

Comparative Study on the Management of Domestic and Foreign Road Transport of Dangerous Goods

Aimin Deng, Ting Sun

Abstract—China's annual road transport of hazardous chemicals has exceeded 1.7 billion tons, of which the road transport volume is about 1.2 billion tons, accounting for 69% of the total transport of dangerous goods. However, at the same time, transportation safety accidents occur from time to time, bringing huge losses to the society. Therefore, this paper, based on the analysis of the current situation of China's hazardous chemical transport management, compared the management of domestic and foreign dangerous goods road transport, mainly including the legal and regulatory system, training and certification, emergency rescue management and vehicle safety management, summarizing the advanced experience of developed countries, put forward some suggestions, including strengthening the improvement and updating of laws and regulations, the establishment of professional law enforcement and inspection agencies, the implementation of joint supervision. The recommendations include strengthening the improvement and updating of laws and regulations, establishing professional law enforcement and inspection agencies, implementing joint supervision, improving the training system for practitioners, strengthening corporate responsibility, strengthening international exchanges and cooperation, establishing a sound emergency rescue system and establishing accident simulation laboratories or training bases, etc.; with a view to providing reference for improving the safety management level of road transport of dangerous goods in China.

Index Terms—Comparative study, Dangerous goods, Road transport, Transport management

I. INTRODUCTION

The road transport of hazardous materials is a highly regulated and safety-critical activity that, if not properly managed, can pose significant risks to public safety, property, and the environment. A comparative study of domestic and international road transport management of dangerous goods aims to explore the similarities and differences between different countries and regions in terms of regulatory systems, industry practices, and safety outcomes, to provide valuable insights into the strengths and weaknesses of different regulatory models and best practices in different jurisdictions, and to provide references for policy formulation, regulatory coordination, and capacity building. For enterprises, it can help domestic transport enterprises to understand the best practices of international road transport of dangerous goods, which can help improve the management level and service

Aimin Deng, the School of Economics and Trade, Hunan University, Changsha, China

Ting Sun, the School of Economics and Trade, Hunan University, Changsha, China



quality of transport enterprises. By comparing the differences in the management of dangerous goods road transport at home and abroad, we can identify the shortcomings of domestic and absorb the experience from international to improve the management level and service quality. For government departments, the study of domestic and foreign management of dangerous goods road transport comparison, you can find foreign experience in the development of regulations and standards, and in the domestic development of relevant laws and regulations and standards for reference. At the same time, it can also learn from the management mode of relevant foreign government agencies and regulatory departments to improve the management capacity and supervision level of relevant management departments in China. For the general public, the study of domestic and foreign dangerous goods road transport management comparison, can improve public awareness of dangerous goods road transport and safety awareness, reduce the occurrence of dangerous goods road transport accidents, through the comparison of domestic and foreign management measures, you can find the shortcomings of domestic management, timely improvement to improve the management system to protect public life and property safety. In conclusion, it is very significant to study the comparison of domestic and foreign management of dangerous goods road transport, which helps to improve the management level and service quality of transport enterprises, promote the improvement of government management ability, improve the public awareness of safety of dangerous goods road transport and protect public life and property safety.

II. DEFINITION AND CLASSIFICATION

A. Definition

Submit your manuscript electronically for review. Road refers to "highways, city roads and places where social motor vehicles are allowed to pass although they are within the jurisdiction of the unit". Road transport refers to "the use of motor vehicles on the road to engage in the transport of passengers or goods". The Regulations on the Transport of Dangerous Goods by Road define dangerous goods as "goods of explosive, flammable, toxic, corrosive, radioactive, etc. nature". When the relationship with these goods, such as production, operation, transportation, storage, use process, if not properly disposed of, prone to loss of people's lives and property or environmental pollution and other accidents. Dangerous goods road transport is the goods are prone to cause combustion, explosion, corrosion, poisoning or radioactive dangerous goods as the object of transport,

transport business activities, in the "People's Republic of China Road Transport of Dangerous Goods Regulations" on the road transport of dangerous goods is clearly defined, that is, "the use of laden vehicles to transport dangerous goods by road operations The whole process". Dangerous goods transported by road need to meet the following conditions of transport:

1. Classification of dangerous goods in line with the "Rules for the Road Transport of Dangerous Goods Part 2: Classification" (JT/T617.2-2018) requirements.
2. Packaging of dangerous goods for shipment meets the requirements of "Rules for the Road Transport of Dangerous Goods Part 4: Requirements for the Use of Transport Packaging" (JT/T617.4-2018).
3. Consignment procedures in line with the "Rules for the Road Transport of Dangerous Goods Part 5: Consignment Requirements" (JT/T617.5-2018) requirements.
4. The choice of means of transport and loading and unloading conditions meet the requirements of the "Rules for the Road Transport of Dangerous Goods Part 6: Loading and unloading conditions and operational requirements" (JT/T617.6-2018).

5. Transport operations alone in line with the "Rules for the Road Transport of Dangerous Goods Part 7: Conditions of Transport and operational requirements" (JT/T617.7-2018) requirements.

Specifically, to determine whether a certain cargo in road transport is dangerous goods, mainly through two ways: First, directly find the "Rules for the Road Transport of Dangerous Goods Part 3: Name and Transport Requirements Index" (JT/T617.3-2018) Appendix A of the "List of dangerous goods for road transport" to determine; second is For those not included in the "Dangerous Goods List", the relevant laws and administrative regulations or the results announced by the relevant departments of the State Council shall prevail.

B. Classification

China uses the United Nations classification method to classify dangerous goods, according to GB6944-2012 "Classification and Numbering of Dangerous Goods", dangerous goods are divided into 9 categories and 20 items, as shown in the Table 1:

Category	Title	Item	Title
Category 1	Explosives	1.1 items	Articles with an overall explosive hazard, such as nitroglycerin
		1.2 items	Does not have the overall explosive hazard, but there is an ejection hazard items, such as rockets carrying explosives
		1.3	Do not have the overall explosive hazard, but part of the risk of ejection or explosion of items with flammable and explosive hazards, such as fireworks
		1.4 items	Articles that do not show significant risk, such as fireworks
		1.5 items	Items with an overall explosive hazard but very insensitive, such as latex explosives
Category 2	Gases	1.6 items	Extremely insensitive substances that do not have an overall explosive hazard
		2.1 items	Flammable gases, such as methane
		2.2 items	Non-combustible gases, such as oxygen
Category 3	Flammable liquids	2.3 items	Toxic gases, such as chlorine
			Including: (1) flammable liquids; (2) liquid desensitized explosives, such as gasoline, methanol, kerosene
Category 4	Flammable solids, easily spontaneous combustion, flammable substances in contact with moisture	4.1 items	Flammable solid, easy to burn or friction can ignite the solid, such as red phosphorus
		4.2 items	Substances that are prone to spontaneous combustion, such as yellow phosphorus
Category 5	Oxidizing substances, organic peroxides	4.3 items	Substances that emit flammable gases when in contact with water, such as potassium
		5.1 items	Oxidizing substances that can cause other substances to burn through oxidation reactions, such as potassium permanganate
Category 6	Toxic and infectious substances	5.2 items	Propane substances with peroxy groups in their molecular structure are items that undergo violent chemical reactions under the influence of external forces, such as hypochlorite
		6.1 items	Volatile liquid, airborne, through human breathing, attached to the skin surface, causing pain, corrosion of the skin, causing harm to the human body substances
Category 7	Radioactive substances	6.2 items	Contains pathogenic viruses, including plants and animals for experiments in laboratories, new substances produced by artificial synthesis, such as Clostridium botulinum gold
			Radioactive, radioactive activity exceeds the specified limit value of the material, such as luminous powder
Category 8	Corrosive substances		Substances that can seriously damage biological tissues or other cargo and transport equipment when in contact, such as potassium permanganate
Category 9	Miscellaneous hazardous substances and articles		Other hazardous substances, such as: (1) substances that cause environmental pollution; (2) substances with extremely unstable physical properties, (3) organisms that have undergone genetic mutations

III. CURRENT SITUATION OF DOMESTIC ROAD TRANSPORT OF DANGEROUS GOODS AND THE EXISTING PROBLEMS

A. *The current situation of road transport of dangerous goods in China*

There are three main forms of dangerous goods transportation: road, railroad and waterway, among which road transportation is the most common and main mode of

transportation, because road transportation has the advantages of flexibility, high speed and low cost. Firstly, road transport can flexibly adapt to different types of cargo and transportation needs without the need to build special infrastructure such as docks, railway lines, etc. Trucks can directly access production and sales points and can be transported door-to-door. Secondly, although railroad and waterway transportation can be fast, but because of the need for cargo loading and unloading at specific stations or



terminals, coupled with long distances and many transit links, the transport time is usually long; while road transport can transport goods quickly, especially for short-distance transport is more suitable. In addition, road transport is usually less expensive because it does not require specific infrastructure such as railroads or waterways, and road transport can be adapted to different types of cargo and transport needs by using different models, thus better controlling costs. In contrast, although rail transport can carry large amounts of cargo, it requires the construction of special rail lines and freight terminals, which requires significant investment and time, and rail transport usually requires transit, adding time and cost. Waterway transportation is usually suitable for long-distance transportation, but requires the construction of docks and port facilities, which requires a lot of investment and time, and waterway transportation is slower and requires consideration of natural factors such as weather and water level, and transportation is not flexible enough. Therefore, although railroad and waterway transport can also be used for dangerous goods transportation in some cases, but in most cases, road transport is still the most convenient and economic choice. Data show that in 2020, China's total logistics of dangerous goods is 1.7 billion tons, of which road transport is about 1.2 billion tons, accounting for 69% of the total transport of dangerous goods, accounting for 3.5% of the total road transport of goods. Every day nearly 95,000 heavy-duty dangerous goods vehicles carrying 2.2 million tons of dangerous goods on the road.

B. Problems in the management of road transport of dangerous goods in China

1. Weak supervision of administrative departments, joint supervision has not formed a synergy

First, the business qualifications of the audit and supervision is not effective, business qualifications is the operation of dangerous goods transport enterprises access card, good business qualifications to keep the first gate of road transport of dangerous goods safety production. However, through the analysis of many accidents can be seen, a large part of the transport enterprises in the accident is not qualified to transport dangerous goods, and even the driver is not qualified to transport dangerous goods, making the consequences of the accident expanded and serious. The second joint supervision does not form a synergy, dangerous goods characteristics determine its transport management has a wide range of aspects, in the actual management of dangerous goods transport will involve postal, health, industry and commerce, environmental protection, quality inspection, public security and other administrative departments and industries. In the road transport of dangerous goods, the public security department needs to review and approve the transport route, and need to clarify the transport speed, time and safety measures; quality inspection departments need to carefully check the transport of dangerous goods boxes, tanks; transport authorities need to check whether the vehicle can meet the relevant technical performance. In this multi-departmental management mode, to a certain extent, to enhance the supervision and management of dangerous goods transport, but at this stage there is no effective interface between departments, each

department has its own information management system, but has not yet formed a unified standard integrated information management platform, resulting in the management of various departments can not share information, functions can not complement each other, thus making it difficult to effectively improve the efficiency of administrative management. Third, the transportation organization is not strict in gate-keeping. According to the operation regulations, a container truck transporting dangerous chemicals should undergo strict inspection of the condition of the vehicle before transportation, and professional training for drivers of highly toxic chemicals transportation (special products fixed vehicle, fixed driver). Route selection, the choice of time, if necessary, every 4 hours of driving the driver to get off to check the condition of the vehicle, after unloading inspection, professional cleaning company to clean the empty car treatment and more than 10 procedures. In some of these procedures, the procedures related to the type of dangerous goods must also be handled, carrying the relevant documents and protective equipment. However, the current actual situation is that drivers often choose the route at will, registration procedures are not sound, there is a dangerous goods transport who to regulate, how to regulate, how to do each transport under supervision.

2. The implementation of the main responsibility of enterprises is not in place

First, the level of enterprise safety management needs to be further improved, the enterprise safety investment is insufficient, risk resistance is not strong, the enterprise by traditional management to modern governance in the process of transformation, or traditional management, management means a single, the lack of effective management of information systems. Second, some enterprises are weak in safety management capabilities, enterprises focus on economic benefits, disregard for safety management, there is a fluke mentality. Safety risk classification and control and the implementation of hidden danger investigation and treatment is not in place, emergency plans and emergency drills in form. Third, dynamic monitoring is not in place. Some dangerous goods vehicles still exist speeding, fatigue driving and driving in the process of answering the phone and other illegal violations, enterprises can not effectively use monitoring data to manage the problems of driving, not timely remind, real-time disposal of violations found. From the accident situation, the number of fatalities in the decade more than 30 people in a particularly major accident, Shaanxi "8-26" accident involved in the company's vehicle "hanging regardless", the main responsibility for enterprise safety is not implemented; Shanxi "3 1" accident involved in the two tank cars tank not installed in accordance with the standard provisions of the emergency shut-off valve, two tank testing agencies for the unqualified tank cars issued a commissioned inspection report "allowed to use"; Hunan "7-19" accident The enterprises involved did not check the qualifications of the vehicles carrying dangerous goods and the drivers and escorts, and repeatedly filled ethanol for the illegally modified light trucks without road transport permits for dangerous goods. These accidents reflect, on the one hand, the main responsibility of the enterprises and units involved

in the production of safety is not implemented, there are violations of the law; on the other hand, reveals that there are still some system loopholes at the level of regulations on the road transport of dangerous goods, there are gaps in the supervision.

3. The quality of practitioners is not high and the degree of specialization is not enough

Practitioners in the road transport of dangerous goods in the main problems include violations of labor discipline, illegal operation and illegal operation, the main reason is the lack of professionalism, not clear their own responsibilities, did not put the safety of dangerous goods transport in the first place. This also reveals that the training of the employees is not in place, the pre-service training time is too short, the training effect is not good, resulting in a serious lack of professionalism of dangerous goods employees, do not understand the safety knowledge of dangerous goods road transport, do not operate in accordance with the relevant procedures, while not having the ability to deal with accidents in a timely manner. From the age background of the practitioners, the drivers generally have a low level of education, age, some drivers do not know the physical and chemical characteristics of dangerous goods, safe operation of solid thinking, the ability to deal with unexpected accidents is insufficient. Second, the road transport of dangerous goods industry is a professional, technical requirements of the industry, the industry's safety management of law enforcement officers should have a wealth of specialized knowledge and skills. Currently, safety management personnel to participate in training focused on the interpretation of laws and regulations and related policies, as well as their application in the daily business handling, administrative law enforcement work, but less training from a professional perspective related to safety supervision, resulting in the vast majority of front-line law enforcement officers do not have the ability and level, and this shortcoming will bring many obstacles and hidden dangers to the work of safety supervision.

The current domestic road transport safety supervision system for dangerous goods is not perfect, industry standards are not in line with international standards, the relevant legal boundaries are vague, the knowledge base of dangerous goods transport management is relatively weak, the knowledge base of professionals is seriously inadequate and limited management level of enterprises engaged in transport has led to the frequent occurrence of dangerous goods transport accidents. Most of the production enterprises pay attention to production technology, and the development of management technology of transport risks is relatively lagging behind; some advanced technologies and methods, for example, real-time monitoring of vehicles, route optimization, accident prediction and alarm, have not been applied to practice. Therefore, it is especially important to compare the methods of management of dangerous goods road transport at home and abroad, to find worthy experiences, with a view to guiding dangerous goods road transport through effective safety management knowledge and improving the level of enterprise safety management.

IV. COMPARISON OF DOMESTIC AND FOREIGN MANAGEMENT OF ROAD TRANSPORT OF DANGEROUS GOODS

The comparative study of the management of dangerous goods road transport at home and abroad aims to explore the similarities and differences between different countries and regions in terms of regulatory systems, industry practices, safety achievements, etc., to find experiences worth learning from. Europe, the United States, Japan and other developed countries for the management of dangerous goods road transport began earlier, the development has accumulated a wealth of experience and achieved good results, so the focus of this paper is to study the management of developed countries, the study focuses on specific aspects of the transport management system, such as the legal framework, licensing and certification, training and education, vehicle and equipment standards, emergency response and risk management.

A. Regulations and Standards

The transportation of hazardous materials in the United States is governed by complex federal and state regulations. While the federal government has primary responsibility for regulating the transportation of hazardous materials, state governments also play an important role in enforcing these regulations. The primary federal agency responsible for regulating the transportation of dangerous goods in the United States is the Department of Transportation (DOT), whose regulations are contained in Title 49 of the Code of Federal Regulations (CFR), which sets forth detailed requirements for the packaging, labeling, and transportation of dangerous goods. In addition to federal regulations, each state has its own hazardous materials transportation regulations, which may be more stringent than federal regulations and may impose additional requirements on shippers, carriers, and other parties involved in the transportation of hazardous materials. For example, in California, the California Highway Patrol (CHP) is responsible for enforcing the state's hazardous materials transportation regulations, which include requirements for permits, placards and route restrictions for certain hazardous materials. Enforcement of regulations governing the transportation of hazardous materials is the responsibility of several federal and state agencies, with the U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHMSA) responsible for enforcing federal regulations and state agencies responsible for enforcing their own state regulations.

The EU has established a comprehensive legal framework for the transport of dangerous goods by road, designed to ensure the safety and security of people and the environment. The primary legislation governing the transport of dangerous goods by road in the EU is the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR), which is updated and revised every two years. The ADR sets out detailed requirements for the classification, packaging, labeling and documentation of dangerous goods for transport by road, and it also establishes specific requirements for the construction, equipment and operation of vehicles for the transport of dangerous goods, as

well as for the training and certification of drivers and other personnel involved rules. In addition to the ADR, several other EU regulations apply to the transport of dangerous goods by road, including the European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN), the Regulations concerning the Carriage of Dangerous Goods by Rail (RID) and the International Maritime Dangerous Goods Code (IMDG Code). Carriers transporting dangerous goods must comply with these regulations and ensure that their personnel are adequately trained and equipped to handle these goods safely, and the national authorities of each EU member state are responsible for enforcing these regulations and conducting inspections to ensure compliance. Failure to comply with these regulations can result in serious penalties, including fines, suspension or revocation of licenses, and even criminal charges in serious cases where public safety is at risk.

In Japan, the main law governing the road transportation of dangerous goods is the Transportation of Dangerous Goods Law (Transportation of Dangerous Goods Law, Kikenbutsu Yusō Hō). This law outlines the requirements and obligations for transporting dangerous goods by road in Japan, including classification, packaging, marking, labeling, and documentation of dangerous goods. In addition to the Transportation of Dangerous Goods Law, there are a number of other laws and regulations governing the road transportation of dangerous goods in Japan, including the Road Transportation Law (Dōro Unsō Hō) and the Labor Safety and Health Law (Rōdō Anzen Eisei Hō). These laws and regulations are designed to ensure the safe transportation of dangerous goods on Japanese roads and to protect the health and safety of the public and the environment.

The existing regulations on the management of dangerous goods road transport in China mainly include the Regulations of the People's Republic of China on Road Transport, the Regulations on the Safe Management of Dangerous Chemicals, the Marking of Vehicles for the Transport of Dangerous Goods by Road, the Rules for the Road Transport of Dangerous Goods (JT/T 617-2018), the Administrative Regulations on the Transport of Dangerous Goods by Road, the Road Transport of Dangerous Goods Safety Management Measures", etc. The rules fully absorb the "United Nations Recommendations on the Transport of Dangerous Goods Model Regulations" (TDG), "European Convention on the International Carriage of Dangerous Goods by Road" (ADR) and other international rules on the basis of the actual situation in China, the classification of dangerous goods, transport packaging, consignment, loading and unloading, road transport and other aspects of the operational requirements of the systematic provisions.

In contrast, first of all, the developed countries have full participation in the legislation, not only the views, will and wishes of managers, but also widely consulted representatives of all sectors of the industry, operability and practicality. Second, the developed countries road transport management of dangerous goods laws and regulations, a number of years to supplement, revise and improve, with the times; for example, the European ADR every two years to update and revise once, compared to the lack of a unified

domestic regulations of dangerous goods transport authorities, the lack of regular assessment of laws and regulations, the failure to maintain and update laws and regulations in a timely manner. In addition, developed countries often set up a special road transport of dangerous goods enforcement and inspection agencies, built a professional law enforcement and inspection team, equipped with advanced equipment, developed countries, professional, high-quality law enforcement and inspection team and detailed law enforcement inspection process, effectively improve the level of road transport of dangerous goods law enforcement. In comparison, China's transport management of dangerous goods for the use of multi-departmental joint management, has not yet formed a joint supervision, and the United States of the unified form of management and implementation of the form of the actual situation around the world, compared to the effectiveness of management caused by the negative impact.

B. Training and Certification

1. United States

The U.S. Department of Transportation requires that anyone who provides transportation or transports hazardous materials in commerce must be properly trained and certified. This includes drivers, loaders, packers, and shippers. PHMSA establishes minimum training requirements for individuals involved in the transportation of hazardous materials, and the training must cover the following topics:

- ① General awareness/familiarity training
- ② Function-specific training
- ③ Safety training
- ④ Safety Awareness Training
- ⑤ In-depth safety training

Training can be conducted by the employer or a third-party training provider, and it is the employer's responsibility to ensure that their employees are properly trained and certified, which is valid for three years from the date of issuance. In addition, the Department of Transportation requires that all persons involved in the transportation of hazardous materials have a valid Commercial Driver's License (CDL) with a Hazardous Materials Endorsement (HME), and to obtain an HME, they must pass a written test and background check.

2. European Union

The EU has a strict set of rules and requirements for the certification and training of professionals involved in the road transportation of hazardous materials, which is to ensure that the transportation of hazardous materials is safe and in compliance with the relevant legislation. Training and certification requirements vary depending on the role of the individuals involved in the transport of dangerous goods. The main categories of personnel involved in the transport of dangerous goods by road include the following: ① Drivers: Drivers of vehicles transporting dangerous goods must hold a valid ADR driver training certificate. This certificate is issued after the driver has completed a training course and passed a test on the safe transport of dangerous goods by road. The training course includes topics such as classification and identification of dangerous goods, packaging and labeling requirements, loading and unloading procedures, and

emergency response. ② Transportation Manager: Transportation managers responsible for the transportation of dangerous goods must hold a valid ADR Transportation Management Training Certificate. This certificate is issued after an individual has completed a training course and passed a test on the safe transport of dangerous goods by road. The training course includes topics such as risk management, legal requirements, emergency response, and security. ③ Security Advisors: Security Advisors are responsible for advising on the safe transport of dangerous goods. They must hold a valid ADR Safety Advisor Training Certificate. The certificate is issued after the individual has completed a training course and passed a test on the safe transport of dangerous goods by road, which includes topics such as risk management, legal requirements, emergency response and safety. ADR requires 20 hours of basic training for all drivers, with an additional 12 hours for driving tank-type vehicles; a further 8 hours for transporting explosive substances (Class I dangerous goods); and a further 8 hours for transporting radioactive dangerous goods. Attend 8 hours of training and pass the examination before obtaining the corresponding operating license, valid for 5 years. In addition to the above, all persons involved in the transport of dangerous goods by road must receive regular refresher training to ensure that they are up to date with the latest regulations and procedures. The frequency of refresher training depends on the individual's role and the type of dangerous goods being transported.

3. Japan

In Japan, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) is responsible for regulating the transport of dangerous goods by road, and MLIT has established guidelines and regulations for the training and certification of individuals involved in the transport of dangerous goods by road. Under these regulations, all individuals involved in the transportation of dangerous goods by road must be properly trained and certified to handle or transport dangerous goods, and the training program should include topics such as classification of dangerous goods, packaging requirements, labeling, and handling procedures. The Ministry of Land, Infrastructure, Transport and Tourism has authorized several organizations to provide training and certification services for individuals involved in the transportation of dangerous goods, referred to as "designated organizations," including organizations such as the Japan Industrial Safety and Health Association (JISHA) and the Japan Trucking Association (JTA). Individuals seeking certification must complete a training course offered by one of these designated organizations and pass an examination to demonstrate their understanding of the regulations and requirements for transporting dangerous goods; the higher the level, the more stringent the requirements for drivers, with the highest level, Class A, requiring proficient driving skills and certification, in addition to extensive experience in handling hazardous chemicals. It should be noted that the regulations and requirements for transporting dangerous goods by road may vary depending on the type of goods to be transported and the specific route, so it is important to consult the appropriate regulations and guidelines before transporting

any dangerous goods by road in Japan.

Our regulations stipulate that practitioners of road transport of dangerous goods must undergo a special examination in order to obtain the appropriate qualifications. But in recent years, a number of dangerous goods road transport accidents, revealing the practitioners do not match the qualifications, improper operation, fatigue driving, speeding, weak safety awareness and many other problems. In contrast, the developed countries are more detailed and implementation of the qualification and training of practitioners. First, the implementation of driver grading management, regular review and recertification system. Second, clear training time, the implementation of graded superimposed training, and third, training and assessment of practical skills, the British safety management operation test including trailer connection separation, tank emergency shut-off device operation; the U.S. practical operation by setting up a simulation of tanker operation experience vehicles, so that drivers intuitively feel the danger of tanker overturn, and record the driver's emergency response, to guide the driver to correct incorrect Driving behavior; ADR practical training should include at least three items of emergency, fire fighting and accident management, other items can be designed and implemented by the certification body combined with theoretical course training needs. Fourth, a clear division of responsibilities and duties.

C. Emergency relief management

1. United States

A key aspect of HMR is the Hazardous Materials Emergency Preparedness (HMEP) program, which provides training and funding to state and local governments to improve their ability to respond to hazardous materials transportation incidents. The HMEP program is designed to ensure that emergency responders have the knowledge, skills, and equipment necessary to safely and effectively manage hazardous materials incidents. the HMEP program also includes the Hazardous Materials Emergency Response Plan (HERP), which outlines the procedures to be followed in the event of an emergency, including notification procedures, evacuation plans, and emergency response procedures. In addition to the HMEP plan, the U.S. Department of Transportation requires all carriers of hazardous materials to develop a Hazardous Materials Safety Plan (HMSP), which outlines the carrier's policies and procedures for ensuring the safe transportation of hazardous materials, including training requirements for drivers and other employees, inspection and maintenance requirements for equipment, and emergency response procedures.

2. European Union

The EU's emergency response plan for the road transport of dangerous goods is based on the following principles. ① Prevention: The EU promotes the safe transport of dangerous goods by implementing regulations and standards for the design, construction and operation of vehicles and equipment for the transport of dangerous goods. ② Preparedness: The EU requires transport companies to develop and maintain emergency plans, identify potential hazards, establish procedures for responding to emergencies, and provide

training for personnel. ③ Response: The EU has established a system for responding to emergencies involving dangerous goods, including coordination of emergency services, transport companies and other stakeholders, which includes procedures for containment and control of spills, evacuation of affected areas and provision of medical assistance. ④ Recovery: The EU facilitates the recovery of affected areas and the resumption of normal activities following an emergency involving dangerous goods. This includes providing assistance to affected individuals and businesses and conducting investigations to determine the cause of the incident and to determine how to prevent similar incidents in the future.

3. Japan

Japan has implemented an emergency plan for the road transport of dangerous goods, which outlines actions to be taken in the event of an incident involving such goods. The plan is called the Dangerous Goods Emergency Action Code (DGEAC) and is based on the UN Recommendations on the Transport of Dangerous Goods, which provide guidelines for the safe transport of hazardous materials. It outlines the responsibilities of all parties, including vehicle drivers, emergency responders and authorities responsible for managing the incident. It also provides guidance for emergency responders on the use of appropriate protective clothing and equipment, and outlines decontamination procedures for the affected area. In the event of an incident involving the transport of hazardous materials, the first priority is to ensure the safety of the public and the environment, and it is the responsibility of the vehicle driver to immediately report the incident to the appropriate authorities and to take all necessary measures to minimize the risk of injury. The authorities responsible for managing the incident will coordinate the response and ensure that appropriate resources, including emergency personnel and equipment, are mobilized, and they will also ensure that the public is kept informed and that any necessary evacuations are carried out.

In comparison, the developed countries' hazardous chemical transportation accident prevention and emergency response forces mainly include enterprises, regional mutual aid organizations, government departments and other levels. In developed countries, in terms of hazardous chemical transportation accident prevention and emergency rescue, not only do they have established specialized accident rescue organizations, but also are equipped with professional accident rescue personnel. 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.

D. Vehicle Safety Management

1. United States

Mandatory installation of anti-rollover, anti-collision active safety equipment. U.S. Department of Transportation research that by reducing the center of gravity of the tanker, increase the tanker wheelbase, the use of air spring suspension, etc., can significantly improve the tanker's

rollover stability. Actively promote the application of various types of anti-rollover active and passive safety devices, mandatory installation of heavy vehicles tire pressure alarm system, lane departure alarm device, electronic stability system, and vigorously promote the collision warning system, electric control system and automatic emergency braking system installation and application.

2. Europe

First of all, the vehicle tank management, in the body of the vehicle clearly marked clearly the characteristics of hazardous chemicals, the appearance of hazardous chemical vehicles should not only have a highly conspicuous painting, in order to let other road users clearly and accurately find high-risk sources, take the initiative to avoid; there should also be clear and clear identification of the characteristics of hazardous chemicals, indicating the nature of hazardous materials: is flammable and explosive or toxic, is volatile gas or soluble in water, such as toxic liquids, in order to let other Road users to clearly and accurately find high risk sources, take the initiative to avoid. The second is the vehicle time limit management, in addition to the weekend or holidays in the tunnel does not allow dangerous goods vehicles, there is no night ban restrictions, 24 hours without written restrictions. There are also some specific times for the transport of hazardous materials, and these require risk analysis. For example, Hamburg, Germany, because of the relatively high traffic volume during the day, especially via the tunnel road traffic, it was decided to limit the transport of dangerous goods to the night, and during the day, through the bridges around the city to bypass the city.

According to the "People's Republic of Road Traffic Safety Law" Article 39, "Road Transportation of Dangerous Goods Safety Management Measures" Article 49, Article 50 and other provisions, the province's highways from 0:00 to 6:00 daily ban on the transport of dangerous goods vehicles. The above-mentioned time period, the province's highways along the toll stations prohibit the transport of dangerous goods vehicles; has been driving on the highway transport of dangerous goods vehicles, should be driven away from the nearest. In addition to national regulations, provinces also according to their own situation, based on 0-6 hours further restrictions, for example, Shandong Province, the daily 19 hours to 6 a.m. the next day to prohibit the transport of dangerous goods vehicles on the highway. Compared with foreign countries to encourage night driving, China prohibits night driving mainly for the following reasons: ① Some dangerous goods transport vehicles are driven by economic interests and illegal transport, in order to avoid inspection and punishment, most drivers tend to drive continuously at night and in the early morning hours, resulting in fatigue driving, operating movements become sluggish, resulting in traffic accidents. ② highway night lack of lighting facilities, poor visibility, dangerous goods transport vehicles drivers can not observe the surrounding driving environment in a timely manner, so as to judge the distance, identify the direction, avoiding obstacles when the misjudgment, prone to road traffic accidents. ③ Compared with the openness of national and provincial highways, once a traffic accident involving dangerous goods occurs on the highway, it is impossible to

quickly evacuate people and vehicles, and rescue forces, especially at night, are unable to go to the scene in time to deal with the accident, resulting in the expansion of the accident hazard. From the restricted hours can be seen, although the night passage of vehicles less, less interference with personnel, but the provisions should be combined with the actual situation of each country, rather than just copy the management tools of other countries, comprehensive consideration of the pros and cons, to make the right choice.

V. SUMMARY OF EXPERIENCE

A. *Legal and regulatory aspects*

1. Strengthen the improvement and updating of laws and regulations: Establish a dangerous goods transportation authority responsible for coordinating various departments to formulate relevant regulations and policies, while regularly evaluating the existing regulations and timely maintaining and updating them. For example, we can refer to the European ADR model and update the regulations every two years to ensure the timeliness and operability of the regulations.

2. Establish a professional law enforcement and inspection agency: Establish a special road hazardous chemical transportation law enforcement and inspection agency, equipped with advanced equipment, establish a highly qualified and professional law enforcement and inspection team, and develop a detailed law enforcement and inspection process to improve the level of law enforcement of road hazardous chemical transportation to ensure safety.

3. Implement joint supervision: strengthen the collaboration and linkage between various departments, establish an information sharing mechanism of dangerous goods transportation, strengthen the supervision and enforcement of dangerous goods transportation enterprises, so as to achieve joint multi-departmental supervision to ensure the safety of dangerous goods transportation.

4. Strengthen the consultation of industry representatives: Establish a mechanism for extensive industry representatives to participate in the formulation of regulations and policies, so as to fully consider the actual situation and needs of each industry and improve the operability and practicability of regulations.

B. *Training and Certification*

1. Strengthen the implementation of regulations: increase the supervision of the examination, qualification certification and review of road transport of dangerous goods practitioners to ensure that each practitioner meets the qualification requirements. For personnel who do not meet the qualification requirements, should be timely rectification or elimination

2. Establish a training system for practitioners: develop a detailed training program for practitioners of road transport of dangerous goods, clear training objectives, content, time, manner, etc.. Should be based on the different levels and responsibilities of practitioners, graded overlay training to ensure the quality and effectiveness of training. Training content should include theoretical knowledge and practical skills, and set the appropriate assessment links.

3. Strengthen the responsibility of enterprises: strengthen the supervision of enterprises to ensure that enterprises pay attention to the training and safety awareness of employees. For enterprises that violate the provisions of the law, serious penalties should be imposed, and publicly exposed. At the same time, encourage enterprises to conduct their own training and strengthen the construction of internal training mechanisms.

4. Strengthen international exchanges and cooperation: Drawing on the experience and practices of developed countries, international exchanges and cooperation to learn from their advanced training systems and management experience to promote the quality of China's dangerous goods road transport practitioners. Exchange and cooperation can be carried out through the organization of seminars, technical training, etc.

C. *Emergency rescue plan*

1. Establish a sound emergency rescue system: actively draw on the construction of emergency response system for road transportation of dangerous chemicals in developed countries, establish a system of emergency response system for road transportation of dangerous chemicals, establish and improve the relevant organizational structure, enrich the professional team for emergency disposal, equip the emergency rescue guarantee capacity, establish a pool of experts, emergency rescue equipment, develop computer-aided decision-making system for emergency rescue, etc.

2. Establish an accident simulation laboratory or training base: organize annual training for relevant personnel to receive new knowledge, skills and methods in theory and practice to continuously improve rescue capabilities.

VI. CONCLUSIONS

In summary, strengthening the transport supervision of dangerous chemicals is a long-term work, developed countries have accumulated rich experience and achieved good results for the transport management of dangerous chemicals, worthy of our study and reference. We need to establish and improve the legal and regulatory system to further refine and strengthen the management of China's road transportation of dangerous chemicals; establish a professional law enforcement team, strict law enforcement, and further improve the level of law enforcement; establish a sound emergency rescue system to improve the ability to deal with emergency accidents; further improve the training system for practitioners to improve the modern management of China's transportation of dangerous chemicals.

ACKNOWLEDGMENT

This research was financially supported by Hunan Provincial Transportation Science and Technology Project (Project No. 201943), Research on Safety Risk Assessment and Prevention and Control System for Road Transportation of Dangerous Goods Cargo - Hunan as an Example; The project of the National Social Science Fund of China (No. 18BJY168): The Logistics Development of Gwadar Port

Based on B&R and CPEC; Guangdong Provincial Government Procurement Project (Project Procurement No: GPCGD182171FG095F) Study on the Development Planning of Freight Logistics Corridors and Hub Nodes in Guangdong-Hong Kong-Macao Greater Bay Area under the Strategy of Strong Transportation

REFERENCES

[1] Li Zhaohua. Research on safety supervision of dangerous goods road transportation based on 4R crisis management model [D]. Three Gorges University, 2022.

[2] 2019.Ministry of Transport of the People's Republic of China.Measures for the administration of road transportation safety of dangerous goods:Order No.29 (2019) of the Ministry of Transport of the People's Republic of China[S].Beijing:China Legal Publishing House,2019.

[3] Zhang Guowu. Road transport safety and management--The 40th meeting of the "7+1 Forum on Transport"[J]. Transportation System Engineering and Information,2015,15(05):1-9.DOI:10.16097/j.cnki.1009-6744.2015.05.001.

[4] Wu Jun. Research on the participation of third-party monitoring platform in the safety supervision of dangerous goods road transportation[D]. Nanchang University,2022.

[5] Wei Shanshan. Research on accident mechanism of dangerous goods road transportation based on data mining[D]. Chang'an University,2021.

[6] Zou Min, Ouyang Juan. Introduction to the safety management of road transport of dangerous goods [J]. Science and Technology Information (Academic Research),2008,No.258(10):189-190.

[7] Zhang Xisheng. Analysis of safety management measures in the transportation of dangerous goods by road [J]. Transport Manager World,2022,No.667(21):120-122.

[8] Lv Fangzhou. Introduction to the current situation of safety management and countermeasures of dangerous goods transportation enterprises[J]. China Safety Production,2020,15(09):44-45.

[9] Brief analysis of the causes of accidents of dangerous goods road transport vehicles and the current situation of industry management[J]. Automobile and safety,2020,No.271(07):19-20.

[10] Wang Haibing. Discussion on the safety management of dangerous goods road transport under the new situation[J]. Transportation energy saving and environmental protection,2022,18(04):111-114.

[11] Zhang Qiong. Analysis of the characteristics of typical heavy road traffic accidents and preventive measures [J]. Labor Protection, 2020, 10:73-75.

[12] Wang K. The current situation of the development of road transport of dangerous goods in Liaoning Province and suggestions for countermeasures [J]. Journal of Liaoning Higher Institute of Transportation, 2021, 23(05):25-29.

[13] Office of the State Council Safety Committee on further deep learning from the lessons of the "8-26" special major road traffic accident in Yan'an, Shaanxi Province, to do a good job in the prevention of serious accidents [J]. Announcement of the State Administration of Work Safety, National Coal Mine Safety Supervision Bureau, 2013, No.140(09):18-20.

[14] Chen Jing. Why methanol transportation became a "high explosive bomb"-Analysis of the "3-1" special major road traffic hazardous chemical explosion accident in Yan Hou Tunnel, Jincheng section of Jinji Expressway, Shanxi[J]. Hunan Safety and Disaster Prevention,2014(07):44-45.

[15] The traffic tragedy caused by illegal purchase, sale and transportation of black powder--analysis of the "3.19" large explosion accident in Miluo section of Beijing-Hong Kong-Macao Expressway in Hunan[J]. Jilin Labor Protection, 2020(10):38-40.

[16] Peng Jianhua. Safety management of the whole chain and elements of dangerous goods road transport[J]. Labor protection,2020,No.536(02):80-82.

[17] Sun Jun. Safety management of road transport of dangerous goods[J]. Times Automotive,2022,No.383(11):181-183.

[18] Song Yumei, Xiong Qian. The construction and consideration of safety management system of hazardous chemical logistics under the background of Internet+[J]. China Storage and Transportation,2022,No.261(06):198-199.DOI:10.16301/j.cnki.cn12-1204/f.2022.06.048.

[19] Feng R. Research on the safety supervision of road dangerous goods transportation in Xinjiang [D]. Xinjiang University, 2021.

[20] XING Z Y. Research on the safety supervision system of road transportation of dangerous goods [D].Chongqing:Chongqing Jiaotong University,2018.

[21] LI Danyao,SHANG Meng,ZHOU Juanjuan. Research on risk assessment of dangerous goods road transportation based on AHP[J]. Small and medium-sized enterprise management and technology(Zhongjian Journal),2020,No.632(12):168-170.

[22] Dumlupınar M T, Öztürkoglu Y. Analyzing the risks of transportation of dangerous goods based on the ADR [J]. Trakya Üniversitesi Sosyal Bilimler Dergisi, 2019.

[23] Nowacki G, Krysiuk C, Kopczewski R. Dangerous goods transport problems in the European Union and Poland[J]. TransNav: International Journal on Marine Navigation and Safety of Sea Transportation, 2016, 10(1): 143-150.

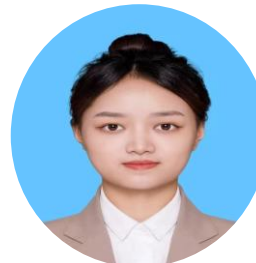
[24] Uchino A. Safety of packages on transport of dangerous goods. kikenbutsu yuso to yoki no anzensei[J]. Anzen Kogaku (Journal of Japan Society for Safety Engineering); (Japan), 1991, 30(5).

[25] Kuncyć R, Laberge-Nadeau C, Crainic T G, et al. Organisation of truck-driver training for the transportation of dangerous goods in Europe and North America[J]. Accident Analysis & Prevention, 2003, 35(2): 191-200.DOI:191-200.10.1016/S0001-4575(01)00103-8

[26] Liu WC, Zhou ZQ, Liu XZ, et al. Comparison and reference of safety management for drivers of dangerous goods transport at home and abroad[J]. China Road Transport, 2014(12):3.



Aimin Deng Ph.D., Professor of School of Economics and Trade, Hunan University, Ph.D. Supervisor, Director of the Institute of Transportation and Logistics, Hunan University; the first batch of scholars of the Hundred Talents Project of Hunan Province, Director of the Expert Committee / Vice President of Hunan Modern Logistics Society , Expert in the evaluation of master's and doctoral dissertations in the degree center of the Ministry of Education, and Expert in reviewing the National Social Science Fund.



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