Exploration of Operation and Maintenance Management Mode and Innovation Mechanism of Pilot Base of Chemical Park

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Abstract Based on the current situation of the operation and maintenance management of the pilot base in many chemical parks in China, this paper conducts an in-depth exploration of the operation and maintenance management and innovation mode of the pilot base from the aspects of the evaluation of the pilot project entering the park, safety and environmental protection supervision, pilot mode, and industrialization mode of the pilot test results, so as to provide solutions for accelerating the process and industrialization of the pilot project and realizing the innovation value of the pilot base.

Key words Chemical parks, Pilot base, Operation and maintenance, Mode, Industrialization, Exploration

1 Introduction

Chemical industry, as an important basic and pillar industry of the national economy, is of great significance to the economic development and the rapid development of the industrial system. At present, there are some problems in the domestic chemical industry, such as structural overcapacity, the bottleneck risk of key core technologies, and insufficient reserve of innovative talents, which urgently need innovation, upgrading and transformation of the chemical industry. The *13th Five-Year Plan for National Scientific and Technological Innovation* issued by the State Council clearly requires the transfer and transformation mechanism of innovative scientific and technological achievements, so the transfer and transformation of scientific and technological achievements will be vigorously promoted, and the pilot base and the construction of common technology research and development platforms combining production, education and research will be strengthened. Therefore, it is a strategic choice to promote the transformation of scientific and technological achievements into real productive forces to attach importance to the pilot link of transformation of scientific and technological achievements, build a pilot base of chemical industry park and build a public platform for the pilot transformation of scientific and technological achievements[1-4].

Now, many top 100 chemical industry parks in China, such as Taixing Economic Development Zone in Jiangsu Province, Shangyu Economic and Technological Development Zone in Hangzhou Bay and Quzhou High-tech Development Zone in Zhejiang Province, have started to plan pilot base of chemical industry parks, aiming at focusing on chemical industry chain and innovation chain, relying on chemical technology sources such as enterprises, universities and scientific research institutes. Through the construction of pilot base, it provides a platform for pilot verification, product inspection and personnel training for the transformation of scientific and technological achievements, thus promoting the industrial transformation and upgrading of the chemical industry parks. After the construction of pilot base is completed, how to review and supervise the admission of pilot project on the basis of existing national laws and regulations, accelerate the pilot process and pilot project industrialization, and realize the self-hematopoietic and innovative value of pilot base are the practical problems faced in the management process of pilot base operation and maintenance. Therefore, on the basis of pilot base operation and maintenance management research in Hangzhou Bay Shangyu Economic and Technological Development Zone, Zhejiang Quzhou High-tech Development Zone, Liaoning Panjin Fine Chemical Industry Park and other chemical industry parks, it is of great significance and practical value to conduct in-depth research on pilot base operation and maintenance management mode and innovation mechanism.

2 Management mode of pilot project

2.1 Evaluation of pilot project entering the park The pilot base operation and maintenance management department consists of a technical review committee. After the pilot project party submits the enterprise introduction, project situation and other preliminary information, the technical review committee will conduct a preliminary review on the technical frontier and market prospects of the pilot project. After the preliminary review, the pilot project party shall provide more detailed information on environmental protection and safety, including the feasibility study report, the physical and chemical properties and usage of materials, the sum-

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mary report of technical small-scale test, the usage of utilities, the treatment capacity and treatment process of the three kinds of wastes, the identification of hazardous factors and related safety control measures, and the safety risk assessment. The technical review committee will conduct a comprehensive assessment on the technical advancement of the pilot project to determine whether it meets the requirements of the pilot project for introducing the industrial direction and the safety and environmental protection management and control documents, so as to ensure that the safety and environmental protection risks are controllable. After that, the pilot base will be inspected to determine the use demand of pilot workshop, utilities and warehouse, specify the rent and management fee of pilot project, and sign the pilot cooperation agreement and industrialization agreement of pilot project.

2.2 Safety supervision The pilot project party should entrust a third-party unit with relevant qualifications to prepare the pilot project safety evaluation report and safety facility design plan, and the pilot base operation and maintenance management department shall organize experts to conduct review and demonstration, and the safety evaluation report, safety facility design plan and review and demonstration results shall be reported to the local emergency management department.

2.3 Environmental supervision The pilot project party shall prepare an environmental impact assessment report in accordance with laws and regulations, and the ecological environment bureau of the city with districts shall be responsible for examination and approval. At present, there are two types of environmental protection supervision models:

(i) The pilot base has formulated relevant systems for the direction of industrial introduction and pilot project, and prepared the general environmental impact assessment document of pilot base according to the direction and characteristics of industrial introduction, and obtained the approval documents through the review of the local ecological environment bureau. For the subsequent introduction of pilot project, if its pollution production is within the scope of the overall environmental impact assessment (EIA) document, in order to shorten the pilot test time, the pilot project EIA report will not be prepared separately, and only the chapter of EIA pollution production shall be provided and submitted to the pilot base operation and maintenance management department.

(ii) The pilot base has not prepared the overall EIA document, and the pilot project has prepared the EIA report separately and submitted to the competent EIA department for approval.

3 Pilot modes of pilot project

According to the research on pilot base operation and maintenance management of several chemical industry parks, the pilot project pilot modes in China mainly include "pilot project + pilot supervision" mode and "pilot project + pilot team" mode, as shown in Table 1.

Table 1 Pilot modes and characteristics of pilot project

Pilot modes	Characteristics
"Pilot project + pilot supervision" mode	(i) The pilot project party proposes the pilot test requirements, builds the pilot test device (including equipment, pipelines, instruments, *etc.*), and carries out the pilot test. The pilot test personnel are provided by the pilot project party. (ii) The pilot base only provides the pilot test site and supporting utilities (water supply, steam, gas supply, *etc.*) for the pilot project, and supervises the admission review, "three simultaneities" (simultaneous design, simultaneous construction, simultaneous production and use) and pilot test process of the whole project, and does not participate in the specific pilot process of the pilot project.
"Pilot project + pilot team" mode	(i) This mode is to set up a pilot team in pilot base, provided with process, automatic control, equipment, safety, maintenance and other professional personnel. (ii) For the pilot project party, the owner shall propose the process flow and process parameters for the pilot test, and the pilot test team shall set up the pilot test device (including equipment, pipelines, instruments, *etc.*) according to the pilot test process flow and conduct the pilot test. After the pilot test is successful, the pilot test team shall return the corresponding process parameters to the pilot project party. And then the pilot project party carries out the industrialization of the pilot project.

From the perspective of the confidentiality of pilot project, the current pilot project side accepts the mode of "pilot project + pilot supervision"; from the perspective of pilot project safety management and personnel control, "pilot project + pilot team" is a new innovative mode to solve the problems of shortage of engineering personnel and lack of engineering experience in pilot project.

4 Industrialization mode after pilot project success

At present, after the pilot project is successfully verified, the domestic pilot bases have a variety of cooperation modes for industrialization, as shown in Table 2.

Pilot project industrialization is the goal of pilot base construction. According to the actual situation of the pilot project, the pilot base operation and maintenance unit often develops multiple industrialization models such as "Achievement + Funds" and "Achievements + Land Purchase" at the same time, and needs to carry out continuous innovation in industrial policies and financial support to accelerate the industrialization of the pilot project and better produce economic and social benefits.

5 Other supervision requirements of pilot base

5.1 Pilot project parameter management and control Because the pilot base involves a large number of pilot projects that are being carried out at the same time, and it is difficult to manage the large number of personnel, from the perspective of security

control, the pilot project should be supervised as follows.

(i) The alarm signal of pilot project's flammable and toxic gas alarm device involves the key parameters of "two key and one major" (dangerous chemical process under key supervision, dangerous chemicals under key supervision, major hazard sources) areas, such as temperature, pressure, liquid level, flow and other over-limit alarms, as well as the corresponding safety control actions. It shall be connected to the intelligent management platform of pilot base.

(ii) The signals of concentration detection devices for tail gas treatment and sewage treatment shall be connected to the intelligent management platform of pilot base.

(iii) Nitrogen, air, circulating water, chilled water, tap water, steam and other utility metering facilities involved in pilot project shall be connected to the intelligent management platform of pilot base.

(iv) It is necessary to establish procedures such as alarm, confirmation, elimination, and emergency disposal of pilot project parameters, and link them with the emergency rescue plan of pilot base.

(v) The construction unit shall compile technical regulations, safety technical regulations, post operation methods and accident contingency plan, and link up with the emergency rescue plan of pilot base to ensure that rescue and rescue are targeted.

(vii) If the risk assessment of the control parameters of a pilot project is too large, the pilot base shall have the function of notifying the whole staff and exiting in time when a pilot project has a safety accident, so as to stop all pilot projects and evacuate the staff.

Table 2 Industrialization modes and characteristics of pilot project

Industrialization modes	Characteristics
"Achievements + Incubation Park, Sci-tech Innovation Park" mode	(i) The newly-built incubation park and sci-tech innovation park are used to undertake the industrialization projects after the pilot test is successful, and there is no need to invest in the plant, so the investment is saved and the benefits are quick. (ii) Incubation park and sci-tech innovation park mainly construct standard workshops, which shall be based on the industrial direction of pilot project and focus on the commonality of workshops. (iii) This mode is suitable for the middle and lower reaches of petrochemical industry, fine chemical industry, new chemical materials and other projects. (iii) Based on the current approval process for industrialization projects, it is necessary to consider the issue that project declaration, safety and environmental protection supervision and project legal person are the same subject.
"Achievements + Funds" Pilot Achievement Transformation Mode	(i) Universities, management committees and external funds set up joint investment funds to invest in pilot project achievements in the form of fund equity, this mode is applicable to pilot projects with insufficient funds. (ii) This mode solves the problem that after the pilot project is successful, it will not be industrialized in the region, and it can obtain benefits with the landing of the project, which is flexible and changeable.
"Achievements + Land purchase" Direct Industrialization Mode	(i) This mode purchases land directly in the park, implements pilot project, to generate economic benefits. (ii) In case of industrialization in the chemical industry park, certain preferential treatment and financial support in terms of rent, equipment and land can be provided in the pilot base pilot test process.

5.2 Personnel positioning control Personnel positioning management and control is an important part of pilot project security management and control. At present, IC card and radio frequency identification (RFID) technology are mainly used to carry out real-time and accurate positioning and location management for pilot base personnel.

(i) Employee attendance management: with the help of RFID technology, it can automatically sense the time and place of employees entering and leaving the work area or designated location, and automatically generate attendance records.

(ii) Personnel safety monitoring: in hazardous environments, such as high temperature, low temperature, toxic gas and other workplaces, RFID technology is used to track and monitor the safety behavior of personnel, so as to take timely measures to ensure the health and safety of employees.

(iii) Confidentiality management: through personnel positioning, when the personnel enter the area without authorization, the alarm will be given to ensure the confidentiality management of pilot project.

5.3 Material storage and use control Due to the different raw materials involved in different pilot projects, the materials should be set in different warehouses with different storage requirements from the aspects of constraints and physical and chemical risks. For example, the medium that is easy to decompose at high temperature should be set in a cold storage. Besides, through the operation and maintenance management survey of multiple pilot bases, the warehouse is frequently used, and the existing warehouse area is often insufficient to support the demand of pilot base[5]. Therefore, from the perspective of material control, we should focus on the whole process control of material storage and use. On the one hand, the storage area of materials is reasonably planned, on the other hand, the use end of materials is controlled to achieve material balance and prevent the disorderly stacking of materials and the disorderly discharge of three wastes. In the automatic management and control, QR code intelligent management and control measures are adopted to scan the code from the storage end to clear the storage medium, storage location and storage quantity; scan the code from the user end to clear the user, receiver, receiving medium and receiving quantity; scan the code from the entry section of the workshop to clarify the direction of materials and the amount of materials entering the workshop, so as to realize the whole process supervision of the storage and use of materials.

6 Conclusions

Establishing a scientific, reasonable, practical and operable pilot base operation and maintenance management system and safety and environmental protection supervision procedures is the key

(To page 22)

sistance, and ease of maintenance, to improve their service life and stability in complex environments. Different anti-corrosion technologies have their own advantages in materials, structures, and functions, which need to be selected according to specific application environments and needs. By selecting materials reasonably and optimizing structural design, the corrosion problem of mountain photovoltaic brackets can be effectively solved, and various challenges in complex mountain environments can be addressed, thereby achieving efficient operation and long-term stability of mountain photovoltaic systems. In the future, research on mountain photovoltaic brackets should further explore environmentally friendly, low-cost, and efficient anti-corrosion technologies, and promote the sustainable development of the photovoltaic industry combined with the development and application of new materials.

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(From page 18)

for the government and scientific research institutes to promote the construction and operation and maintenance management of pilot base in chemical parks. Firstly, it is necessary for government departments to provide a good ecological environment for scientific and technological innovation, simplify the approval process of pilot projects, and accelerate the industrialization process of pilot projects. Secondly, it is necessary to innovate in the pilot project pilot mode, industrialization cooperation model, innovation system, *etc.*, from the mode of relying on government subsidies to maintain the normal operation and maintenance management of pilot base, to the blood making by pilot base itself, truly give full play to the scientific and technological innovation value of pilot project, and promote the transformation and upgrading of the national and local chemical industry.

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