Safety risks and Countermeasures of Chemical Industry Park in Jiangsu Province

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Abstract: This paper introduced the basic situation and layout of Chemical Industry Park (concentration) in Jiangsu Province. There are some problems in the park: Due to the relevant planning of chemical industry park is proposed in recent years, part of the park planning is missing, and the planning at all levels is not coordinated; Due to the early site selection and construction of some parks, the lack of overall planning, the problems of planning red line crossing enterprises and residential areas in the park, and the imperfect infrastructure construction of the park; due to the authority of examination and approval for the establishment of institutions and personnel in the park, the responsibilities of some institutions in the park are not clear, and the number of professional supervisors is insufficient; In view of the problems existing in the park, this paper puts forward relevant countermeasures and suggestions from the aspects of the integrity of the park planning, the rationality of the location and layout, the compliance of the organization and personnel, and the importance of the park infrastructure.

1. Preface

Chemical industrial park is the product of modern chemical industry with the aim of adapting to the conversion of resources or raw materials, and following the development trend of large-scale, intensive, optimization, internationalization of operation and maximum benefit [1]. By the end of 2017, there were 601 key chemical industrial parks in China, including 15,000 chemical enterprises above designated size, accounting for about 51% of the country's petroleum and chemical industries [2]. Chemical industrial park has the characteristics of large area, great number of enterprises, different kinds of dangerous chemicals, complex production process, etc., which not only promotes economic development, but also brings serious safety problems. There are numerous and densely distributed enterprises in the park. If a certain enterprise fails to handle the emergency properly or on time after a major accident such as fire and explosion, it may spread to neighboring enterprises and cause a catastrophic domino accident chain effect, bringing serious consequences. In August 2015, a particularly serious fire and explosion accident occurred in the dangerous goods warehouse of Tianjin Port Ruihai International Logistics Co., Ltd. in Binhai New Area of Tianjin, resulting in 165 deaths, 8 missing, 798 injured and hospitalized, and a direct economic loss of RMB 6.866 billion [3]. In March 2019, a major explosion occurred in the old solid waste warehouse of Tianjayi Chemical Co., Ltd., located in the ecological chemical industrial park of Xiangshui County, Yancheng City, Jiangsu Province, resulting in 78 deaths, 76 serious injuries, 640 hospitalizations and direct economic loss of 1986.3507 million yuan, as well as significant social impact and huge economic losses [4].

In order to deeply draw lesson from special major explosion accident "3.21" at xiangshui, jiangsu
and to screen chemical industrial park and dangerous chemical enterprise safety risk, the Jiangsu provincial party committee, provincial government take actions as follow: first, formulated the "security environmental renovation plan of chemical industry in Jiangsu province" ([2019] no. 96); second, put forward the policy of reducing chemical industrial park (des) quantity, improving the level of chemical industrial park development, strictly managing chemical industry clusters and promoting chemical industrial park (des) regulation. Emergency Management Department formulated the "chemical industrial park safety risk screening management guideline (try out)" and "dangerous chemicals enterprise hidden perils in safety risk management guidelines" (emergency [2019] no. 78), which required chemical industrial park with safety risk level for A class, in principle, not to renovate, modify and expand hazardous chemical construction projects; also to be ordered to make rectification within time limit to effectively reduce the safety risk. For chemical industrial parks with safety risk level for B class, overall consideration should be taken, and serious investigation should be made from the aspects of enterprise size, socially acceptable risk and safety distance, etc. In principle, renovating, modifying and expanding construction projects of hazardous chemicals should be restricted. The Department of Emergency Management of Jiangsu Province organized and carried out the safety risk level assessment in 29 chemical industrial parks (centralized) in the province in April 2020.

2. Current Situation of Chemical Industry Park (Concentration) in Jiangsu Province

2.1 Basic information of chemical park (centralized) area

According to the management form, Jiangsu chemical parks (centralized) can be divided into two categories: one is the independent professional chemical industrial parks, such as Jiangsu Changshu New Materials Industrial Park and Jiangsu Yangzhou Chemical Industrial Park. Another is the chemical industrial parks set up in industrial zones and development zones, such as Lianyungang Petrochemical Industrial Base and Nanjing Jiangbei New Material Science and Technology Park.

After industrial optimization and continuous improvement in recent years, there are about 40 chemical industrial parks (concentration) in Jiangsu Province by the end of 2019. According to the file "provincial government on strengthening the province chemical industry park chemical industry clusters of standardization management notice "(Sue ZhengFa [2020] no. 94) published by Jiangsu province people's government on October 30, 2020, the provincial government on strengthening the province chemical industry park chemical industry clusters of standardization management notice "(Sue ZhengFa [2020] no. 94), 14 coastal and riverside park including Nanjing Jiangbei New Materials Science and Technology Park, Jiangyin lingang chemical industrial park are defined as chemical industrial park; 15 parks including yixing new material industrial park, xishan economic and technological development zone new material industrial park are defined as chemical industry clusters.

2.2 Current Layout of Chemical Industry Park (Centralization)

The chemical industrial parks in Jiangsu Province are scattered, with one in Nanjing, three in Wuxi, two in Xuzhou, two in Changzhou, six in Suzhou, three in Nantong, four in Lianyungang, one in Huai'an, two in Yancheng, one in Yangzhou, one in Zhenjiang, two in Taizhou, and one in Suqian (as shown in fig.1). Chemical parks (Centralization) mainly focused on petrochemical industry are mainly distributed in Nanjing and Lianyungang; chemical parks (Centralization) mainly focused on fine chemical industry are mainly distributed in Nantong, Changzhou, Taixing and other places; chemical parks (Centralization) established by old enterprises are mainly distributed in Wuxi, Suzhou and other places.
3. Analysis of Reasons for Safety Risk in Chemical Industry Park (Concentration) Area of Jiangsu Province

3.1 Lack of relevant planning and coordination of different plans
As the requirement that the establishment of chemical industrial parks should be recognized by the people's government at the provincial level and above is put forward in the Guidance on Safety Risk Detection and Management of Chemical Industrial Parks (Trial) in 2019, most of the parks have been recognized by the people's government at the county (district) level or districted city level, but lack of the recognition by the people's government at the provincial level and above. As the compiling requirements of the general planning and industrial planning of the park were put forward by the Ministry of Industry and Information Technology in the Guiding Opinions on Promoting the Standardized Development of Chemical Industry Parks (Ministry of Industry and Information Technology of the People's Republic of China, No. 433 [2015]) in 2016, some parks still lack general planning and industrial planning. Due to the department in charge of planning, park management departments at all levels is not overall scheduling, planning involved in the park at all levels of land use types are not harmonious and unified, Part of the land use properties of some parks are inconsistent in the general urban planning, general park planning or controlling detailed planning, especially the land used for the established chemical enterprises is non-industrial land; In the process of self-construction and development, the park has adjusted the planning scope, planned area and leading industry due to various reasons. The planning scope and planned area of various park plans are inconsistent, and the direction of leading industry is greatly different due to the different planning time.

3.2 Unreasonable site selection and layout
Because the construction and development of chemical industrial parks generally need enough water, convenient traffic and transportation conditions, enough environmental capacity of sewage body, The 29 chemical industrial parks (concentration) in Jiangsu Province are distributed along the coast and the river, among which Nantong Economic and Technological Development Zone, Jiangsu Changshu New Materials Industrial Park and other 14 are distributed along the Yangtze River, Lianyungang Petrochemical Industry Base, Coastal Industrial Park of Jiangsu Coastal Economic Development Zone and other 6 are distributed along the coast, Xishan Economic and Technological Development Zone New Materials Industrial Park, Suqian Ecological Chemical Science and

![Figure 1 Distribution of chemical industry parks in Jiangsu Province](image)
Technology Industrial Park and other 9 are distributed along the river (Table 1). According to the chemical industry in Jiangsu province safety environmental renovation plan "([2019] no. 96), It is required to reduce the number of chemical production enterprises in the area along the Yangtze River, evaluate the enterprises in the chemical industry park and put forward disposal opinions. All enterprises that are not connected with the industrial chain and have great safety and environmental risks in the park will be closed down and withdrawn by the end of 2020. It is strictly prohibited to build or expand chemical industrial parks or projects within one kilometer of the main and tributaries of the Yangtze River. Some parks have signed closure agreements with chemical enterprises within 1 km along the river to vacate space.

Table 1 Distribution of chemical industrial parks along the river, coast and stream in Jiangsu Province

| serial number | Distribution along the river | Distribution along the coast | Distribution along the stream |
|---------------|----------------------------|-----------------------------|-----------------------------|
| 1             | Jiangsu Changshu New Material Industrial Park | Lianyungang Petrochemical Industry Base | Xishan Economic and Technological Development Zone New Material Industrial Park |
| 2             | Taixing Economic Development Zone, Jiangsu Province | Coastal Industrial Park, Jiangsu Binhai Economic Development Zone | Jiangsu Pizhou Economic Development Zone Chemical Industry Cluster |
| 3             | Yangzhou Chemical Industrial Park, Jiangsu Province | Dafeng Port Petrochemical New Material Industrial Park | Suqian Ecological Chemical Technology Industrial Park |
| 4             | Nantong Economic and Technological Development Zone Chemical Industry Park | Jiangsu Lianyungang Chemical Industry Park | Chemical Industry Cluster Zone of Xinyi City |
| 5             | Nanjing Jiangbei New Material Science and Technology Park | Zhe Wang Lingang Industrial zone Chemical Industry park | Yixing New Material Industrial Park |
| 6             | Jiangsu Yangzijiang International Chemical Industrial Park | Guanyun County Lingang Industrial Park Chemical Industry Park | Kunshan Fine Material Industrial Park |
| 7             | Taizhou Binjiang Industrial Park | | Suzhou Wuzhong Economic and Technological Development Zone New Chemical Materials Science and Technology Industrial Park |
| 8             | Changshu Economic and Technological Development Zone Chemical Industrial Park | | Jintan New Material Science and Technology Industrial Park |
| 9             | Changzhou Binjiang Economic Development Zone New Material Industrial Park | | Jiangsu Huaian Industrial Park |
| 10            | Taicang Port Economic and Technological Development Zone Chemical Industrial Park | | |
In combination with the overall planning of the site, the park should consider the possible hazard sources and dangers of the chemical industrial park at the initial stage of construction (planning and site selection stage), and plan the site selection of the park from the perspectives of natural environment characteristics, hydrology, meteorology, geology and geomorphology, and environmental capacity [6]. Due to the early site selection and construction of some parks, the overall planning lacks rationality [7] and the scientific method of safety planning of land use [8]. The surrounding living facilities are gradually improved around the park, the distance between residential areas and the park boundary is gradually shortened, and the original planning range of some parks is less than 500 meters away from the surrounding residential areas. According to the former Notice on Printing and Distributing the Implementation Plan for Further Strengthening the Environmental Protection of Chemical Industry Parks (Suhuan Weizhan [2012] No. 23) and the Notice on Distributing and Distributing the Construction Specifications for the Environmental Protection System of Jiangsu Chemical Industry Parks (Trial) > (Suhuan Ban [2014] No. 25) issued by Environmental Protection Department of Jiangsu Province, the separation zone between the chemical industrial park and the residential area should be no less than 500 meters wide. The planning scope and area of the park should be adjusted after 500 meters backward according to the surrounding residential areas. After the adjustment, the planning red line crosses some enterprises in the park, resulting in the fact that some of the factory boundaries of enterprises are in the park, while some are outside the park. The park closure requires electronic or physical isolation of the planning red line, which causes certain contradictions to the enterprise management. Due to the gradual expansion of the scale of some parks from small to large, there are residential points, national roads and other traffic arteries in the red lines of individual parks.

At present, the only national standards for chemical industrial parks are Management Regulations for Public Pipeline Gallery in Chemical Industrial Parks (GB/T 39217-2018) and Guidelines for Comprehensive Evaluation of Chemical Industrial Parks (GB/T 39217-2020), which were issued in recent two years. The only standard for chemical industrial parks in Jiangsu Province is the "Guidelines for Safety Risk Assessment of Chemical Industrial Parks (concentration Areas)" (DB32/T 2916-2016) issued in 2016, and the above standards do not involve the site selection and layout of the park.

3.3 The unclear responsibilities of the institutions and lack of professional supervisors

The long-term and effective supervision of production safety and emergency management is restricted by the reason as follow. At present, the work of safety management in the supervision mode and means, supervision of the main responsibility implementation, education and training methods have greater contingency and arbitrariness. Safety supervision departments at all levels lack unified standards and standards. It is difficult for dependency supervision department staff to undertake professional and systematic safety supervision tasks due to the lack of systematic and professional technical knowledge [9]. Because the establishment of the park organization and personnel needs the approval of the
institution establishment committee of the local municipal Party committee, some parks have not adjusted the departments with clear responsibilities of the park emergency management according to the institutions. Industrial zone, development zone, part of the chemical industrial park (concentration), office of chemical industrial park and local government offices (concentration) are managed by the superior industrial zone, economic and technological development zone or township government safety department. However, the responsibility relationship with other departments is not clearly sorted out from the park level due to the lack of work safety and emergency management organizations at the park level, which fails to meet the requirement that all kinds of production parks (concentration areas) should set up separate safety supervision agencies in Jiangsu Province Chemical Industry Safety and Environmental Protection Improvement Program (Suban [2019] No. 96).

There is a brain drain in the chemical industry, and the demand for chemical professionals exceeds supply as a result of frequent accident occurrence in recent years and higher industry risk. The number of professional supervisors in some parks cannot meet the requirement of The General Office of the Provincial Party Committee and the General Office of the Provincial Government < Notice on Printing and Issuing the Three-Year Action Work Plan > for the Special Improvement of Work Safety in Jiangsu Province > (No. 34 [2020] of the General Office of the Provincial Government) in which the chemical industrial park is required to be equipped with 10 professional supervisors, and the centralized area is required to be equipped with 6 professional supervisors. In some parks, the proportion of personnel with relevant chemical professional education or chemical safety production practice experience or registered safety engineer is less than 75%.

3.4 Infrastructure construction is not perfect
Some parks have not considered park level public accident emergency pools as a whole, or have not completed the construction of the planned and designed public accident emergency pools, and some parks have not completed the construction of public accident emergency pools, which failed to meet the requirement of Jiangsu Province Chemical Industry Safety and Environmental Protection Improvement Plan (Suban [2019] No. 96) in which parks are required to construct an environmental accident emergency pool; Some parks have not even carried out reasonable and effective analysis and demonstration on the emergency response capacity of the park, and cannot determine whether the existing emergency response pool capacity can meet the needs of public accident wastewater treatment in the park.

The chemical park safety risk screening governance guidelines (try out) "the requirements of the" chemical industrial park public utility tunnel management procedures "(GB/T 36762) was released in August 2019 while most of the parks were built earlier. At present, Most of the parks with public management corridors cannot meet the requirements of the management regulations, there are mainly problems such as the construction of public management corridors or pipe racks and incomplete management information.

4. Suggestions

4.1 Coordinate planning at all levels
It is recommended to study and formulate relevant safety management policies such as industrial planning and access conditions in the chemical park (concentration) zone from the perspective of environmental safety and safety capacity of the park. Planning departments at all levels should coordinate the park land when preparing a new round of land and space planning to avoid inconsistencies in the nature of the planned land at the upper and lower levels; while the park management department compiles relevant plans according to its own needs, it should also verify key content such as industry categories and land properties in various plans to avoid the occurrence of content and the actual situation does not match.
4.2 Reasonably plan the internal layout of the park
It is recommended that the park gradually eliminate companies that are not related to the direction of the leading industry, gradually clean up the residential areas, restaurants, and traffic roads at the provincial level and above in the park, and optimize the existing layout in terms of sensitive targets, functional zoning, emergency rescue, and infrastructure.

4.3 Set up an independent safety management organization and equipped with professional supervisors
It is recommended that the local government of the park should coordinate with the town government, higher-level industrial park or safety administrative departments set at the park level of economic and technological development zones to clarify the park’s safety production and emergency management responsibilities, coordinate with environmental protection, fire protection, planning, investment promotion and other related departments to solve the major production safety problems among enterprises in the park, coordinate emergency rescue work in the park, and establish and improve a linkage mechanism for industry supervision, coordination of law enforcement, and emergency rescue. On the other hand, the local government and industrial parks have increased the introduction of professional safety supervisory personnel, equipped with professional supervisory personnel, and strengthened the professional training of personnel.

4.4 Improve park infrastructure construction
It is recommended that the layout and construction of various infrastructures should be considered when planning the layout of the park, mainly including: production and domestic water supply in the park, water supply pipe network, power supply that meets dual power requirements, public pipe corridors, and centralized industrial sewage treatment. The construction of infrastructure such as factories and sewage pipe networks, public accident emergency pools, and centralized solid waste (including hazardous waste) disposal; On the basis of already formed planning layout, the existing parks should speed up the construction of the above infrastructure and improve the emergency response capacity of the parks.

5. Conclusion
For the basic situation, the present layout and existing problems of chemical industrial park in jiangsu province (concentration), planning of land property all levels and the consistency of leading industry shall be coordinated, optimizing the layout of park functional partition, the emergency rescue and infrastructure, safety management institutions shall be equipped with enough professional supervisors, perfecting the construction of infrastructure, reduce chemical industrial park (concentration) security risks, improve the level of chemical industrial park (concentration) of production safety.

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