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Dangerous Goods Road Transport Management: A Comparative Study between China and the West

AiMin Deng, Xiao Qing Zhan*

***Abstract*—Under the background of rapid development of chemical market, the volume of dangerous goods transportation in China has increased significantly. Therefore, the importance of dangerous goods transportation management has become prominent, playing a vital role in maintaining the safety and stability of China's transportation. In this paper, we take the European Union and the United States as examples, and comparatively analyze their management of dangerous goods transport with China's in terms of enterprise and personnel management, transport process management and accident secure management, and then put forward policy suggestions on this basis.**

***Index Terms*—Dangerous Goods, Road Transport management, European Countries, America**

I. Introduction

Hazardous chemicals are flammable, explosive, toxic and corrosive substances such as explosives, petrol, strong acids, strong bases, benzene, etc. The Global Chemicals Outlook II report, released during the 4th United Nations Environment Assembly in 2019, states that the current production capacity of chemicals is 2.3 billion tonnes, and is expected to double by 2030. According to the《Oil & Gas Journal》, global oil production rebounds moderately in 2021, improving by 1.3% from 2020 to 4,423 million tonnes. The rapid growth of the petrochemical industry has also led to an increase in the production of hazardous chemicals. There are more than 45,000 kinds of chemicals produced in China, among which nearly 3,000 kinds of hazardous goods are listed in the national standard "List of Dangerous Goods" and more than 7,000 kinds of hazardous goods are listed in the Ministry of Communications "List of Dangerous Goods for Automobile Transportation". According to data from China Federation of Logistics and Purchasing, most of the dangerous chemicals transported in China every year are transported by road, and the road transport volume of China's dangerous chemicals logistics industry will be about 1.2 billion tons in 2020, accounting for 69%, and the transport volume is increasing year by year. These large quantities of flammable, explosive, highly toxic and corrosive dangerous goods transported on the roads comes to be a mobile danger in the country, threatening the public safety of society at all times. Therefore, the management of dangerous goods road transport is of great concern to governments and enterprises.

Aimin Deng, School of Economics and Trade/ Institute of Transportation and Logistics, Hunan University, Changsha, China
XiaoQing Zhan*, School of Economics and Trade, Hunan University, Changsha, China

II. Enterprise and Personnel Management

Human plays a decisive role in the safety management of transporting hazardous chemicals. Whether it is the enterprise or individual employees, their credentials and quality have an absolute impact on transport safety. Fang Zhaoqi et al. (2012) conducted an in-depth analysis of the current situation and problems of the management of road dangerous goods transport personnel in Zhejiang Province, pointing out that the management of road dangerous goods transport personnel is of great significance.

A. Enterprises Qualification Management

According to the China Federation of Logistics and purchasing, by the first half of 2021, China's hazardous chemical road logistics enterprises exceeded 13000, with a total of more than 575,000 transport vehicles and more than 1.5 million employees. In 2021, enterprises with less than 50 vehicles accounted for 66% and those with more than 100 vehicles accounted for only 9.26%,which means the industry is of low concentration and dominated by small and medium-sized enterprises. Meanwhile, a considerable number of enterprises have operated in irregular ways such as leasing or affiliating, and some even operate without a license due to the high access threshold. For instance, the investigation of "6.13" liquefied petroleum gas tanker explosion accident found that the major company in the accident involved vehicle affiliation operation and failed to implement the safety production responsibility of such as GPS dynamic supervision, safety education and management, and truthful uploading of electronic road orders, which was the main cause of the accident. In contrast, European and American countries have stricter market access requirements for hazardous chemical transport enterprises. Germany requires the person in charge of the applicant enterprise to have no criminal or violation records, and the enterprise needs a high level of financial strength, with the starting capital deposited in the enterprise bank account and frozen by the bank, and additional funds are required if additional vehicles are purchased in. After approval, a permit is issued and insurance is taken out. Those engaged in the transport of dangerous goods are also required to take a special examination and obtain a dangerous goods transport permit after passing the examination.

B. Employee Training and Management

First of all, compared with European and American countries, there is no specific training institutions for China's hazardous goods transporting workers, and it's usually done by some local driving schools designated by the municipal transportation department, in which the quality of trainers can not be guaranteed, and the knowledge and skills learned is

relatively thin. In addition, due to the small and scattered number of practitioners, courses are often offered on an irregular basis, resulting in practitioners not being able to attend training in a timely manner and often starting work without a certificate in advance. At the same time, the hazardous goods transport qualification examination in China is not that strict, and some enterprises and individuals get the qualification through informal channels or forge false certificates. The developed countries are more mature in the training of hazardous goods transport practitioners , and have their specific training institutions. European countries based on European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR) attach great importance to personnel training, and have implemented a set of effective personnel training mechanism. First, the law authorizes the German Chamber of Commerce and Industry(DIHK) to take overall responsibility for the organization of training, examinations, licensing and licensing of professional training institutions for those safety consultants and drivers. Professional training institutions and their instructors must be authorized by the DIHK. Second, as ADR stipulates, one or more safety advisers must be appointed for the carriage of dangerous goods to prevent the risks inherent in such activities. Their duties include the proper training of the undertaking's employees and verification that employees involved in the dangerous goods activities have detailed operational procedures and instructions. In the UK, drivers are mainly managed and trained by an independent third party, and are issued with a dangerous goods vehicle driving certificate, which is valid for a minimum of five years, with training and certification every five years. When transporting dangerous goods by road in Sweden there is only one driver (no escort), who is specially trained and whose license is renewed every year, after which the driver is expected to attend a three-week course.

Secondly, compared with European and American countries, China has low educational requirements for dangerous goods transport practitioners, and therefore the educational and cultural levels of drivers, loading and unloading and escorting workers are generally low, coupled with the short training period, simpler content and lower difficulty of examinations, which are mainly written and less practical. This has led to a general lack of legal awareness, poor safety awareness, technical skills and the ability to deal with emergencies. In Europe and the United States, the level of education and culture of dangerous goods transport workers is higher, and the government and the industry also attach great importance to the professional ethics education of transport workers. The self-discipline and self-awareness of dangerous goods transport workers are higher with more scientific and strict training and assessment procedures.

C. *Management of Law Enforcement Personnel*

The law enforcement agencies and law enforcement personnel play an important role in the dangerous goods road carriage safety management. Compared with developed countries, China currently does not have a specific law enforcement agency for dangerous goods road carriage inspection. THE road transportation administrative department do not have the right of enforcing the law, nor do police station set up special road transportation law enforcement inspection department, or have professional law enforcement inspection personnel. Lack of due law enforcement inspection institutions bring great practical difficulties to the dangerous goods road carriage inspection and management. While America and European countries have set up special road law enforcement departments, such as the German Federal Freight Administration and the federal state police jointly responsible for law enforcement inspection, through random inspection of dangerous goods transport vehicles, equipment and cargo loading, labels, signs. According to the law, every law enforcement officer must taken professional training in the transportation of dangerous goods and be familiar with the relevant regulations for the transportation of dangerous goods. Moreover, every law enforcement inspection team is equipped with professional and technical equipment necessary for law enforcement inspection and accident handling of the transportation of dangerous goods on the road. In the UK, the Transport Authority is responsible for the issuance of hazardous chemicals transport permits, and the Dangerous Goods Professionals Association is responsible for the implementation, with the police and the Roads Authority in coordination.

III. Transport Process Management

A. *Prohibited Hours*

Considering the safety and rescue efficiency, all provinces and regions in China have restricted highway access hours for vehicles carrying dangerous goods. most of the province's limited hours are from 0:00 to 6:00, such as Zhejiang, Hunan, Jiangxi, Guangxi, Chongqing, Sichuan, Shanxi, etc.; some provinces, such as Shandong, Jiangsu, prohibit the passage of hazardous chemical transport vehicles from 22:00 to 6:00. In contrast, developed countries such as Europe and America rarely have night-time traffic bans. On the one hand, the traffic flow on motorways in Europe and America is relatively low, and on the other hand, the planning of motorways in these countries is more rational and of higher quality.

B. *Speed Limits*

In terms of speed, due to the specific properties and dangerous nature of the goods being transported, no higher speeds are permitted, with a relatively low limit of 90 km/h in Europe.

IV. Safety Secure Management

A. *Safety Equipment Management*

Currently, there are many small-scale enterprises in China's hazardous chemical transport industry and even illegal business enterprises, whose safety equipment is not improved and even not equipped with GPS satellite positioning monitor. As the national network supervision is not unified, it can not provide rescue locations as soon as possible after the occurrence of transport safety accidents, delaying the best time for rescue. In Germany, when transporting dangerous goods, drivers must wear helmets, protective goggles and have shovels and fire extinguishers in their vehicles. Companies in Europe and the US use advanced technologies such as RFID and GPS to track and supervise all aspects and processes of dangerous goods logistics. With the help of RFID monitoring, it's clear to accurately understand the location of the goods in real time to determine the location

of the accident, ensuring the fastest possible time to deal with the emergency.

B. Rescue Team Management

Chemical accident emergency rescue can be divided into two forms: unit self-help and social rescue. Self-rescue by the accident unit is the most basic and important form of emergency rescue for chemical accidents. Units transporting chemicals must establish professional teams for accident emergency rescue. China's social rescue mainly includes fire rescue teams, public security and local rescue teams. However, the construction of China's existing professional rescue teams are relatively of small scale and lack of professional and systematic training. In developed countries, the prevention and emergency rescue forces of hazardous chemical transport accidents mainly include enterprises, regional mutual aid organizations, and government departments.

In developed countries, not only do they have special organizational structures for accident rescue, but they also have professional accident rescue personnel in place for the prevention and rescue of hazardous chemical transport accidents. At the same time, they often have accident simulation laboratories or training bases, and organize annual training for relevant personnel to receive new knowledge, skills and methods in theory and practice to continuously improve rescue capabilities. For example, the fire services of the German federal states have a dangerous goods transport accident division, with professional rescue personnel responsible for the rescue of dangerous goods transport accidents on the road. Dangerous goods transport accident rescue personnel must take rigorous training, familiar with the features of various types of dangerous goods and accident rescue requirements. In addition, the fire brigades of the German federal states usually have a dangerous goods accident simulation laboratory in their fire brigades, where accident rescue personnel can learn new knowledge, gain an in-depth understanding of the dangerous goods, and master new accident rescue methods and techniques. Germany also has a system of safety advisors for companies and individuals involved in the transport of dangerous goods to consult on safety-related matters.

V. Policy Advice

A. Improve the Practitioner Training System and Establish a Professional Law Enforcement Team

For the management of enterprises and personnel, firstly, further improve the personnel training system. Specific suggestions are: set up official or semi-official personnel training institutions and teaching staff, classify and compile training materials and assessment forms suitable for the professional knowledge training of personnel mainly involved in the transport of dangerous goods by road in China, combine written knowledge with practical exercises, and adjust the assessment for the Dangerous Goods Certificate of Competence. Establish a system of safety consultants, give safety consultants full play to the function of supervision and inspection in the process of transporting dangerous goods by road, and to promoting the training of professional knowledge of all personnel involved in the transport of dangerous goods by road. Secondly, establish a professional law enforcement team, strictly enforce the law and further improve the level of law enforcement. It is suggested that the Ministry of Transport and the Ministry of Public Security further study and consult on the setting of law enforcement and inspection agencies for the transport of dangerous goods by road . We should set up a special law enforcement and inspection agency for the transport of dangerous goods by road at an early date, refine the legal and regulatory procedures for law enforcement and inspection, train and establish a professional enforcement and inspection team for the transport of dangerous goods by road, and equip them with the necessary advanced enforcement and inspection equipment.

B. Rationalize the Restricted Hours

Foreign countries often have no restricted hours because they can effectively safeguard the safety of road transport of hazardous chemicals by road planning. New York City, USA, Hamburg, Germany and Red Deer, Canada adopt a series of access management strategies including prohibited access, available access, alternative access and vehicle restriction in terms of access rule making. For hazardous chemical road transport regulations, New York City has achieved precise rules for the direction of travel and road sections for almost all transport vehicles in the city. The US state of California, in terms of route management, evaluates and selects the best transport routes, introduces a dynamic adjustment system, develops an autonomous route selection program for hazardous materials road transport, and builds an electronic map of tanker truck rollover accident distribution based on a large number of accident cases to proactively remind drivers in due course.

Set up special rescue teams for dangerous goods road transport to ensure timely rescue even at night. For example, Transport Canada has a Dangerous Goods Transport Emergency Service Center, which currently has 12 operational experts who are available 24 hours a day, 7 days a week, to provide emergency advice to relevant units (including transport companies, consignment companies, fire services, etc.) on emergency situations in dangerous goods transport.

C. Standardize Vehicle Requirements

Standardize the safety and technical inspection process for vehicles transporting dangerous chemicals; integrate resources in the dangerous chemical transport industry to promote the scale of dangerous chemical transport enterprises and improve the efficiency of the management of transport vehicles. Unify the relevant signs and markings on dangerous chemicals vehicles, and eliminate the phenomenon of different transport enterprises using or hanging homemade signs or symbols that are not uniform with industry standards on their transport vehicles for publicity purposes. Updating the catalog of vehicles transporting dangerous chemicals and their signs and markings in a timely manner; prohibit the passage of vehicles that are not equipped with escort personnel; and disallow the transport of vehicles that are not designated according to the type of dangerous chemicals on the road. It is extremely dangerous to use iron-wheeled vehicles, battery-powered vehicles or other vehicles without explosion-proof devices to transport explosives.

D. Establish and Improve the Emergency Rescue System

It is critical to establish an emergency response system for the transport of dangerous chemicals by road, enrich professional teams for emergency disposal, equip emergency rescue and protection capacity, establish a pool of experts and emergency rescue equipment, and develop a computer-aided decision-making system for emergency rescue and relief. We should require dangerous chemical vehicles to be equipped with driving recorders and GPS positioning systems, and establish a satellite positioning platform in the country, so as to facilitate the retrieval of information and enable the active supervision of every hazardous chemical transport vehicle to see whether it is legally carried. We should also enhance the awareness of the main responsibility of chemical production enterprises, and establish emergency rescue teams belonging to chemical production enterprises in different categories.

VI. Conclusion

In summary, the management of dangerous goods logistics in China still has a long way to go, and there are still problems such as multiple management, low quality of staff, small scale of enterprises, low level of modernization and backward emergency response mechanism. Therefore, based on the importance of dangerous goods transport in China's traffic safety management, China must give sufficient attention to the management of dangerous goods transport to ensure that we fully learn from other countries' excellent experience of dangerous goods transport management to fundamentally improve the effectiveness of China's dangerous goods transport management.

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AimingDeng:

Dr.Aimin Deng is a full time professor and doctoral supervisor at the College of Economy,and Trade of Hunan University; the founder and Director of the Institute of transport and logistics (www.tl-hnu.cn)the founder and Director of Sino-German Center for transportation and logistics of Hunan University(www.tl-cnde.org,).Research areas: logistics and supply chain management (including finance)systems, transportation systems,e-commerce and IOT systems.She studied in Germany, has a certificate of advanced English to study abroad by the Ministry of Education in China, and was the head of E-Commerce and Logistics Management Department and Information Management and Information System.She has a wide range of exchanges and cooperation with national and international enterprises, institutions and Governments,and social and academic positions;hosted and completed nearly more than 40 domestic and international projects, published more than 90 papers and guide more than 100 graduate students.

XiaoQing Zhan:

Master's degree from Hunan University；Major in International Business； The research direction is supply chain management and logistics.