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Modified Assessment Methodology for Mechanical Recovery Capacity for Oil Spill Response at Sea

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Abstract

Mechanical recovery for oil spill at sea is an integral part of overall oil spill response. Few countries have developed quantitative methodologies to assess mechanical recovery capacity. As a country which is facing high risk of oil spill at sea, China has adopted a quantitative methodology by which to require legally oil facilities and vessels to maintain a certain level of preparedness and response capability. Firstly, the background of existing methodologies and its calculation formula is introduced. After exploring its shortcomings, a modified formula is proposed based on actual situation of skimmer operation at sea. Then, by choosing two typical skimmers in China as samples to validate the new methodology, experimental results have shown big difference between the existing formula and new formula. Accordingly, suggestions on fully maximizing the effectiveness of skimmer are made for on-scene commanders based on the findings of the new formula.

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Keywords:Assessment methodology; mechanical recovery; skimmer; oil spill response

1. Introduction

In the same year of 2010, two catastrophic oil spills in history of the world occurred, i.e. the "Deepwater Horizon" oil spill incident in Gulf of Mexico, USA and the "Dalian 7.16" oil spill in China which have caused public concerns on oil spill to marine environment and questions on the present preparedness capability to combating oil spill at sea. Some approaches can be used to combat oil spill at sea, such as mechanical recovery by skimmer, absorption by sorbents, dispersion by chemical dispersion, burning oil at sea, etc. However, mechanical recovery is regarded as the

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most environment-friendly and frequently used approach for oil spill response in practice. So there is necessary to assess the mechanical recovery capacity by skimmers as an integral part of overall oil spill response and preparedness capability.

Very few countries have developed quantitative methodologies to assess the overall capability of oil spill preparedness. In 1996, U.S. Coast Guard developed a methodology on overall capability assessment for oil spill from vessels and facilities to maintain their preparedness capability and to develop their contingency plan, in which the mechanical recovery capability is based on a concept named as Effective Daily Recovery Capacity (EDRC)(U.S Coast Guard), the methodology was adopted by another government department, the Bureau of Safety and Environmental Enforcement of the Department of the Interior (BSEE) , as the requirements for the owners and operators of oil handling, storage, or transportation facilities (33 CFR) . After the "Deepwater Horizon" oil spill incident, to improve the methodology, BSEE is revising the methodology and intends to develop a new concept as Estimated Recovery System Potential (ERSP) to replace EDRC(Genwest Systems, 2012) .

In recent years, China has carried out research projects on the mechanical recovery assessment methodologies. One of the outcomes is the Guidelines on the Assessment of Ship-source Oil Spill Response Capability which was promulgate by the Department of Transport of China (JT/T 877-2013) where the calculate formula of mechanical recovery capacity of skimmer is the core part to evaluate the overall oil spill response capability.

2. Interpretation of the Existing Methodology on Assessment of Mechanical Recovery Capacity

2.1. Introduction of the existing methodology

The mechanical recovery capacity is also based on the philosophy of EDRC as USA does and its calculate formula is as follows (JT/T877-2013) :

$$R = T \times P_1 \div [\rho \times \alpha \times Y \times 6 \times (1 - \varphi_1)] \quad (1)$$

Where:R is recovery rate of skimmer (m3 / h), which is the amount of mixture of oil and water can be recovered by skimmer labelled by manufacturer; T is the total oil spilled (t); P_1 is percentage of oil to be recovered by skimmer accounted for oil spilled (%); the value range is 40% to 60%; ρ is density of mixture of oil and water (t/m3); α is the ratio of actually recovered oil accounted for labelled R (%); 6 is daily working hours of skimmer (h); Y is working days (d), normally taking 3 days for operation at sea, 2 days for operation at inland waters, and the value can be adjusted according to the size of oil spill; Φ_1 is surplus amount, normally taking 20%.

In the above formula, three parameters are the key factors which affect the outcomes of the methodology.

Firstly, the rate of oil recovered by skimmer (P_1) should take into account of the type of oil and environment characteristic as well as other two approaches for oil spill response, i.e. the percentage of oil dispersed by chemical dispersants and the percentage of oil absorbed by sorbents. The sum of percentage for the three kinds of oil spill response approaches should not be less than 1.

Secondly, type of oil and sea conditions may affect the ratio of actually recovered oil accounted for labelled recovery rate of skimmer (α) , so the following empirical value in Table 1 may be taken as the value of α:

Table 1 Actually recovered oil accounted for labelled recovery rate of skimmer (α)

Type of oilspilled	A	
	In close water	In open water
Intermediate crude oil, fuel oil	15%	7%
Heavy crude oil, fuel oil	10%	5%