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International Oil Spill Response Technical Seminar

Research on Development and Effectiveness Evaluation Technology of New Environment-friendly Oil Spill Dispersant

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Abstract

Reasonably using oil spill dispersant has become one of the important emergency means intended to handle offshore oil spill accidents. With the worldwide nonstop occurrence of offshore oil spill accidents, the effect and toxicity influence of oil spill dispersant have seized popular attention. In particular, oil spill dispersant used in deepwater oil spill accidents urgently needs undergo evaluation of its underwater jetting effect. In this paper, the authors summarized the present condition and existing problems of researches on formula development, sea-surface and underwater application effect evaluation of oil spill dispersant. In addition, the authors gave a description about the progress made in the researches on new environment-friendly oil spill dispersant carried out by their laboratory and in the effect evaluation technology of sea-surface and underwater application of oil spill dispersant.

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1. Introduction

In recent years, with worldwide implementation of increasingly more hydrocarbon production activities, subsea pipeline cracking, offshore oil drilling platform leakage, or some other reasons have led to frequent occurrence of

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underwater oil spill accidents. Subsea spilled oil has severely impaired both marine environment and mankind in the entire process in which it enters water body undersea all the way to sea surface. For example, in the oil spill accident happened to a drilling platform named Deepwater Horizon in Mexico in April 2010, about 700,000 tons of crude oil leaked. The crude oil leaked and entered water body at the water depth of 1,500 m, and then formed a suspending plume zone at the depth between 1,000 m and 1,200 m; moreover, about 50% of crude oil rose to sea surface under the influence of buoyancy (Jane Lubchenco, et al, 2012), significantly damaging water body and marine organisms. With the further deepened exploration and development of gas and oil in South China Sea, offshore drilling platforms have advanced to the deepwater zone where subsea pipelines are constantly extended and thus lead to a relatively high risk of deepwater oil spill.

Surfactant, as the major component of oil spill dispersant, is able to remarkably decrease the interfacial tension between spilled oil and seawater and the viscosity of spilled oil, turning it to stable oil-in-water emulsion that will be rapidly dispersed in seawater due to its accelerated biological degradation, reducing the hazardous impact of spilled oil on marine environment.

Reasonably using oil spill dispersant has become one of the important emergency means intended to handle offshore oil spill accidents. For offshore oil spill accidents, oil spill dispersant is usually sprayed via either vessel or plane. However, the sea-surface spraying effect of oil spill dispersant cannot be quantitatively evaluated mainly because of: (1) Uncertainty of environmental conditions such as sea wave and temperature; (2) Difficult accurate evaluation by current technology of area and thickness of sea-surface oil films dispersed by oil spill dispersant. For an underwater oil spill accident like that happened to Deepwater Horizon in Mexico, Remote Operated Vehicles (ROV) was used to jet 3,000 m3 of oil spill dispersant at seabed oil spill starting spot. This is the first large-scale underwater jetting of oil spill dispersant for oil spill accident in the world. However, few researches on underwater application technology and effect of oil spill dispersant are reported so far.

In this paper, on the basis of summarizing present research situation of oil spill dispersant development and the evaluation technology of its sea-surface and underwater application effect, the authors gave a description about the researches on these aspects carried out and progress made by their laboratory.

2. Development of New Environment-friendly Oil Spill Dispersant

Since 1960s, the international community started the research and development of chemical oil spill dispersant. In 1967, a great volume of oil spill dispersant was used to handle the spilled oil from the Torrey Canyon oil spill accident; due to its high toxicity, the oil spill dispersant severely damaged the marine ecological environment. Hence, many scholars began to focus on the researches of low-toxic oil spill dispersant. Generally speaking, the oil spill dispersant products have undergone three development stages by types of surfactant and solvent (Su, 1992): For the first generation of products, the major component is anionic surfactant and the major solvent light aromatic hydrocarbon; for the second generation, the major component is nonionic surfactant with lower toxicity (mainly ether surfactant); for the third generation of concentrated products, its D-sorbite, fatty acid, and other raw materials come from agricultural and sideline products, and the solvent is polyethyleneglycol so that the oil spill dispersant products are much less toxic.

The performance indicators of oil spill dispersant mainly include emulsification rate, biodegradability and biotoxicity. Through comparatively analyzing existing oil spill dispersant products in China, we found that they are mostly prepared using chemical surfactant serving as major component. Although they do have a great emulsification capability, their biodegradability and biotoxicity are not ideal.

In view of this situation, we launched the research on new efficient environment-friendly oil spill dispersant by starting with the international exploration focus-biosurfactant and its application. Firstly, we chose and cultured high-yielding strains of biosurfactant in addition to sampling bed mud and water body. After fermenting these