Information Strategy Research on Emergency Management of Major Accidents in Chemical Industrial Park

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**Keywords:** Chemical industrial park, Emergency management, Hazard source, Emergency information, Coordination.

**Abstract.** Emergency management can not be separated from the management of emergency information. Emergency management is the process of gathering information, processing, and making decisions accordingly. However, there are still many problems in the development of emergency management in China's chemical industry park. In this paper, the investigation and analysis on the samples from a few chemical industry parks has been conducted. Through understanding the current situation and spotting the existing problems of the emergency information management of chemical industry parks, the strategy for reinforcement and improvement has been proposed.

**Introduction**

The rapid development of chemistry industrial park brought high value as well as serious problems into China\(^1\). From the information point of view, the emergency management process of chemical industry park is actually the process of collecting information, analyzing information, transmitting information, making decisions and taking actions based on information. Therefore, integrating information management with emergency management of the chemical industrial park has both theoretical value and practical guiding significance.

**Current Situation of Emergency Information Management in Chemical Industry Park**

In order to understand the current situation of emergency information management in chemical industry park in China status, questionnaire surveys were conducted on Fangshan Industrial Park of Beijing, Tianjin Development Zone Industrial Park, Huanggang Chemical Industrial Park and Yangxin Industrial Park in Hubei as the object. After the investigation and further analysis on the issues existing in emergency information management during emergency treatment of Industrial Park in China, proposals are raised to improve emergency information management during emergency treatment of Industrial Park in China.

Investigations were conducted through random sample, with investigator visiting the enterprise in the Industrial Park. The survey covered the company's security staff (Security Department), the management staff of the office and operators of the workshop. The questionnaires were issued, completed and collected on the spot. A total of 60 copies were issued and 56 were collected among which 52 were valid. According to investigation and further analysis, existing issues in Emergency Information Management of Chemical Industry Park are listed in Table 1:
Table 1. Existing Issues in Emergency Information Management of Chemical Industry Park.

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<th>Existing Issues</th>
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| Pending resolution on Integration of Regular Supervision and emergency Management in Chemical Industrial Park | - Regular supervisions were neglected. Emergency treatment was a traditional concept of disaster relief, focusing on the aftermath response of the accident.  
  - Research on the integration of regular supervisions and emergency work was not done adequately in the Chemical Industrial Park.                                                                                       |
| Cheveron Lack of Effective Early Warning Information System                      | - Some domestic enterprises in China have started the relevant practice to establish response plan for emergencies and carry out the exercise on the regular basis. But their efforts were still in the initial stage, and the real effective system to combine precaution and response into one was still not set up.  
  - The information infrastructure, equipment and safety production management technology of some enterprises were out of date, and the information amount and coverage were limited.  
  - Production and security monitoring system adopted a distributed system, with poor openness, more supervision and less control.                                                                                      |
| Inadequate Communication of Emergency Information                                | - Emergency coordination mechanism between departments has not yet been established when the most serious accidents happened in the Chemical Industrial Park  
  - Emergency coordination mechanism between Industrial Park and the enterprises in the park has not been established for most of them  
  - Mutual assistance mechanism has not been established for most of the enterprises in the Chemical Industrial Park  
  - Emergency assistance mechanisms between the Chemical Industrial Park and external emergency rescue organization were just paperwork                                                                                                                                              |

Proposals to Improve the Emergency Information Management of Chemical Industrial Park

Strengthen the Ability of Information Processing

Only after processing and analysis will the emergency information of the accident be changed from non-applicable to applicable and from poorly available to highly available until the information is converted into knowledge for decision making. For example, the deviation sequence during production process of refining device can be expressed as a series of "chain of events", including the deviation of the observed variables which can be read from the sensor on the spot in such changes as temperature, pressure and flow rate of each production unit, and the deviation of hidden status which can not be directly observed by sensors such as coke deposition conditions, equipment corrosion etc. But the deviation of hidden status of these devices can often be obtained from analysis of the observation vector sequence. That means that each observation vector can represent a variety of status through probability density distribution and can be generated by a sequence of status with corresponding probability density distribution.

Based on the correlation warning method of "deviation - observation - status", the process of how deviation triggered by various factors evolved into accident can be expressed clearly and completely step by step. Thus it is beneficial to take the safety measures to control the trigger factors and to cut off the link between the deviations, which will be the core theory of the accident early warning system.

Establish the dynamic alert correlation model of "self correlation – diverse correlation – event correlation", and set up the alarm correlation analysis engine which includes three steps: alarm reduction, alarm correlation and priority level disposal. When receiving information with the deviation, the correct alarm information can be recovered from the existing "memory". Alarm self correlation analysis is used to deal with the optimization of alarms caused by the same attribute flow deviation in the MFM-HAZOP model.

Diverse correlation analysis refers to association of others from a single alarm or from one type to another type, in which the input and output information belong to different category or different domain. Alarm diverse correlation analysis is used in the MFM-HAZOP model to deal with warning
Establish an Efficient Emergency Coordination Management Mechanism

Based on the analysis of current situation of China’s Chemical Industry Park, it is difficult to meet the needs of a large number of enterprises in the chemical industry park only through the safety supervision and emergency rescue of the government departments. In this paper, it has been proposed to establish emergency coordination mechanism guided by supervision department of the government and joined by enterprises in the Chemical Industrial Park, with the theme set as exchange and cooperation, we can see in Figure 2.

Because of large number of enterprises close to each other in the Chemical Industry Park, to ensure safety production of the enterprise itself is far from meeting the realistic requirements of safety development. Each chemical enterprise expects to obtain more safety information of neighboring enterprise during the production process, Emergency rescue in the park should follow the principle of sharing the emergency rescue resource. During the rescue, each enterprise should jointly participate in the rescue of neighboring enterprise by applying the philosophy of "mutual rescue also means rescuing yourself". At the same time, it is also important to prevent unnecessary damage to itself caused by the accident expansion, and to minimize casualties and property losses as well as the occurrence of the accident Domino effect. When carrying out its own safety management mode, the enterprise should corporate and discuss with each other with regard to major safety issues crossing enterprises. In terms of supervision of chemical enterprises in the park, the government supervision department in the park, in cooperation with enterprises, should jointly review project safety, make the safety development plan of the park, develop the safety policy, find out potential hazard source which may impact the safety operation of the whole park and timely eliminate the risk. Maintaining working order of high efficiency and safety operation in the chemical industry park, the safety production of the enterprise in the park can be ensured and the coordination development of the enterprises can be promoted at the same time. Achieving overall long-term safety production is the ultimate target of the safety supervision of Chemical Industrial Park. In addition, people's awareness and preparation for the prevention of dangerous sources is very poor. Residents, enterprises and personnel of administrative institutions do not have proper ability to prevent dangerous accidents and handle emergency. Residents and enterprises, especially migrant workers, lack the necessary training and education. They tend to work in a more dangerous job. Therefore the risk is much higher.
Organization coordination and communication is a key step in the process of the establishment of major hazard sources emergency system. However, the efficiency of the emergency system can’t be achieved solely depending on functional departments of the enterprises. It needs to stimulate the initiative of each employee of the enterprise to actively participate in the emergency process. Furthermore, the neighboring residents and enterprises should be included in the organization of the emergency management. It is expected to escalate the accident emergency management system to social management level, and reinforce the participation and coordination of all stakeholders. Only through constant communication and coordination, the efficiency and effectiveness of emergency management can be realized. Therefore, all departments of the enterprises must have the ability to communicate, coordinate and corporate quickly for both routine and emergency occasion. They should also be able to announce the information effectively, guarantee rapid transmission of information and transmit prevention and rescue information to employees in time.

**Improve the Contingency Plan System of the Chemical Industrial Park**

The establishment and improvement of the contingency plan system is of great importance in current construction of the Chemical Industrial Park (Figure 3). The following should be considered when making contingency plan: disaster monitoring and early warning ability, social control efficiency, residents reaction capacity, chemical disaster rescue capability, and resource availability.

![Figure 3. Contingency Plans based on scenario-construction.](image1)

**Figure 3. Contingency Plans based on scenario-construction.**

![Figure 4. Major Hazard Emergency Information Coordination Model of Chemical Park.](image2)

**Figure 4. Major Hazard Emergency Information Coordination Model of Chemical Park.**

**Improve the Emergency Information Management System**

In our survey, we found that enterprises did not have unified safety information system and development plan. They did not have clear target. They were short of compound talent mastering both safety production and information management, and lack of standard procedure of safety production information management. Their understandings of the development of information technology were inadequate and investments in information technology were inadequate too. They did not have perfect policies, technical standards and norms for the construction of safety production information system, nor assessment and evaluation system.

To effectively carry out information management in emergencies, it is necessary for the enterprises to build various sound policies of emergency information management, including report policies, analysis policies, responsibility policies, rewards and punishment policies and learning policies, to ensure responsibilities of information management agencies to be clear, staff's enthusiasm and initiative to be developed, basic principles and procedures dealing with emergencies to be implemented and emergency information management to be carried out in an orderly manner. We can see the major hazard emergency information coordination model of chemical park in Figure 4. For example, quantitative management of major hazard source can be achieved through tracking the key monitoring points. Monitoring system can produce and demonstrate data in terms of the relevant monitoring points according to all kinds of information such as monitoring data of the hazard sources, equipment specifications, the nature and capacity of equipment storage media etc. These data can be
listed for statistic to facilitate daily management. The distribution map of major hazard points can be developed on the geographic information map of the enterprise and the surrounding vector, to provide relevant information for the monitoring personnel. The information of major hazard sources location inside the enterprise, road distribution, firefighting set, surrounding environment and weather should be marked out on the geography information map, to support the accident disposal.

Conclusions

Any companies do not expect the accidents happen in their own areas, but accidents still happen. It is not only for the benefit of the enterprises, but also the social responsibility to be undertaken by the enterprises to strengthen the emergency management of enterprise hazard sources and strengthen the safety management of Chemical Industry Park. The safety resource database on the basis of major hazard sources in the park has to be set up to realize comprehensive basic information management. Through integration with the real-time operation system, both dynamic update of the basic information and real-time tracking and warning of site safety information can be achieved. In addition, simulation models of different accidents are to be established to put the expert system into application such as accident simulation and evaluation and accident hazard analysis. At the same time, the configurable emergency rescue contingency system will be provided to assist in the decision making about the accident drill and accident rescue. Only through constant innovation of emergency tools can the value of the emergency information be explored to the maximum extent, to make the emergency management of the Chemical Industrial Park process-based, standardized and scientific.

Acknowledgment

Supported by Central University basic scientific research business special fund project Youth Academic Innovation Project (11zy051).

References


