Comparative Study on Hazardous Chemicals Management Systems at Home and Abroad

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Abstract: With the development of science and technology and the improvement of production processes, chemicals have become indispensable means of production and consumer goods in the process of modern social and economic development, playing a very important part in economic and social activities and people's production and life. However, with the wide application of chemicals, especially hazardous chemicals, the incidence of safety accidents caused by poor supervision in the process of production, operation, storage, and use is increasing. The safety of hazardous chemicals affects the safety of society and people's lives and property, and strengthening the safety supervision of hazardous chemicals is the key. Therefore, this article starts from the research background, research status at home and abroad, and combines the current situation of hazardous chemicals management in the author's unit., Through research on the safety supervision experience of other domestic units, as well as the European Union, the United States, South Korea, Japan, Germany, and other hazardous chemicals, feasible means for better supervision of hazardous chemicals have been summarized.

1. Introduction

Chemical industry is an important part in China's national economy, and is the basic and pillar industry of China's industrial development. HC are an indispensable component of China's chemical industry development. With the development of chemical industry, China has become the world's largest chemical country since 2010. The production process of the chemical industry is complex, and the reaction conditions are harsh. The types of HC involved, especially those prone to explosion the quantity and usage are increasing year by year. Due to its characteristics such as toxicity, corrosion, explosion, combustion, and combustion-supporting, once an accident occurs due to regulatory loopholes and improper operation, it is highly destructive and has a significant social impact, which is extremely likely to cause immeasurable damage to public safety and personal safety, and seriously impact the people's sense of safety and well-being[1]. Therefore, the safety of HC is the top priority of safety production work.

In the past decade, there have been more than 5000 hazardous chemical accidents in China, causing more than 5000 people to be injured, including more than 2000 deaths. According to the data of the NEMD, in the first half of 2022 alone, there were 15 major accidents involving more than 10 casualties, and there were also many major accidents, causing serious losses to the safety of people's lives and property.

Although China is currently paying more attention to the safety of HC and has increasingly comprehensive supervision over the entire chain of production, sales, transportation, use, and storage of HC, it has successively formulated the "Regulations on the Safety Management of HC" and the "Regulations on Public Security and Prevention of Storage Places of Precursor HC" etc. The overall trend of hazardous chemical safety accidents is downward, but there are still certain difficulties in the supervision of HC.

Although China has initially established a HC management system, due to the fact that supervision involves multiple aspects, multiple departments, multiple industries, and multiple links.

Through research on the regulatory theory of HC, based on the current status of HC management, through research on relevant domestic HC management units, and in combination with the relevant experience of foreign HC management, this paper proposes HC management regulations that meet the actual situation of our unit, and puts forward suggestions on the safety management of HC in China.

2. Research on the Current Situation of HC Management at Home and Abroad

2.1 Domestic research status

Currently, China's research on HC, especially explosive HC, is mainly based on the perspective of safety

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management or management systems formulated by enterprises based on their own safety management needs. However, from the perspective of the government, there is less management of HC, mainly focusing on institutional mechanisms, regulatory agencies' functional responsibilities, administrative law enforcement, and other aspects [2].

Although the domestic HC industry has developed relatively late, it has developed rapidly, and there are many studies on the safety supervision of HC in China, mainly focusing on improving safety production laws and regulations, improving the regulatory capacity of the government, strengthening the construction of government regulatory teams, and implementing the main responsibility for safety of enterprises. However, in general, the existing research on the safety regulation of HC at home and abroad is mostly focused on unilateral enterprise research or unilateral government regulatory research, lacking the overall safety regulatory research and innovative safety regulatory methods of the government and enterprises. To do a good job of safety regulation of HC. it is precisely necessary for the government and enterprises to cooperate with each other and innovative regulatory methods that are in line with the development of the times, To ensure that there are no vacuum and loopholes in the safety supervision of HC.

Some scholars believe that improving the system, the management powers and responsibilities of regulatory agencies and the law enforcement capabilities of administrative law enforcement agencies can improve the efficiency of HC regulation. For example, speeding up the pace of government regulatory reform, solving the problem of unclear functional definitions, and updating legal standards and norms to promote comprehensive safety supervision and management, using the rule of law to clarify management procedures. Discusses the influencing factors of safety supervision from the perspective of institutional policies, and believes that China should currently establish and improve a long-term mechanism for safety supervision to improve safety supervision capacity; Other scholars have pointed out that factors such as "safety capital investment, enterprise industry scale, government regulatory costs, and the incentive mechanism and punishment range of regulatory agencies" are the most important factors affecting government sector regulation, emphasizing that social regulation, enterprise's own regulation, and other issues may also affect regulatory efficiency. Some scholars put forward that in today's Internet era, administrative supervision, by combining with "Internet plus" and big data applications, can realize the innovation of public services through the network, and enhance the ability of public services is the general trend. The "Internet plus" model with big data as the driving force for government supervision is an innovation in practice, as well as an innovation in ideas and concepts. Foreign scholars have also conducted research on the factors affecting government regulation. For example, by establishing an analytical model to study the relationship between government regulation, corruption, and institutions, it is pointed out that "the root cause of government regulatory problems is corruption.". Some studies have suggested that when oversight mechanisms such as accountability are effectively implemented, government regulation can be more effectively constrained by oversight mechanisms, and oversight is also a key factor affecting government regulation. Other scholars have studied the relationship between government regulation and corruption in Nordic countries and believe that excessive benefits and abuse of power in the regulatory process can lead to more corruption, which can have an impact on the planning and results of government regulation[3].

In the early stages of the construction of the petrochemical industry, major domestic chemical enterprises have successively established occupational disease prevention and treatment centers to carry out rescue and rescue work for chemical accidents. The laws and regulations governing the safety supervision of HC in China began in the 1980s. China has begun to study and formulate laws and regulations related to the safety supervision of HC that meet China's national conditions in the new situation of safe production. In 1979, the National People's Congress approved and promulgated the Environmental Protection Law of the People's Republic of China (which stipulates that toxic chemicals must be strictly registered and managed. Highly toxic substances should be strictly sealed to prevent leakage during storage and transportation). In 1987, the State Council issued the "Regulations on the Safety Management of HC" (to strengthen the safety management of the production, storage, operation, transportation, and use of HC within the territory of the PRC)[4]. In 1996, the former Ministry of Chemical Industry and the National Economic and Trade Commission established the National Chemical Accident Emergency Rescue Command Center. In the same year, the former Ministry of Labor and the Ministry of Chemical Industry jointly issued the Regulations on the Safe Use of Chemicals in the Workplace. In September 2000, the State Economic and Trade Commission promulgated the "Regulations on the Registration and Administration of HC". In 2002, the implementation of the "Production Safety Law of the PRC" marked a new stage in the safe production and management of HC in China. In 2002, the "Regulations on the Safety Management of HC" and the "Production Safety Law of the PRC" were successively promulgated, marking the comprehensive strengthening of safety supervision and management of HC in China. With the in-depth promotion of comprehensive rule of law, China has now formed a series of laws and regulations for the safety supervision of HC, which are complemented by national laws, administrative regulations, and departmental rules. In 2005, the State Administration of Quality Inspection and Quarantine and the National Standardization Administration approved the issuance of two standards, namely, the "List of Dangerous Goods" and "Classification and Numbering of Dangerous Goods"[5].

In February 2020, the General Office of the Central Committee of CPC and the General Office of the State Council issued the "Opinions on Comprehensively Strengthening the Work of Safe Production of HC", which set out clear requirements for improving the level of technology and information technology in the work of

safe production of HC. It is pointed out that it is necessary to study and establish a full life cycle information monitoring system for HC, comprehensively utilize high-tech technologies such as electronic labels, big data, and artificial intelligence to conduct the entire process information management and monitoring of various links of HC, achieve traceability of the source of HC, traceability of use, and controllable status, and promote the interconnection between enterprises, regulatory departments, law enforcement departments, and emergency rescue departments[6]. Integrate information on administrative penalties for work safety into the regulatory and law enforcement information system, achieve information sharing, and replace the traditional layered filing. Accelerate the establishment of a remote monitoring system that connects emergency management departments with chemical parks and HC enterprises within their jurisdiction. The Office of the Work Safety Commission of the State Council and the Emergency Management Department issued the "Guiding Opinions on Accelerating the Construction of the Monitoring and Early Warning System for the Safety Production Risks of HC" in 2019, requiring emergency management departments at all levels to take the construction of the monitoring and early warning system for the safety production risks of HC as an important task to improve the regulatory level and efficiency, and accelerate the modernization of regulatory capacity. The system is implemented at ministerial and provincial levels For municipal level 3 applications, some key cities with HC can establish a separate monitoring and early warning system for HC after being approved by the provincial emergency management department. Currently, there are more than 40 laws, regulations, and specifications related to the safety management of HC in China. In summary, the Chinese government has initially formed a safety management system for HC in the formulation of safety management regulations for HC and the implementation of safety management policies[7].

2.2 Research status abroad

The research on the regulation of HC in foreign countries is different from that in China. Many western developed countries regard the safe production of HC as a standardized process for enterprise production, implement enterprise independent management, and fully implement market-oriented processes. Accident compensation is mainly borne by insurance. The government plays a weak regulatory role in the safe production of HC, and does not assume regulatory responsibilities, Similar functions are classified into occupational health, safety, and hygiene (OSH) management in the HC industry, which is the responsibility of specialized organizations and managed jointly with industry associations. Although government departments have the responsibility to fulfill legal provisions, due to the relatively complete legislative provisions, theoretical research on government safety supervision of HC is rarely conducted in professional fields. The research focus is mainly on the establishment and improvement of government legislative systems and relevant provisions. Notable legislative provisions closely related to the HC industry mainly include: the Occupational Safety and Health Act of the United States The Law on the Safety Management of Highly Hazardous Chemical Processing Processes, the Law on the Transport of Dangerous Goods, the Law on the Control of Toxic Substances, and the European Union's Measures on the Registration, Evaluation, and Authorization of Chemicals (REACH). In addition, some researchers have pointed out that the safety management of HC in foreign countries often exhibits comprehensive and whole-process characteristics. The EU has adopted strict management systems and norms to provide an overall system architecture for the safety management of HC; The European Commission for Standardization (CEN) breaks down the management work in Europe by formulating specific technical standards. The regulatory systems for the safety management of HC in Germany, the UK, the USA and other countries have a wide coverage and specific content. Government departments use legal norms to carry out more macro management of HC, and use technical standards to subdivide and ensure the management of HC.

Due to the safety supervision of HC in Europe and the United States, it is mainly focused on the prevention and control of production safety accidents, good management of enterprise safety production, reducing the impact of accidents, and safety culture. There is less research on government safety supervision [8].

In 1928, the Chemical Hazardous Materials and Explosives Committee of the National Fire Protection Association of the United States, in collaboration with the Chemical Society, compiled a list of commonly used chemical hazardous materials. After nearly a century of development, the United States government has had a very rich historical accumulation in research and management of hazardous chemical safety technology.

The safety supervision and management of HC in the USA is mainly accomplished through legislation, law enforcement, and legal operations. The relevant legislation on the supervision and management of safe production of HC mainly includes the Occupational Safety and Health Law, the Toxic Substances Control Law, the Hazardous Materials Transportation Law, the Federal Hazardous Substances Management Law, the Federal Environmental Pollution Control Law, the Food, Drug, and Cosmetic Law, the Federal Water Pollution Control Law, the Consumer Product Safety Law, the Toxic Substances Packaging and Hazard Prevention Law "Clean Air Law Amendment", etc. In the United States, the government agencies engaged in chemical safety supervision and management are generally the Federal Environmental Protection Agency (EPA), the Occupational Health Administration (OSHA) and the National Food and Drug Administration (FDA) etc. Each institution shall supervise and manage different links of chemical production in accordance with the authority granted by national laws and regulations.

In summary, the comparison of relevant HC management systems at home and abroad is summarized in the table below:

Table 1 Comparison of domestic and foreign HC management systems

Internal and abroad		Particular year	Name of relevant system	Key content and data
Internal		1979	Environmental Protection Law of the PRC	It is stipulated that toxic chemicals must be strictly registered and managed
		1987	Regulations on the Safety Management of HC	Strengthen the safety management of the production, storage, operation, transportation, and use of HC within the territory of the PRC
		1996	Regulations on the Safe Use of Chemicals in the Workplace	
		1999	"Notice on Carrying out the Registration of HC"	
			Regulations on the Administration of Registration of HC	
		2000	Production Safety Law of the PRC	Marking that the safe production and management of HC in China has entered a new stage
		2002	Regulations on the Safety Management of HC	
			Opinions on Comprehensively Strengthening the Work of Safe Production of HC	There are clear requirements for improving the level of technology and information technology in the safe production of HC
		2020		
Abroad	European union	1979	Directive 67/548/EEC on the Classification, Packaging and Marking of Hazardous Substances	If the amount of new chemicals used and sold in the EU market exceeds 10kg, it is necessary to carry out experimental assessment of human health and environmental risks
		2007	REACH Management Act	The Act strictly defines the scope, subject, and object of chemical management, thereby gradually establishing a complete system for the registration, evaluation, approval, and restriction of chemicals in the EU.
	USA	1928	List of Common HC	Occupational Safety and Health Act, Toxic Substances Control Act, Hazardous Materials Transportation Act, Federal Hazardous Substances Management Act, Federal Environmental Pollution Control Act, Food, Drug, and Cosmetic Act, Federal Water Pollution Control Act, Consumer Product Safety Act, Toxic Substances Packaging and Hazard Prevention Act, Clean Air Act Amendment
	Japan	1973	Chemical Substances Review and Regulation Law "Labor Safety and Health Law," "Toxic and Hazardous Substances Control Law," "Chemical Substances Control Law," "Environmental Basic Law," "Waste Law," "Explosives Control Law," "Rules for the Transport and Storage of Dangerous Goods on Ships," "Air Dangerous Goods Transport Law," "High Pressure Gas Control Law," "Consumer Product Safety Law"	
		2020	Established a Japanese chemical accident database and network system (RISCAD)	

3. Countermeasures and suggestions for the current situation of HC management

3.1 Improve the safety management mechanism for HC

Based on the current situation of safety management of HC in China, drawing on advanced management experience and practices from abroad, and referring to international conventions, formulate and improve laws, regulations, and standards for the safety management of HC, and further align with international standards such as HCclassification systems, labels, and markings, and safety technical manuals.

To carry out the whole chain management of HC, first, it is necessary to ensure that management rules and standards are clear, regulatory departments are clear, and the responsibilities between the competent departments and collaborative departments are clear, to prevent the occurrence of shifting responsibilities between various departments due to different management requirements, and to improve management efficiency; Secondly, it is necessary to standardize the regulatory responsibilities of enterprises, guide enterprises to timely fill in and submit relevant production, sales, purchase, storage, and other data. Enterprises that refuse to cooperate should bear corresponding legal responsibilities, and improve the quantity and quality of data collection; Third, strengthen the construction of a monitoring platform for HC, support supporting policies, increase investment in human, material, and financial resources, and improve data collection capabilities[9].

3.2 Build a safety supervision platform for HC to achieve data interconnection

The management of HC should rely on a mature information security platform to achieve data interconnection throughout the entire chain of production, sales, use, and storage of HC, transform the supervision and management of HC from a paper version to an electronic version, and achieve data sharing between government management departments (such as administrative approval, law enforcement supervision, and other departments) and various production, sales, use, and storage enterprises, thereby comprehensively improving the efficiency of data collection and search. It is recommended to establish unified standards to achieve data interoperability between different platforms[10].

3.3 Create a new regulatory model

By building a monitoring and early warning platform for HC third-party safety assessment institutions and safety experts should make full use of the platform to carry out safety guidance, potential hazard identification, technical services, and other work. Through the platform, they should timely grasp the safety management status of HC, deeply understand the operation situation of the enterprise, and upload guidance opinions, potential hazard identification issues, and technical service processes to the platform, Deeply participate in the production, operation and safety management of HC in enterprises.

Building an information technology platform and a big data database for HC. Currently, except for government notifications, it is difficult to find relevant information for the safety supervision of HC in China. The majority of the people can only provide suggestions through complaint hotlines and other channels, which brings difficulties to the public's safety supervision of HC. The innovative construction of an information platform can make it easier for residents to understand the operation and safety status of hazardous chemical enterprises in their areas, creating conditions for social supervision

Promote the safety of HC through media channels such as radio, television, and the Internet to create a media effect that everyone pays attention to, thereby creating a social environment for the safety supervision of HC[10].

Therefore, it is necessary to explore the creation of a new safety supervision model with the participation of the whole people, mobilize the enthusiasm of all parties, and form a new model of government supervision, enterprise responsibility, expert popularization, and social supervision.

3.4 Strengthen safety training and professional talent cultivation

With the continuous increase in government supervision and the improvement of enterprise safety awareness, HC supervision not only requires an integrated platform, but also requires the cultivation of outstanding personnel in safety management and information technology.

Strengthen safety training and education for enterprise safety practitioners, establish safety training that covers all employees, and equip professional technical teams that meet requirements; When conducting safety inspections and filing permits, it is necessary to highlight the verification of whether safety training and education have been completed, and re-examine corporate entities that fail to properly identify potential hazards, so as to promote the continuous improvement of the safety awareness and safety management ability of hazardous chemical practitioners; Strengthen the construction of a talent team for safety supervision and law enforcement, encourage supervisors to strengthen their learning and continuously improve their abilities and professional skills through induction training, further education, re education, and two-way temporary employment; Carry out targeted training to enhance the familiarity of hazardous chemical safety supervisors and enterprise safety management personnel with relevant information systems, data collection, application, and safety supervision capabilities. At the same time, it is necessary to give full play to cooperation with system platform operation and maintenance

personnel and relevant security experts, and invite professional information technology talents to provide education and training to regulatory and law enforcement personnel and enterprise management personnel, so as to improve the ability and level of conducting intelligent supervision[11].

4. Conclusion

This article has conducted a survey of the current situation of HC supervision in China, proposed the current problems faced by HC supervision in China, and put forward suggestions on the problems encountered in the safety supervision of HC.

The study found that there are still some problems and room for improvement in the current safety supervision of HC, mainly manifested in four aspects: imperfect laws and regulations, inconsistent standards across multiple departments, inadequate platform construction, and inadequate regulatory coverage. The reasons for these problems include inadequate policies and systems, incomplete closed-loop management of online platform supervision, and the absence of social governance Factors such as insufficient staff capacity.

In order to further improve the safety supervision capacity of HC, it is necessary to combine practical issues and learn from relevant experiences in conducting safety supervision of HC at home and abroad, continuously improve and optimize the safety supervision methods of HC, solve a series of current problems, and prevent safety risks of HC.

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