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Review

The management in response to marine oil spill from ships in China: A systematic review

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ABSTRACT

Historical trends about marine ship-source oil spill incidents from 1990 to 2010 in China were analyzed, and it provided an overview of the status quo of China's management in response to marine oil spill from ships. The Chinese government has issued a series of laws on marine environmental protection since 1982, and promulgated many regulations to prevent and tackle ship-source oil spill. At present, the oil spill emergency response system established in China has five levels: the national level, sea level, provincial level, port level, and ship level. China has demonstrated its ability to control and remove small-scale oil spill from ships in port area and near-shore coastal waters, and also paid attention to related research and development projects. Although China has made significant progress in managing shipping oil spill, challenges still exist, including strengthening oil spill emergency cooperation, enhancing China's response capability, and improving relevant research and development projects.

Contents

1. Introduction

Annually, about 5 million tons of petroleum, on average, is transported across the seas around the world. This is putting the marine lives and ecosystems at a dire risk (Anisuddin et al., 2005). Hence, the impacts of marine oil spill on marine ecosystems cannot be overlooked. In addition, marine oil spill can negatively affect local society and economy where an incident occurs (Kingston, 2002; Miraglia, 2002; Wirtz and Liu, 2006). Although marine oil spill may come from different sources, the ship-source oil spill plays a more important role in polluting marine

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environment than other marine activities such as pipelines, exploration, and production of oil (Eckle et al., 2012; Liu et al., 2015).

Marine ship-source oil spill can occur as a result of ship accidents or operations, or the intentional discharge of oily wastes into oceans (Hassler, 2011; Knapp and Velden, 2011). Among these causes, the accidental oil spill is the primary cause responsible for large spills such as collision, grounding, and hull failure (International Tanker Owners Pollution Federation Limited, 2011; Huntington et al., 2015). During the past decade, the number of large oil spills resulting from ship accidents has decreased gradually because more stringent regulations on maritime transport safety have become effective. Although the large spills were only a few, they were comprised most of oil spills occurring in the last decade. For example, there were 181 spills over 7 tons in the 2000s worldwide and these spills resulted in a total loss of 210,000 tons of oil, among which 44% was spilt in just two incidents (International Tanker Owners Pollution Federation Limited, 2011). Nevertheless, the number of small and so-called operational shipping spills is still large and increasing because of an increasing oil demand on a global basis (Radović et al., 2012). Given that incidents in deep waters are particularly difficult to cope with and the volume of oil spilled in marine environments can be extremely large (Crone and Tolstoy, 2010), it is why the international conventions on oil pollution (e.g., International Convention for the Prevention of Pollution from Ships, MARPOL; The United Nations Convention on the Law of the Sea, UNCLOS) have given special attention to the prosecution of polluting vessels (Radović et al., 2012).

Ships and vessels that may be involved in oil spills include oil tankers, bulk carriers, barges, fishing vessels, and pleasure craft. The amount of spills can be very large when released from oil tankers or small when accidentally discharged from small crafts in marinas (Garcia et al., 2013). Historically, the most serious oil spills often resulted from accidents associated with oil tankers such as the 1989 Exxon Valdez spill in Alaska, the 1999 Erika spill in France, and the 2002 Prestige in Spain (International Tanker Owners Pollution Federation Limited, 2011; Al-Majed et al., 2012). For instance, in terms of tonnage, the "Exxon Valdez" oil spill that happened in 1989 due to maritime transport by shipping was listed as the 26th largest spill in history. It was also the most expensive shipping oil spill accident in history.

The oil spill incidents resulting from oil tankers have concerned more and more coastal countries and forced them to have taken a series of measures to prevent and tackle such ship-associated pollution (Lin et al., 2013; Santos et al., 2013). For example, in order to reduce the number of oil spill accidents, to ensure the safety of navigation and to protect marine environment, the International Maritime Organization has issued a series of rules – such as the "International Convention for the Prevention of Pollution from Ships, MARPOL73/78", and the "International Convention on Oil Pollution Preparedness Response and Cooperation, OPRC 1990 (International Maritime Organization, 1973, 1990). In the United States, the "Port and Tanker Safety Act" (PTSA) was issued in 1978. This law established some rules for the inspection of foreign oil tanker equipment before they enter the US waters such that the effect of potential oil pollution on the US marine environment can be minimized. In August 1990, the US Congress passed the "Oil Pollution Act of 1990" (OPA 90). This Act mandated comprehensive oil pollution liability, compensation, prevention and response requirements. For over twenty years, the OPA 90 has played an important role in reducing the number of oil spills worldwide (Homan and Steiner, 2008). In Canada, in order to prevent and control pollution, the regulations under the "Canada Shipping Act, 2001" and the "Arctic Waters Pollution Prevention Act" set discharge limits for a variety of marine pollutants and required Canadian and foreign ships in Canadian waters to meet specified construction, equipment, reporting and operational standards. Canada also has established a marine pollution preparedness and response system for ships. This system contains two equally important components: Canada's Marine Oil Spill Preparedness and Response Regime regulated by the Transport Canada, and the Government of Canada's operational response capability contained within the Canadian Coast Guard (part of Fisheries and Oceans Canada) (Office of the Auditor General of Canada, 2010).

China has a coastline as long as 18,000 km and a total coastal area of nearly 3 million square kilometers, an area that is equivalent to about 30% of China's landmass (State Council of China, 2004). China's coastal waters are ecologically diverse and rich in marine resources, including numerous species of fish, shellfish, seabirds, and mammals. These biotic resources have contributed and will continue to contribute to China's economic, social, and environmental well-being. Therefore, the occurrence of ship-source oil spill in these waters, regardless of its pollution quantity, can seriously harm China's economic, social, and environmental well-being. Although China has not experienced such large-scale oil spill incidents as the Exxon Valdez, a relatively smaller-scale oil spill incident may still bring important impacts on China's marine environment, especially when the accident occurs in ecologically sensitive areas (Sivanesan, 2013). The "Tasman Sea" oil spill incident (about 200 tons crude oil) that happened in 2002 is such a good example. This oil spill incident caused 786 km^2 of the Bohai Sea to have been polluted by oil spills. It affected 1490 fishermen and farmers and resulted in a significant loss of fishery production from local fisheries. The responsible parties were charged about $5,070,000 as compensation for these negative effects or losses in 2003 (Zhang, 2010).

In 2011, China has once again become the fastest growing energy consumption country in the globe, and the second largest consumer of crude oil in the world. The China's consumption of crude oil is about 10 million barrels per day (British Petroleum, 2012). In addition, China has about 179,200 water transport vessels with about 213 million deadweight tons (Ministry of Transport of China, 2012). The China's shipping fleet tonnage continues to be ranked as the fourth in the world. With the gradual increase in China's oil demand and vessel traffic, it increases the risk of oil spills, which pose a threat to China's marine environment. So, it is necessary to take a series of management measures in response to potential oil spill from ships in China's water. Fortunately, China has already realized the urgency of this issue and its current inadequacies in managing oil spill from ships. Through about 20 years' development till the 1990s, China has made great progress in management in response to oil spill from ships. So far, although some studies have reviewed China's management on oil spill, including establishment of laws and regulations, conducting shipping oil spill risk assessment, and developing emergency management system (Zhang, 2011; Shi, 2012; Jiang et al., 2012), most of these studies mainly focused on specific aspects of oil spill management in specific ports or seas of China. A synthesis study on China's management in response to oil spill from ships is still necessary to reduce the potential risk and protect China's marine environment.

The objectives of this study are to review the evolution and progress in China's management on oil spill from ships, discuss the status quo and problems regarding China's marine oil spill management, and provide useful information for improving China's marine oil spill management. The rest of this paper is structured to contain three main sections: the section two analyzed the historical trend in oil spill incidents from ships occurring in China; The section three reviewed China's management of marine oil spill from ships, China's oil spill emergency response plans and capability, and related R&D projects in China; The section four discussed the future opportunities and challenges of China's oil spill management.

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