oil slick

The oil physical properties such as surface tension, density, pour point, solubility in water and viscosity dramatically effect on the spreading speed of oil or oil slick. Density of most oils, that is an important factor in order to predict, determine the behavior in water, is lower and smaller than that of water so the oils will float and lie flat on water surface and tent to spread, expand horizontally. Lower density of oils results in increasing the evaporation of lighter materials and substances and they have left the heavier materials, which sink in water column, interact with water or others in seawater to form the dangerous sedimentation on seawater body. Oil viscosity is also a index of evaluating the rate of oil spreading [3].

The hydrocarbons with 50 to 98% of oil total components dominate the chemical characteristics thus chemical characteristics of oils are very complex. Furthermore, oil also includes non- hydrocarbon compounds such as oxygen, nitrogen, sulfur, and trace metals. Oils may be divided into saturated and unsaturated hydrocarbons, aromatic hydrocarbons, resins and asphaltenes, refined products. The chemical properties of oil spill and slick are given in Table 1 [4].

Table 1: The chemical properties of oil spill and slick

No	Primary class	Compounds
1	Straigh chain alkanes, n-ankanes	Propane, n-Hexane, n-Dodecane
2	Straigh chain alkenes, n-ankenes	Cis-but-2-ene, Pent-1-ene; Trans-hept-2-ene.
3	Cycloalkanes, a ring with single bond	Cyclohexane; n-Propyl-cyclopentane; Ethyl-cyclohexane
4	Cycloalkenes, a ring with double bonds	Cyclopentene, 3-Methyl-cyclopentene
5	Branched chain alkanes	2-Methyl-propane; 2,2-Dimethyl-butane; 2,2-Dimethyl-propane; 2-Ethyl-hexane
6	Branched chain alkenes	2-Methyl-but-1-ene; 4,4-Dimethyl-cis-pent-2-ene
7	(Alkyl) benzenes	Benzene; Methyl benzene; Ethyl benzene; (o-

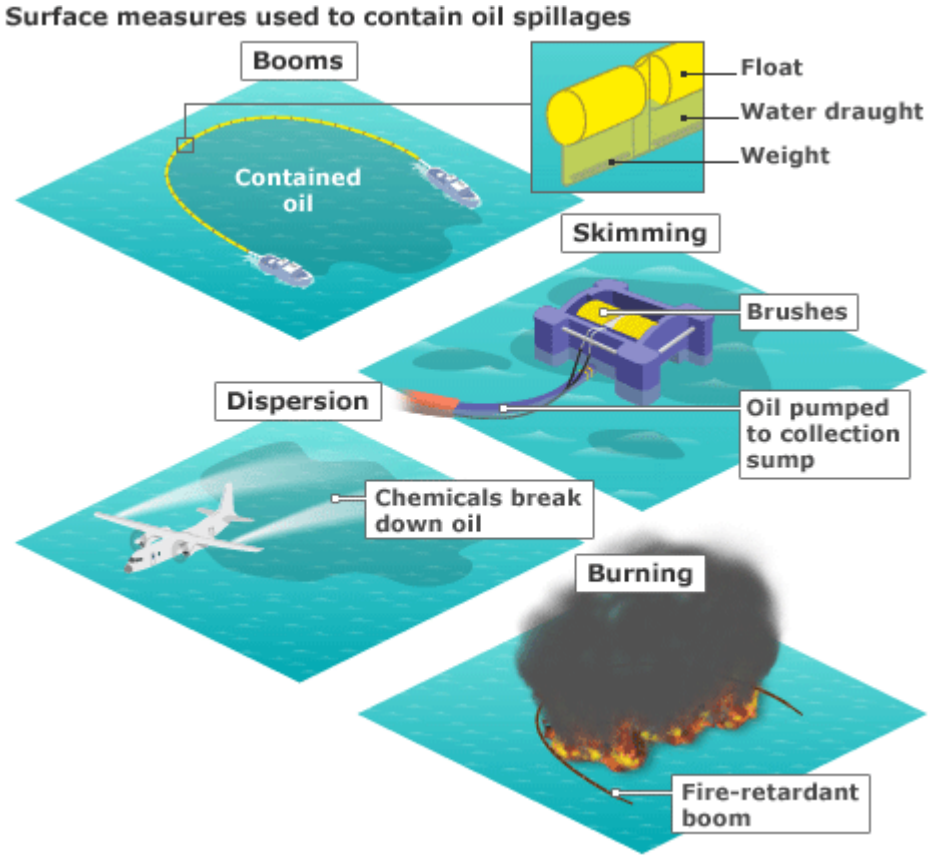
		Xylene) o-Methyl-toluen; (m-Xylene) m-Methyl-toluen; (p-Xylene) p-Methyl-toluen; 1,2-Dimethyl-3-ethyl-benzen; 1,2,3-Trimethyl-benzen; n-Propyl-benzene
8	Other aromatic hydrocarbons	Phenol; Crezol; Hexacloro-cyclohexane
9	Polycyclic aromatic hydrocarbons	Acenaphthene; Naphthalene; Athracene; Chrysene; Coronene; Pyrene
10	Straigh chain alkanes, n-ankanes	Propane; n-Hexane; n-Dodecane
11	Straigh chain alkenes, n-ankenes	Cis-but-2-ene; Pent-1-ene; Trans-hept-2-ene
12	Cycloalkanes, a ring with single bond	Cyclohexane; n-Propyl-cyclopentane; Ethyl-cyclohexane

3. Physical methods for oil spill recovery

Physical methods are mainly used as booms, skimmers, adsorbent materials aiming at controlling oil spills and oil slicks.

Booms

Boom is a normal type of equipment used to prevent oil spill and slick from spreading. However, the effective operation of booms not only depends on the boom design, but also is strongly affected by the characteristics of the currents, wind direction, velocity, and wave height. In case of current velocity over 0.41 m/s, wind velocity over 5.1 m/s or the height of waves over about 1m will carry spilled oil and oil slick underneath the barrier [5]. Based on taking barrier for oil movement, the oil spills and slick can be recovered through skimmers or other techniques. Picture 1 shows a method of oil recovery by booms.



Picture 2: Oil recovery technologies

Skimmers

After using booms to limit the effective area of spilled oil, skimmer equipments are used with booms in order to recover oil spill and slick from the surface of seawater but changing oil properties are maintained hence recovered oil spills can be reused. The characterized disadvantages of skimmers are depending on the factors of weather condition and the thickness of floating oil. Moreover, the current, wave and wind characteristics are the same as for booms. However, self-propelled, towed from the shore, and operated by vessels are the advantages of skimmers in comparison with booms. Skimmers may be classified as oleophilic skimmers, weir skimmers, elevating skimmers, submersion skimmers, suction/vacuum skimmers and vortex/centrifugal skimmer which is shown in Figure 2 and performance of skimmers is given in Table 2 [6, 7].

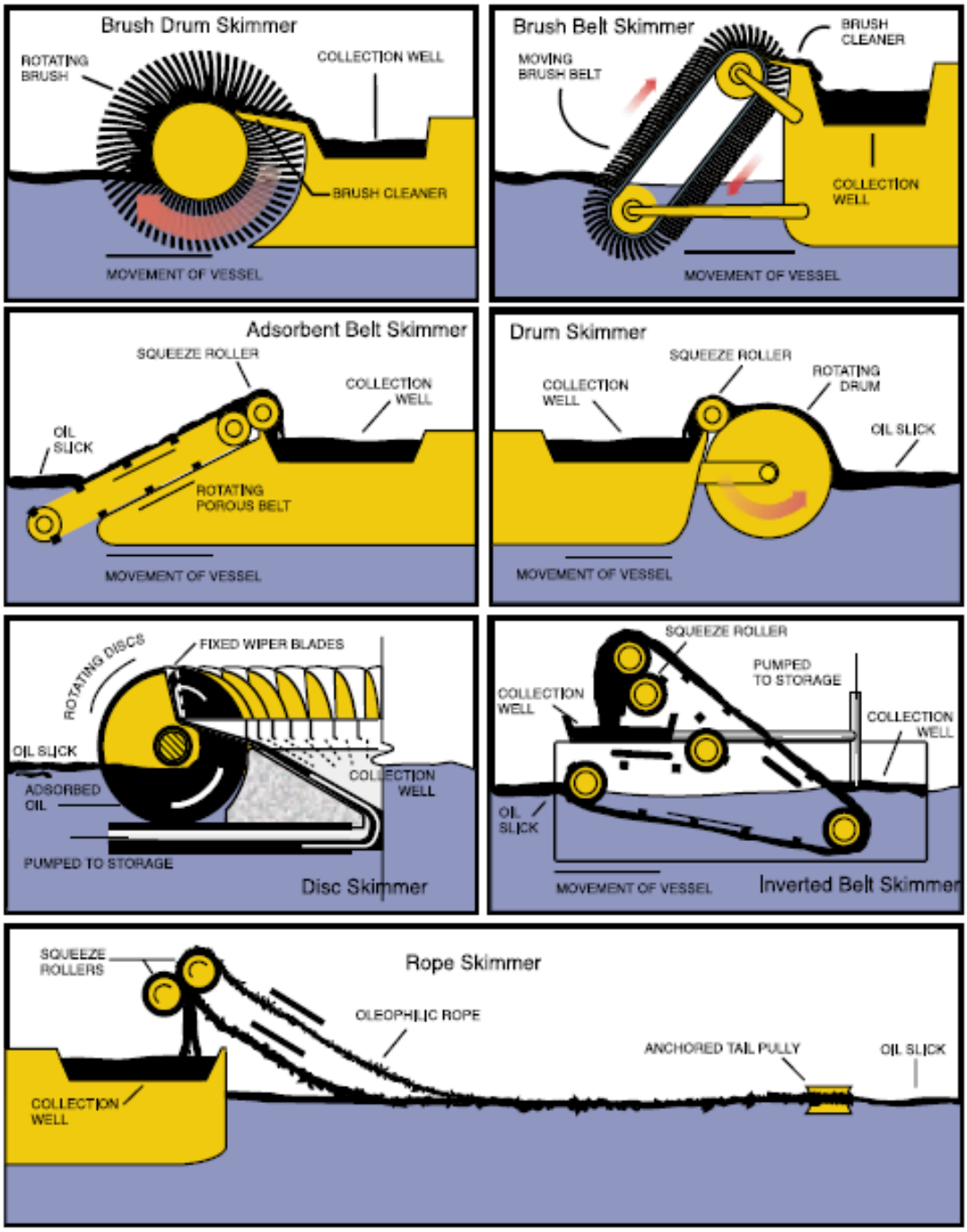


Fig. 1: Classification of skimmers

Table 2: performance of skimmers

Skimmer type	Recovery rate for oil type (m^3/h)			Percent oil (%)
	Diesel oil	Light crude oil	Heavy crude oil	
Oleophilic skimmers				
Disc	0.4 - 1	0.2 - 20	10-50	80-95
Brush	0.2 - 8	0.5 - 20	0.5 - 2	80 - 95
Drum	0.5 - 5	0.5 - 30		80 - 95
Belt	1 -5	0.5 - 20	3 - 20	75 - 95
Rope		2 - 20	2 - 10	
Elevating skimmers		1 - 10	1 - 20	10 - 40
Submersion skimmers	0.5 - 1	1 - 80	1 - 20	70 - 95
Suction skimmers	0.3 - 1	0.3 - 40	3 - 10	3 - 90
Vortex skimmers	0.2 – 0.8	0.2 - 10		2 - 20

Adsorbent materials

Adsorbent materials are considered as the interest for recovering oil spills at final cleanup step after using skimmers with a high capacity of adsorbing the oil and

repelling water. The purpose of using adsorbent materials is to convert the liquid into semisolid in order to remove oil spill and oil slick. There are 3 types of adsorbent materials such as natural organic products (materials) and inorganic sorbent materials, synthetic materials [8]. The sorbent material is given into the oil slick aiming at adsorbing and collecting oil. Depending on the kind of sorbent, the sorbent is usually wringed in order to remove oil and reused or disposed safely. The efficient usage of sorbent materials is evaluated by the factors such as recyclability, sorption capacity, sorption rate because they conclude the required time for spreading and harvesting the sorbents. For all sorbents, the spreading on/over the oil spill before increasing of oil viscosity to the impossible sorbent point is an ultra-important requirement. Using sorbents were recorded as the most effective materials and cheapest solution of oil spills and slick cleanup.

4. Conclusions

This paper reviewed the environmental impacts of oil spill, a variety of methods for oil spill cleanup, the advantages and disadvantages of techniques of recovering oil spill. The results can be concluded as: Physical methods can recover most kinds of oil, inflammable, effective as final cleanup, simple. However, they are expensive, complex, not able to use without being assisted by technological devices. Chemical methods, they are able to be used quickly in all of weather conditions with high efficiency on many kinds of oil. Thermal or in-situ burning method, it is able to be used quickly but with high efficiency if supported by specialized devices, cheap, and it is only suitable for the area of open water, snow or ice. Biodegradation method is considered as suitable for all of weather conditions, efficiency with cheap cost. Based on the level of oil spill and oil slick, kind of oils, weather conditions at each area, the reality condition of each countries, the choice of suitable methods, solution or remedies are necessary to recover the oil efficiently.

5. References

1. http://www.conserve-energy-future.com/effects-of-oil-spills.php
2. ITOPF. Effects of pollution on the marine environment. Technical information paper.
3. Payne JR, Philips CR. Petroleum spills, in the marine environment-the chemistry and formation of water-in-oil emulsions and tar ball. Lewis, Chelsea, Michigan. 1985, 1-24.
4. Olah GA, Molnar A. Hydrocarbon Chemistry (2nd edition). Wiley Interscience Publications. 2003, ISBN: 9780471417828: 1-50.
5. ITOPF. International Tanker Owners Pollution Federation, Response to Marine Oil Spills, 2nd Edition, Whiterby Seamanship, Edinborough, Scotland, 2012.
6. Nomack M, Cleveland C. Oil spill control technologies. In: Encyclopedia of Earth. 2010.
7. Fingas M. The Basics of Oil Spill Cleanup, Third Edition, Lewis Publ., Boca Raton, FL, USA. 2012a.
8. Buist I, McCourt J, Potter S, Ross S, Trudel K. In situ burning. Pure Applied Chemistry. 1999, 71: 43-65.
9. Daling PS, Indrebo G. Recent improvements in optimizing use of dispersants as a cost effective oil spill counter measure technique. Society of Petroleum Engineering Health, Safety and Environment in Oil and Gas Exploration and Production Conference, 9-12 June, 1996, New Orleans, Louisiana.
10. Kapoor S, Rawat HS. Indian West coast spills: a remedial preparedness. Society of Petroleum Engineering Health, Safety and Environment in Oil and Gas Exploration and Production Conference, 25-27 January, 1994, Jakarta, Indonesia.
11. Deschamps G, Caruel G, Borredon ME, Bonnin C, Vignoes C. Oil removal from water by selective sopriton on hydrophobic cotton fibers. Study of sorption properties and comparison with other cotton fiber-based sorbents. Environ. Sci. Technol., 2003a, 37: 1013-1015.
12. Buist I, Potter S, Newed T, Mullin J. Herding surfactants to contract and thicken oil spills in pack ice for in situ burning. Cold Regions Sci. Technol., 2011, 67 (1-2): 3-23.
13. Fingas M, Fieldhouse B. Review of Solidifiers. Oil Spill Sci. Technol., 2011, 713-733.
14. Yang SZ, Jin HJ, Wei Z, He R, Ji X. Bioremediation of oil spills in cold environments: A review. Pedosphere., 2009, 19: 371-381.