

Research of Oil Spill Cleanup Materials in Oceans

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Abstract. In many oil spill accidents, the crud oil flowed into the ocean led to serious crisis to environment as one type of pollution. It can pollute air, water and soil. A research on oil spill cleanup materials in oceans showed new material fibers can absorb several times oil as the materials' weight. If a new material which is easy to get, convenient to use and friendly to circumstance, it should be a good choice in the future to prevent the oil pollution spread. Polypropylene and calotropis gigantea fiber were evaluated as oil-absorbing materials. To recycle the oil slick, people should do more research and nano fiber is the most promising material because of the high oil absorption efficiency.

Introduction

Oil spill made the petroleum flowed into the ocean about 390000 tons per year. The Gulf war made eight million barrels of crude oil leaked into the Persian Gulf and oil floating over 101 times 42 miles. [1] In the wake of BP's Deepwater Horizon oil spill that occurred in the Gulf of Mexico, the oil spill polluted the environment in 2010. Oil and gas gushed out into the ocean at approximately 35,000 to 60,000 barrels per day for 87 days, while several government agencies, BP, and Transocean scrambled to stop the oil spill. [2] In June, 2011, Penglai 19-3 oil field in China which was cooperated build by U.S.A and CNOOC was found oil spill and the spill kept over half a year, and the polluted area is over 5500km². [3] [4] Mainly of the floating oil residual material is tar on the sea while it is very difficult to degrade. All the oil spill effects will destroy the ocean ecological balance because the pollution has concealment and cumulative characteristics. [5]

To prevent the pollution spread, people used many methods to cleanup the oil after oil spill. People often used oil barricade to prevent the oil slick spread and pollute more water areas. Dispersant is a chemical method to disperse the oil slick into mini balls to promote the decomposition of oil. So that the oil slick can disappear in short time. This method can only clean a little amount oil while needs a high cost. [6] The general cleaning methods in the world are burn and abandon that can clean 50% to 90% oil floating on the sea. [7] Unfortunately, the method shall pollute the environment the second time.

There is another way to solve the problem of oil floating that microbiological and biological agents can "eat" or degradation of the oil slick. By the way, agriculture wastes can absorb the oil. But these methods cannot clean mass area or thick oil slick and they must affect in long time. Dispersants used for remediation of oil spills have been found to be harmful to a range of bacteria now. [8, 9]

Thus, people face a new question, how can we prevent the harm of oil slick in time? The answer is new material shall be found in next years. If a new material which is easy to get, convenient to use and friendly to environment, it should be a good choice in the future.

The Oil Spill Cleanup Methods

The Traditional Methods Used in Oil Slick.

The traditional methods to cleanup oil spill include oil barricade, burning and spraying chemical reagents, most adapted the oil contain boom to collect the oil on the surface of the ocean as faster as they can. Oil barricade is used as a defence to oil spread which was often used with other methods to cleanup oil slick. As a quick method, burning can cleanup most combustibles and give a good outlook sea area to people fast. But it just suitable to oil slick thickness over 2mm. If the thickness of oil slick is thinner than 2mm, many combustibles will be left in the ocean and the harm to environment will keep existing in the sea.

The dispersants is the most usually material of spraying chemical reagents that used after an oil spill appeared to separate the oil. Or people can use the separator separate the oil and water by separate the two different physical characteristics and bump the oil into storage cabin to wait for the reuse on the seashore. The water separated from oil-water will return into the ocean and oil will be reused. Dispersants which used in oil slick accidents composed of some chemical components and few chemical components do harm to living things in water, then can do harm to people. Oil spill dispersant perhaps polluted the ocean second time [6] as well as it is not cheap. By the way, this method can only clean a little amount of oil in the sea. Although the method may have some bad effects, it can clean the emulsion which is very difficult to clear up. The emulsion should not disappear in short time after oil spill in ocean while it does great harm to birds and fish.

Another shortcoming is realized to the dispersant in research. In ordinary, the dispersant usage amount is 20%-30% as the oil spill in accident, sometime attain to 100%. When the oil leakage is serious or the oil slick is thin, the oil dispersant should not get good effect. Some reports showed that the oil dispersant will not give a fine outlook when the oil film thickness is not uniform or wave is higher than 1.5m or in a large area on the sea. These conditions will lead a huge waste of money because a high ratio of the oil dispersant can't touch oil film in the sea. At the same time, dispersant usage amount is large in leaks and it needs special facilities such as boat or plane to spray. So many people think the oil dispersant may lead to second pollution after cleaning process.

Oil-absorbing Materials

Oil absorption felts were used in many oil spill accidents in the last decade. People used the felts to prevent oil slick pollute the ocean environment. Although this method can clean the water faster than machinery, the felts which absorbed oil are difficult to recycle the oil in it. Now people used oil absorption felts which were superfine fiber non-woven fabrics can absorb oil ten time weights as themselves original weights and clean the water by the lipophilic property. The fabrics are easy to get in factories' productive process and they are cheaper than dispersants in oil spill cleanup. So the superfine fiber non-woven fabrics are familiar in oil spill cleanup. Oil absorption felts always sink into ocean while being used and cannot salvage from the bottom of sea. This equals to make a new pollution in the ocean. On the other hand, the oil in felts was difficult to reuse. Thus, oil absorption felts will be thrown away on land. [10] The method cost is cheap and absorbs no water indeed. Because oil spill always occurred accidentally, the spilled oil could spread over a wide area in a short time. The oil absorption felts were efficient, large-scalable, and economic method to absorb oil by low cost materials. This is one method used most in past decades. If more oil the felts absorb later, the larger quantities of felts we need. But most oil absorption felts fibers cannot efficiently recover the oil by easy method. Many felts were thrown on seashore and equal to another oil spill disaster on land.

So it can be concluded that environment friendly materials are so important to prevent oil pollution which can be used efficiently in oil spill.

Environmental Friendly Materials in Oil Spill

If one type of materials can "grasp" the oil slick in high efficiency and recover the oil later, people can control oil slick in a small area while people lost less crude oil. So people focus on the new

materials especially nano materials.

Now *Calotropis gigantea* fiber was evaluated as an oil-absorbing material for removal of oil from water. Preliminary experiments show that water droplets can roll off the fiber surface, while oil droplets can spread over the surface completely, indicating its excellent hydrophobic-oleophilic properties. This fiber shows fast absorption kinetics and high absorption capacity and can efficiently recover the oil spills on the surface or below the water. [11] Moreover, this fiber has a recyclable characteristic and shows high efficiency in oil-water separation process in lab. So people hope the fiber used as a sorbent in oil spill or can treat oil-water in oil field on the sea. So people can recycle the spilled oil conveniently in cleanup working and make the cost cheaper than ever.

Polypropylene (PP) is a commercially available hydrophobic-oleophilic polymer with methyl groups positioned at the backbone of the polymer chains. PP is chemically resistant to organic solvents, bases, and acids, which allows it to be used as oil sorbent without further modifications and crosslinkings. PP is reasonably economical, making it the ideal material for oil spill cleanup. Nonwoven PP fabrics produced by electro spinning technique or melt-blown method have been widely used in oil spill cleanup. [12] In people's tests, the fabrics do not show compressible property. People can not get the absorbed oil in fabrics through mechanical squeeze. But now, nonwoven PP fabrics appeared only in laboratory for high cost of device and long production term. The PP sponge is not compressible when it is dry but it showed excellent compressibility in organic liquid. So this is the best characteristic for the oil cleanup process.

The bifunctionalized cellulose nanocrystals (But-CNCs) were new type materials which can be used in oil cleanup working. The fabricated But-CNC suspensions were optically transparent, and the nanocrystals that were isolated were rod-like, with lengths ranging between 35 and 120 nm and with lateral dimensions varying from 2 to 4 nm. Bifunctionalized CNCs at low concentrations (up to 0.45 wt%) were investigated as possible surface-active stabilizers in o/w emulsions. [13] Particularly, the ability of But-CNCs that can enhance the emulsification of marine diesel oil in liquid was different to other fabrics. So people regarded But-CNCs as a green material for oil cleanup in urgent time.

All above materials are researching in lab or using in few tests and have gotten good results. They aren't appeared as oil spill cleanup materials by mass-production difficulty. Some of them were limited by production equipments, some of them were high cost materials. In the future, one of them perhaps can be used widely by mass-production and low cost, especially with green characteristics to environment.

Conclusion

Anyway, in this decade, one fact is the oil spill and produced water at oil platform will keep polluting the circumstance when companies need oil from sea. To recycle the oil slick, people need do more research on oil spill cleanup materials and nano fiber is the most promising material because of the high oil absorption efficiency.

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