

Study on Safety Risk and Overall Safety Improvement of Chemical Industrial Park

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Abstract: As an important supporting base for the national chemical economy, chemical industrial parks face the current situation of lack of coordinated planning, scattered layout of chemical enterprises, and insufficient supporting infrastructure. In order to reduce safety risks in chemical industrial parks, improve safety control and emergency response capabilities, this article conducts research on the overall safety improvement of chemical industrial parks from the aspects of closed management of chemical industrial parks, hazardous chemical transportation roads, hazardous chemical parking lots, fire control, and intelligent safety supervision. It provides a solution for building an advanced domestic chemical industrial park with intelligent control and complete supporting facilities, and realizes the coordinated development of safety improvement and green development in chemical industrial parks.

Keywords: Chemical Industrial Park, Safety Risk, Emergency Management

1. Introduction

The chemical industry, as a fundamental pillar industry of the country, has played a very important role in the national and local economic development. With the implementation of the entry policy for chemical enterprises, the number of chemical parks in China has reached over 600 [1]. Chemical parks have the characteristics of concentration of chemical enterprises, serious consequences of accidents, and serious pollution [2-4]. At present, China is actively improving the infrastructure of chemical industrial parks, providing services for the entry and planning of high-quality chemical projects, achieving the agglomeration effect of chemical enterprises, and driving the development of the local economy. However, most chemical parks lack coordinated planning, scattered layout of chemical enterprises, and poor supporting infrastructure, making it difficult to achieve closed management and facing significant safety control risks [5-7]. With the issuance of documents such as the "Notice of the Ministry of Industry and Information Technology, the Ministry of Natural Resources, the Ministry of Ecology and Environment, the Ministry of Housing and Urban Rural Development, the Ministry of Transport, and the Emergency Management Department on the Issuance of the"

Management Measures for the Construction Standards and Accreditation of Chemical Industry Parks (Trial)", and the "Implementation Rules for Safety Risk Assessment of Chemical Industry Parks", providing evaluation criteria and guidance for the standardized and high-quality development of chemical industrial parks. This paper explores and studies safety risk control measures in chemical parks from the aspects of closed management, hazardous chemical transportation roads, hazardous chemical parking lots, fire control, and intelligent safety supervision, in order to improve the overall safety control ability of chemical parks [8-10].

2. Closed Management of Chemical Industrial Parks

2.1. Closed Management of Chemical Industrial Parks

Based on the source of safety risk control, the chemical park should strengthen the integrated management of pedestrian flow and logistics control, achieving unified monitoring and management of personnel and vehicles entering the chemical park. According to the requirements of the "Guidelines for Safety Risk Investigation and Governance

in Chemical Industry Parks ", the chemical industry park shall be managed in a closed manner according to "classified control, hierarchical management, and step-by-step implementation". It is recommended to adopt a combination of physical and electronic closure methods, such as ramps, video surveillance, high-altitude observation, and electronic red line alarms, to monitor every enterprise and important road intersections in the chemical park, especially in the main and secondary road areas. In principle, three levels of protection should be established: core control area, critical control area, and general control area. For example, core control area mainly aimed at safety control of enterprises involved in major hazardous sources and hazardous chemicals within the park. Critical control area should set up two production area gates within the boundary of the chemical enterprise, isolate the production area from the office and living areas, and control the entry and exit of personnel and vehicles in the production area. The general control area should set up a video monitoring system on the main roads and intersections in the chemical park, using satellite positioning, video monitoring, access control management and other means to monitor the location of hazardous chemical transportation vehicles, driver and material information in real-time, achieving unified monitoring and management.

Generally speaking, it is recommended to set up hazardous chemical transportation entrances and exits on the side of the chemical park near highways and freight roads, and pedestrian flow entrances and exits on the side near cities and towns. At the same time, the pedestrian and logistics entrances should set up license plate recognition systems, gate guards, video monitoring systems, broadcasts, and connected to the emergency command center of the chemical park.

The chemical park should set up vehicle entry and exit reservation system. When entering and exiting the chemical park, enterprises should enter basic information of employees and vehicles in advance in the reservation system. The entire process of production, storage, transportation, use, operation, waste disposal, and other aspects should be managed and monitored through vehicle entry and exit reservation system, to achieve a traceable source, destination, and controllable status of hazardous chemicals, and to achieve information interconnection between enterprises, regulatory authorities, law enforcement agencies, and emergency rescue agencies.

2.2. Planning of Hazardous Chemical Transportation Roads in the Chemical Park

The chemical park should conduct an investigation on the annual transportation volume of chemical enterprises in the chemical park in accordance with the "Design Specification for Urban Roads", analyze the road transportation capacity of the chemical park, and plan and set up hazardous chemical transportation roads based on the distribution of chemical enterprises. The hazardous chemical transportation roads should maintain a certain safe distance from the surrounding sensitive areas, and try to avoid the main trunk roads and passenger flow roads of the chemical park. At the same time, the chemical industry park has increased the investment in

road transportation engineering facilities such as traffic sign and markings, and traffic safety facilities such as isolation and anti-collision, and made clear the construction of road Transportation engineering and traffic safety supporting facilities.

In order to strictly control transportation safety risks, the chemical park should prohibit the passage of hazardous chemical vehicles in sections with high traffic and concentrated passenger flow. Advanced technologies such as the internet of things, IC cards, and video monitoring systems are used to monitor the entire process of the entry and exit of hazardous chemical transportation vehicles, and the walking trajectory. Indication signs are set up at the main entrances and exits of the chemical park, as well as on the logistics roads of the chemical park, through line indication signs and markings, or measures such as vehicle guidance should be taken to guide hazardous chemical vehicles to drive on designated roads, and measures such as dedicated roads, lanes, and speed limits for hazardous chemical transportation should be implemented.

At the same time, the chemical park should set up emergency rescue special passages and emergency evacuation passages to ensure the timely delivery of disaster relief materials, equipment, and personnel, in order to ensure the safety, speed, and timeliness of emergency rescue and personnel evacuation. Promote the use of the big data platform logistics management and control system for risk prevention and control of hazardous chemicals in hazardous chemical production enterprises, and include hazardous chemical transport vehicles in the chemical park into the logistics management and control system.

2.3. Setting Up of Hazardous Chemical Parking Lots

The chemical park should determine the size and number of hazardous chemical parking lots based on the scale of enterprise hazardous material transportation and the classification of hazardous materials. According to the requirements of the "Construction Standard for Hazardous Material Transportation Vehicle Parking Lot in Chemical Park" T/CPCIF 0050-2020, flammable and explosive areas, low toxicity areas, and general chemical parking areas should be set up separately to achieve classified parking. The entrance and exit of hazardous chemical parking lots should set up license plate recognition systems and hazardous chemical tank car leak detection devices, the parking area shall be equipped with video monitoring system, toxic and combustible gas alarm system, annular fire pipe network, electrostatic grounding, foam fire extinguishing system and other safety facilities. The road area shall be equipped with signs and guidance signs permitting the parking of hazardous chemicals, annular fire road and fire fighting return road, and the chemical park should set up necessary facilities of detection, cleaning, plugging, unloading.

According to the distribution of chemical enterprises in the park, the chemical park plans special emergency rescue channels and emergency evacuation channels in the event of toxic and harmful gas leakage and diffusion. The chemical industry monitoring, emergency measure planning, and

disaster prevention and control measures should be implemented to ensure timely delivery of disaster relief materials, equipment, and personnel, ensuring the safety, speed [5].

2.4. Firefighting Facilities

The chemical park should determine the design scale and overall layout of the fire station in accordance with the requirements of the "Ten Prohibitions and Two Prohibitions" and the "Guidelines for Safety Risk Investigation and Governance in Chemical Parks (Trial)" and other documents, combined with the industrial classification, production capacity scale, and safety risk assessment of the chemical park. According to the "Urban Fire Station Construction Standards", the fire station in the chemical park should be set up, and the process hazard characteristics of enterprise materials should be taken into account, equip corresponding types, quantities, structures of fire trucks, as well as the quantity of on-board fire extinguishing agents, equipment, protective equipment, and other fire-fighting facilities. The layout of the fire station should be based on the principle that after 5 minutes of receiving an alarm, the fire brigade can reach the edge of the chemical park enterprise.

Traffic signal lights, signs, markings, and other facilities should be installed on both sides of the main entrance and exit of duty vehicles at the fire station, along with basic facilities such as fire water sources, fire hydrants, and fire water intake docks. At the same time, it is recommended to sign a fire mutual assistance and sharing agreement between the chemical park and enterprises, to achieve personnel and material linkage, and to build a unified command and emergency rescue system that is both specialized and regular.

The chemical park should set up a water intake dock, with surrounding natural water bodies, ponds, etc. as fire water intake points. A fire lane should be set up for fire trucks to take water, and a parking area for fire water intake should be designated to meet the requirement of at least two fire trucks taking water simultaneously.

Chemical industrial parks can set up gas protection stations in hospitals or fire stations, or rely on large enterprises in the chemical industrial park to jointly set up them. According to the requirements of the "Design Specification for Gas Protection Stations", professional instruments and equipment such as protective equipment, first aid equipment, testing equipment, and professional personnel can be equipped.

2.5. Smart Safety Supervision

The chemical park should establish an emergency rescue command center, utilizing information technology and intelligent means, and build "smart safety supervision" safety production integration platform, with dedicated personnel on duty, responsible for daily information supervision and abnormal information disposal of the platform, to achieve efficient linkage between online monitoring and early warning and offline inspection and law enforcement.

The integrated safety production platform should provide

safety supervision coverage for all hazardous chemical enterprises in the chemical park, establish a three-dimensional oblique photography model of the chemical park, update basic information such as the construction boundary, enterprise boundary, and distribution of the chemical park in real-time on the platform, build a basic information database and a risk and hidden danger database, access real-time online monitoring and monitoring data of major hazard sources, video monitoring of key positions, and abnormal safety instrument alarms in the enterprise automatic control instrument alarm, flammable and toxic gas leakage alarm, emergency rescue linkage (including emergency rescue teams, rescue materials, emergency response systems, expert support, etc.), and other data to achieve online real-time monitoring, dynamic evaluation, and timely automatic warning of key places and facilities in the chemical park. At the same time, the access data is uploaded to the superior emergency management department.

The chemical parks should strictly enforce enterprise admission conditions, establish a joint meeting system for various departments of hazardous chemical projects, and strengthen the preliminary review of chemical projects. Based on the factors such as the number, scale, level, and distribution of vulnerable targets within the chemical park, an overall safety risk assessment of the chemical park will be carried out. A comprehensive and systematic risk identification and evaluation of the chemical park will be carried out. Based on the current situation of the chemical park and the actual situation of chemical enterprises, the consequences of major hazard accidents, and the quantitative analysis results of overall safety risks, the scope of land planning safety control lines will be determined, and utilize the existing natural or artificial buffer zones such as water bodies, mountains, green spaces, and forests in the chemical park to effectively isolate the hazardous sources of chemical enterprises within the park from surrounding protective targets, and strengthen the overall planning of the chemical park from the perspective of safety control.

2.6. Emergency Rescue

The local people's government responsible for park management should establish or designate a park safety production management organization, equipped with personnel who meet the safety management needs of the park, including personnel with practical experience in chemical safety production, to implement integrated safety production management.

The chemical park should establish an emergency rescue command center with functions such as public safety, road traffic, firefighting, transportation, medical first aid, chemical accidents, disaster prevention and reduction, municipal emergency response, environmental protection, etc. The chemical park should establish on-site rescue teams, safety alert teams, material support teams, technical monitoring teams, medical rescue teams, communication liaison teams, public relations teams, and other emergency rescue teams, and establish a safety production database emergency

information systems such as geographic information systems are equipped with emergency rescue and protective equipment according to standards, building a comprehensive and all-weather support network, and conducting contingency plans and practical exercises. At the same time, a medical and health emergency rescue team should be established, and in the event of an accident, they should promptly rush to the scene to carry out medical treatment, disease prevention and control work. Develop a transportation support plan, open emergency special channels during emergency rescue, and ensure that the rescue team rushes to the accident site as soon as possible to carry out rescue.

2.7. Other Safety Measures

2.7.1. Medical Security

The chemical parks and chemical enterprises should sign medical security cooperation agreements with nearby hospitals with emergency rescue capabilities, establish green rescue channels, set up medical first aid facilities, strengthen professional medical rescue equipment and reserves, provide rapid and effective medical support for sudden production safety accidents, and provide annual training and improvement of medical treatment capabilities for chemical accidents (including occupational diseases) to enterprises. Emergency rescue drugs are set up within the enterprise to alleviate poisoning and corrosion of hazardous chemicals, and chemical enterprises are equipped with emergency rescue materials.

2.7.2. Emergency Management Organization

The chemical park should establish a special emergency management organization, establish a professional emergency rescue team for hazardous chemicals, and rely on large enterprises to establish a reserve resource base for emergency supplies for hazardous chemicals accidents covering the key areas of the chemical industry park, such as emergency rescue command vehicles, lighting vehicles, emergency rescue equipment, head end power car, atmospheric transfer vehicles, personal protective equipment. The chemical park should establish an emergency rescue response mechanism for hazardous chemical accidents, and improve a linkage mechanism with emergency management departments at all levels, public security, environmental monitoring, medical first aid, engineering rescue, meteorological and other departments, as well as social rescue forces, to implement a system for sharing and supplementing emergency supplies.

2.7.3. Chemical Safety Skills Training Base

The park should rely on key chemical enterprises and third-party professional institutions within the park to establish chemical safety skills training bases, develop training base construction plans, improve chemical training facilities, increase the development of training materials, share professional teachers and digital resources, and increase training on chemical safety related laws, regulations, norms, standards, and other content for all frontline personnel,

including dispatched laborers and external construction personnel, Focusing on the basic skills and operational procedures of chemical industry practitioners, job risk control, safety hazard investigation, and initial emergency response capabilities, a targeted training course system and assessment evaluation standards will be formed. Enhance the theoretical cultivation and legal awareness of trainees.

2.7.4. Environmental Protection Testing Force

The chemical park should be equipped with environmental protection testing forces and emergency monitoring teams, including on-site sampling teams, laboratory monitoring teams, and logistics support teams. For key chemical substances in chemical enterprises, corresponding environmental protection testing equipment and personal protective equipment should be equipped to strengthen supervision and inspection of environmental protection facilities of enterprises in the park, and enhance the park's environmental protection testing and control capabilities in emergency accidents.

Strengthen the preparation of environmental emergency plans and the construction of environmental risk prevention and control systems in chemical parks, establish environmental monitoring and monitoring systems, and network with ecological and environmental departments to achieve data exchange. Install online monitoring of water flow and water quality at rainwater discharge outlets in chemical parks and chemical enterprises, build environmental monitoring stations, strengthen the monitoring of characteristic pollution factors for VOCs emissions, and provide feedback to the environmental monitoring and monitoring system [11-12].

2.7.5. Smart Comprehensive Management Service Platform

The chemical park should establish the "smart comprehensive management service platform", which includes comprehensive business management, park closure management, collaborative office work, intelligent diagnosis, industrial internet applications, and other contents, providing strong information application support for the park's investment attraction, personnel management, public management, operation management, and project settlement services.

Build an intelligent safety and environmental emergency management platform, including the control center, safety production monitoring, intelligent safety supervision, emergency command, hazardous chemicals monitoring, major hazard management and early warning, and use advanced Internet, Internet of Things, cloud computing, Big data, multimedia monitoring, geographic information, mobile applications and other technical means to monitor abnormal alarm data such as video monitoring and safety instruments for key posts, Realize online real-time monitoring, dynamic evaluation, and timely automatic warning of key locations and facilities in the chemical park. At the same time, establish a three-dimensional oblique photography model to update basic information such as park construction boundaries, enterprise boundaries and distribution within the chemical park in

real-time on the platform, and achieve dynamic intelligent management of the chemical park by management departments.

3. Conclusion

From the perspective of safety improvement and green development of the chemical industry park, only by continuously improving the closed management of the chemical industry park, transport roads for hazardous chemicals, parking lots for hazardous chemicals, fire emergency, intelligent safety supervision and other infrastructure construction, and fully relying on "Internet plus", "Internet of Things", "big data" and other technologies, can effectively promote the construction of intelligent, digital and information-based chemical industry parks, improving the overall safety and environmental control capabilities of chemical parks, reduce safety risks, promote the construction of advanced domestic chemical industrial parks with advanced technology and complete supporting facilities, and achieve sustainable development in society, economy, safety, and environmental protection.

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