A Study of Detection and Prediction of Oil Spill in Ice Seasons of the Bohai Sea

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ABSTRACT

The ice seasons of the Bohai Bay have a significant influence on the ocean engineering, oil exploration as well as transportation. The behavior of oil spill and the state of the art of oil spill detection and modeling in ice season were introduced in this paper with the discussion on the research of oil spill detection and modeling. At last, the prospect of oil spill detection and prediction in ice season was presented, too.

KEY WORDS: the Bohai Bay; oil spill in ice seasons; detection; prediction.

INTRODUCTION

Oil spills have serious impacts on ocean ecology and coastal economy. It is true that oil spill monitoring and prediction in open water, with great achievements, have played significant roles in ocean petroleum exploration and spills prevention. However, researches are not carried out on oil spill monitoring and prediction in ice season as much as in the open waters. The sea ice has a significant influence on offshore exploration and development, as well as marine operations. What’s worse, the ice disaster could even destroy offshore facilities, leading to potential oil spill. Even worse is that it is difficult to clean up and recover the oil spill in cold winters and ice season. A sever oil spill in ice season occurred in 1989 in the US [Yu, Wang and Chen, 1997]. A huge oil tank “Exxon” of Exxon Corporation was stranded in order to escape from floating ice and 37600 tons of crude oils were spilled. The accident had fearful influence on ecologies, which could last for decades. The Bohai Bay, which is the largest offshore oil and gas development area in China, has a three-month ice season each year. The sea freezes and can probably result in oil spills. Therefore, it is necessary to carry out researches on oil spill monitoring and prediction of the Bohai in ice seasons to support emergency response. The advancement of oil spill monitoring and modeling technology for ice seasons is crucial to oil spill emergent disposal. The study on the monitoring and modeling technology of oil spill in ice seasons will benefit the oil and gas developments in the Bohai Bay and other circumpolar latitude areas. The research on oil detection and prediction in ice season have been developed from almost 30 years ago as experiments have been conducted [Gill R. 1979; Fingas, Brown, 2000; Wang, Li and Wang, 2002; Minerals Management Service, 2005; Ross S L. D F Dickins, 1987; Spaulding M L, 1988; D F Diskins Associates Ltd and Fleet Technology Ltd, 1992]. As for detection, the feasibility of high frequency impulse radar, acoustic equipment, laser fluorosensor and ethane gas sensor is discussed [Gill R. 1979; Fingas, Brown, 2000; Wang, Li and Wang, 2002; Minerals Management Service, 2005]. About prediction, large-scale oil-in-ice field experiments were carried out under control in eastern Canadian coastal waters and the Barents Sea marginal area to investigate the interaction between oil and ice and the connection among oil spreading, drifting and ice drifting [Ross S L., D F Dickins, 1987]. Then oil drifts prediction model were established in the presence of ice. This paper firstly addresses the ice conditions in the Bohai Bay and its impacts on oil spill risks. And oil spill detection and modeling techniques are presented here to study a three-dimensional oil spill detection system in ice seasons and oil drift prediction models of Bohai Sea in ice conditions. At last, the prospect of oil spill detection and prediction in ice seasons is given.

THE BOHAI ICE CONDITION AND IMPACTS ON OIL SPILL RISKS

The ice in the Bohai Sea begins to freeze from the midmonth of November to the beginning of December and melts until the late February or midmonth of March. The ice season lasts for 3-4 months, wherein Liaodong Bay has the longest ice season, the next is Bohai Bay, Laizhou Bay the shortest. The ice can be divided into fixed ice or floating ice according to the motion state of ice. Fixed ice usually appears along Liaodong Bay while rarely in Laizhou Bay. The floating ice includes new ice, ice rind, nilas, pancake ice, grey ice and white ice. The thickness of later three types is larger than 10cm [Bai, Liu and Li, 1999]. The features of ice seasons in the Bohai are as follows [Yang, 1999]: (1) the ice in the north is heavier than the north. The Liaodong Bay, especially, the north Liaodong Bay has the most serious ice condition, with large ice coverage, long ice season and thick ice layers,(2)The ice is usually first generated on the coast, then expands into the sea along the bathymetric contours. Ice margins usually parallel with bathymetric contours. (3) The cust coast of Liaodong Bay has heavier ice than the