Study on Emergency Response Countermeasures of Maritime Dangerous Chemical Transportation Emergencies

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Abstract. In recent years, with the rapid growth of marine transportation, emergencies in marine transportation of dangerous chemicals have occurred from time to time. Due to the special characteristics of the marine environment, it is difficult to rescue and dispose of hazardous chemical accidents at sea. So, the emergency disposal of hazardous chemicals at sea requires strong professionalism. This paper analyzes the shortcomings in safety supervision and emergency response by sorting out the current situation of emergency response of marine hazardous chemical transportation in China. On this basis, this paper proposes corresponding countermeasures and improves the emergency response capability of marine hazardous chemical transportation.

Keywords. Hazardous chemicals, accidents, emergency response, emergency response capability, maritime transport

1. Introduction

At present, the globalization of the world economy has become a development trend and the total international trade continues to grow. 90% of the world’s goods depends on maritime transport. Of which, dangerous goods account for 50% of the total sea cargo. Because of the many types of dangerous goods transported by sea and the strong professionalism of disposal, it is difficult to rescue and dispose of when an accident occurs. From this, the emergency response to the transportation of dangerous chemicals by sea has always been a difficult point in management and ensuring the safety of transporting dangerous chemicals by sea has also become an important part of transportation safety work.

A number of hazardous chemical spills occurred one after another in the first half of 2020. For example, the liquefied ship “Genius” had a propylene leak in Fuzhou, Fujian Province, and the oil tanker “Guanghui 616” had a liquid chemical leak in Shidao, Shandong Province. The Ministry of Transportation and Communications leaders attach great importance to these accidents. They demanded the management to strengthen the safety management of dangerous goods transported by sea and scientific response to accidents. The previous accident did not cause casualties and environmental pollution, but reveals many problems that are the safety of dangerous chemical transportation has

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incomplete laws and regulations, weak safety foundation, low quality of practitioners, poor emergency response capability and so on.

2. Current Status of Shipping Hazardous Chemicals

Hazardous chemicals are chemicals that are toxic, corrosive, explosive, combustible, flammable and other properties. According to the characteristics of chemicals, we have promulgated “the Catalogue of Hazardous Chemicals”.

Currently, IMO has registered more than 30,000 types of hazardous chemicals. Due to the wide variety and different nature of hazardous chemicals, emergency disposal of hazardous chemicals is difficult. The International Convention for the Prevention of Pollution from Ships provide for 596 types of chemicals that can be transported in bulk, of which more than 200 can be transported by sea [1].

With the rapid development of China’s national economy, the demand for petroleum and refined oil, liquefied petroleum gas, chemical raw materials and other hazardous chemicals is growing. Because of the rapidly growing demand for hazardous materials, the volume of dangerous chemicals in waterways is increasing and the emergency demand of Marine dangerous chemical accidents is increasing day by day.

3. The Current Situation of Emergency Response Capability of Marine Hazardous Chemical Accidents in China

Marine hazardous chemical emergency contains three aspects, which are emergency planning system, emergency force and emergency resources. Since the reserve of emergency resources is scattered and many social resources cannot be accurately counted, this paper only analyzes the existing information system resources.

3.1. Emergency Response Plan System for Marine Hazardous Chemical Accidents


The national maritime emergency response offices are located in the CHINA SAR and working together with the Emergency Response Office of the Ministry of Transport of the People’s Republic of China. Coastal provinces have established provincial maritime search and rescue agencies. Provincial office of maritime search and rescue agencies located directly under the Maritime Bureau, which undertakes the province’s maritime emergencies emergency response organization and command. According to the
need of the work, the provincial maritime search and rescue agencies can set up city branches.

3.2. Maritime Emergency Forces

Maritime emergency forces are mainly composed of professional rescue forces, official government forces, militaries, social forces and volunteer teams [2]. The emergency rescue force under the Ministry of Transport of the People’s Republic of China mainly includes the official force of China MSA and the professional rescue force of Rescue and Salvage. The emergency rescue force under the Ministry of Emergency Management of the People’s Republic of China is including the National Safety Production Emergency Rescue Center, the Fire and Rescue Bureau’s Fire and Rescue Headquarters and the existing professional emergency response force of large state-owned enterprises for hazardous chemicals.

3.3. Existing Maritime Emergency Rescue Information System

With the rapid development of the shipping economy and the continuous promotion of traffic construction, the information construction of water traffic safety is also deepening. The main achievements in the construction of water traffic safety systems include:

- China has built 22 differential positioning system stations and 75 BeiDou satellite navigation stations, which can provide high-precision positioning services for ships [3].
- China has the world’s largest VTS and AIS (44 VTS centers and 597 AIS shore stations) [3].
- China has built the water distress safety communication system.
- China has built the China Ship Reporting System.

4. The Problems in Emergency Response to Maritime Hazardous Chemical Transportation Accidents

4.1. Insufficient Professional Emergency Response Force for Maritime Hazardous Chemical Accidents

The current level of emergency response to chemical accidents in China is limited, especially the emergency response to marine pollution of chemicals on board ships. In recent years, the emergency disposal capability of marine oil spill accidents on ships has been greatly enhanced, but due to the different of the physical characteristics and handling methods of hazardous chemicals, the disposal of marine hazardous chemical accidents is very difficult. The dangerous chemical transporting ships and shipping companies have established various accident emergency plans, but the emergency response capability of dangerous chemical accidents is still relatively weak. Those are reflected in insufficient emergency equipment for hazardous chemicals, low scientific and technological content of pollution prevention equipment and facilities and unprofessional emergency teams [4].
4.2. Insufficient Funds for Emergency Response

At present, the state’s investment in emergency rescue units is only a one-time investment in equipment. Due to low funding and inadequate staffing, the current emergency response unit staffing is underfunded and the staffing is unstable [5]. The lack of a clear compensation mechanism after the expropriation of social forces has led to a decrease in social motivation.

The cost of emergency rescue and disposal of hazardous chemicals is very high, which included the cost of personnel rescue, fire extinguishing agents and hazardous chemical recovery and disposal [6]. The cost should be paid by the ship insurance company after the accident is determined, but the determination or litigation cycle is long. For these reasons, many of the parties responsible for the accident will delinquent related fees and emergency disposal agencies do not have sufficient funds to pay the bills for emergency rescue and disposal.

4.3. Sharing Mechanism of Supervision Department Information has Imperfections

Safety supervision of hazardous chemical transportation at sea involves more functional departments. The “Regulations on the Safe Management of Dangerous Chemicals” set out the responsibilities of the functional departments. But in practice, there are many problems of cross-functionality between different functional departments. Therefore, it is necessary to establish the linkage mechanism and information sharing platform for forming control synergy.

4.4. Safety of Hazardous Chemical Ships Needs to Be Improved

From the analysis of typical accidents, it can be seen that the “Genius” and “Guanghui 616” leakage accident were caused by their own safety defects. Many dangerous chemical ships have problems such as aging ships, ship safety defects and lack of safety facilities [7]. This shows that the safety condition of dangerous chemical transport vessels needs to be improved.

5. Countermeasures

5.1. Strengthening the Construction of Professional Emergency Response Teams for Maritime Hazardous Chemical Emergencies

Due to the complexity, danger and professionalism of emergency response to maritime hazardous chemical transportation emergencies, it is necessary to build a team with strong professional capabilities, adequate equipment and facilities, and practical experience. The emergency response team should include the professional team which is participated in all phases of emergency response and conduct emergency response.

We should continue to improve the construction of national, provincial and municipal emergency response teams. By optimizing the composition of the expert structure and strengthening the strength of the expert team, we can establish a professional, technically competent, and discipline-specific expert support team for maritime hazardous chemical emergency response.
5.2. Improving the Facilities for Emergency Response to Maritime Hazardous Chemical Transportation Emergencies

Well-equipped, well-operated and ready-to-use emergency disposal facilities are the material basis for the disposal of hazardous chemicals on board ships. In order to effectively enhance the emergency disposal capacity of dangerous chemicals on board ships in various places, we can rely on the existing oil spill emergency depots and dangerous chemical enterprises to set up dangerous chemical emergency supplies and equipment depots and increase the provision of dangerous chemical disposal equipment and facilities for emergency use in the vicinity.

The construction of emergency material depot should consider the characteristics of hazardous chemicals, shipboard hazardous chemical accidents around the world and should be equipped with hazardous chemical detection and control equipment, removal equipment and personnel protection equipment, etc.

5.3. Increasing Funding for Emergency Response to Maritime Hazardous Chemical Transportation Emergencies

(1) Government basic financial guarantee: In the emergency response to the transportation of dangerous chemicals by sea, a relevant basic financial guaranteed system should be established and increase investment in hazardous chemical spill response equipment and emergency response teams. Secondly, we should study and improve the “Ship Oil Pollution Damage Compensation Fund Collection and Use Management Measures” and extend the use of funds to offshore hazardous chemical accidents.

(2) Improve the incentive system for handling dangerous chemical emergencies: The state has a special fund for maritime search and rescue incentives, but each province and region can use a limited amount of funds. It is recommended to increase the incentive for emergency disposal of dangerous chemicals on board ships, so that the initiative of social emergency forces can be fully mobilized [8].

5.4. Improving the Emergency Response Capability of Marine Hazardous Chemical Transportation in Each Region

The risk identification of hazardous chemicals transported by sea in the jurisdiction should be carried out according to the categories of hazardous chemicals transported and the existing emergency response force. By simulating the accident development process, we can develop disposal plans for typical cargo types and study targeted countermeasures for risk prevention and control.

Carry out research on emergency disposal of different types of hazardous chemicals, especially dissolved chemicals. Dissolved hazardous chemicals are dissolved or partially dissolved in water and therefore cannot be treated by normal recycling methods. Under certain environmental conditions, dissolved toxic liquid substances can be treated with chemical agents to mitigate or “neutralize” their harmful effects on humans and the environment. However, a large amount of heat may be generated during the reaction and treatment of chemical agents that can cause secondary accidents. Therefore, a study on the applicability of chemical agents should be carried out for the disposal of different
soluble hazardous chemicals accidents, and a table of corresponding disposal reagents should be prepared.

6. Conclusion

In recent years, China has done a lot of research work on emergency response of dangerous chemicals at sea and also strengthened the safety supervision of dangerous chemicals. However, the emergency disposal of hazardous chemicals at sea differs greatly from that of road transport accidents. There are still some shortcomings in the emergency response to maritime hazardous chemical accidents in China, which affect the safety of maritime hazardous chemical transportation. Therefore, we need to enhance the emergency disposal capacity of dangerous chemicals at sea by strengthening the construction of professional emergency teams, improving the equipment and facilities for emergency disposal, increasing the investment in emergency disposal funds, and improving the emergency disposal capacity of each region and other effective countermeasures.

References