



Research on the construction and application of double prevention system for safety production in chemical enterprises

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Abstract The double prevention system is an effective measure to prevent the occurrence of production safety accidents, improve the production safety management level and ensure the safety of employees' lives and properties in enterprises. Based on the excellent experience in the construction and application of double prevention mechanism in coal mine, non-coal mine, construction and transportation, special equipment and other industry fields, we analyze the current situation of safety management in chemical enterprises, and establish the double prevention safety management system of chemical enterprises' safety production risk grading and control and hidden danger investigation and management according to the characteristics of chemical enterprises' production, which can solve the problems encountered by chemical enterprises in the process of safety management. In the process of safety management, chemical enterprises encountered the problem of "not recognizing, not thinking, not managing". It was also applied on site in a chemical fertilizer production enterprise. By supervising the implementation of the safety responsibility system, strengthening the safety training efforts of front-line employees, and actively leading all employees to participate in the implementation of the dual prevention system, the expected practical effect was achieved, with a view to providing useful reference for the construction and implementation of the dual prevention safety management system of safety production risk grading control and hidden danger investigation and management in similar chemical enterprises.

Keywords Risk classification management; control hidden risks investigation; treatment of chemical enterprise safety management

Introduction

The production and operation activities of chemical enterprises will involve the production, storage and transportation, use of hazardous chemicals and other dangerous operational activities, more dangerous sources and hidden dangers, easy to cause explosions, toxic and hazardous gas leaks poisoning and other accidents, resulting in serious personal injuries, property damage and huge social impact.

In recent years, the situation of safety production in chemical enterprises is very severe with frequent accidents [1]. Taking 2022 as an example, Anhui Haoyuan Chemical Group Co., Ltd. suffered poisoning and suffocation accidents on May 11, and petrochina Qilu Branch suffered poisoning accidents on May 18, causing large casualties. On the one hand, the occurrence of the above accidents is due to the relevant operators did not seriously comply with the safety management regulations of confined space operation, but fundamentally due to the defects in management; As a result, employees' safety awareness is weak, risk control and hidden trouble screening are insufficient, and safety control measures are inappropriate, which leads to accidents. In recent years, the dual prevention mechanism has been gradually implemented in many fields such as coal mine, non-coal mine mountain, rail transit, construction industry, special equipment, and urban construction, and has achieved remarkable results [2].



Analysis of current situation of safety management in chemical enterprises

At present, most chemical enterprises have carried out safety production standardization work for many years, and a set of safety management mode has been formed within the enterprise. However, the traditional production safety supervision mode is based on accident results for management and prevention, and there are still some problems in the process of production safety [3-4]. As far as chemical enterprises are concerned, the following problems still exist:

(1) The consciousness of safety production is weak, the quality of operators is not high. Many accidents are caused by human factors. In the production operation, whether the operation is standardized directly affects the result of things in the current society, there are many chemical enterprises and great demand for employees, but there is a serious shortage of professionals with professional skills. Many employees lack job knowledge, only understand the operating procedures, but do not have a clear understanding of the hazard degree of post hazard sources, risk prevention and control measures, emergency treatment principle and other knowledge, and cannot give attention to the attitude. There are some employees have a fluke mentality, do not operate according to the rules and regulations, rely on experience to omit the operation steps, for problems in the operation or equipment problems, ignore or delay processing. These problems are hidden dangers that cause accidents, which must be addressed in time. Hidden dangers that are not properly dealt with will lead to accidents, which will cause serious consequences.

(2) The production safety responsibility system of all employees has not been effectively implemented and all employees have not participated in the accident. Every link of chemical production will have a great impact on the safety of enterprises. Many employees do not know their own post safety responsibilities, think that safety work should be handed over to professional safety personnel, do not know the hazard source of the post, do not understand the risk control measures, do not actively participate in the safety work.

(3) supervision and management is not in place. Although some enterprises have developed a safety management system, due to the lack of effective combination of corresponding supervision and assessment measures with business performance, the system is not implemented enough, so that the system becomes a mere formality with poor effect; Some enterprises only learn from the relevant experience and norms of other enterprises in the chemical industry when establishing safety management system. The management system differs greatly from the actual situation of the enterprise, which leads to unclear management responsibility and failure to find the person in charge when there are problems, which also causes great obstacles to supervision and management.

Faced with these problems [5-6] in the production process of chemical enterprises, and the rapid development of the new era of social safety management level of the new requirements, the construction of enterprise safety production double prevention system is very necessary, fundamentally eliminate the hidden danger of accidents. Fundamentally solve the problem, effectively control the risk in advance, control the hidden danger, minimize the occurrence of accidents, strengthen the emergency rescue work, the accident emergency measures more perfect, reduce the impact of accidents, so as to improve the production safety management level of chemical enterprises.

Establishment of safety management system of double prevention mechanism in chemical enterprises

1 Preparation stage

1.1 Establish an organizational structure. In order to ensure the orderly development of double body, first of all to establish an organizational structure, strengthen the leadership of the enterprise, establish a leading group and working group, the leading group needs to be led by the main responsible general manager of the chemical enterprise, responsible for the management of production leaders as deputy leaders, production safety maintenance. The heads of financial departments and other departments participate together with the members, and the heads of functional departments lead their own staff to form a working group. Taking a chemical fertilizer factory as an example, the establishment of enterprise organization is shown in Figure 1.

1.2 Clarify the job responsibilities. The general manager is responsible for conveying the policies, requirements, laws and regulations related to production safety issued by the government. The general manager leads the leading group to collect relevant materials, including the process equipment specification and process



flow chart of chemical fertilizer production, and the production of nitrogenous compound fertilizer. The physical and chemical properties and dangers of materials required for synthetic ammonia, as well as the accidents that have occurred in the production of chemical fertilizer and similar accidents in the industry, were sorted out and the detailed implementation plan adapted to the work of the enterprise was formulated, the responsibilities and work contents of responsible departments were clearly divided, and the specific implementation work of the dual prevention mechanism was implemented to the staff.

1.3 Education and Training. The safety department assists in the overall management and supervision of the double-body work, organizes the training and education of all staff, establishes the assessment reward and punishment system, and supervises all departments and personnel at all levels to implement the responsibility of safety risk prevention and control and hidden danger investigation. Employees are trained at different levels, so that employees of different positions in the enterprise have appropriate safety capabilities, and lay a stable foundation for the implementation of safety management of the dual prevention mechanism.

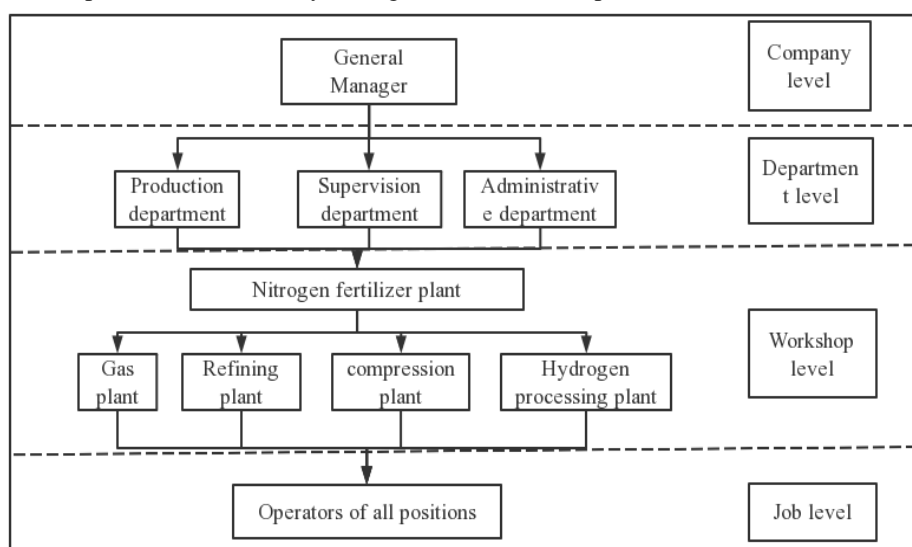


Figure 1: management organization of a fertilizer enterprise

2. Establishment of risk hierarchical control system

2.1 Workflow

Risk hierarchical control system is to make enterprise security management more systematic, more targeted and more practical improvement, is the basis of hidden danger investigation and management system. The specific construction process is shown in Figure 2 [7].

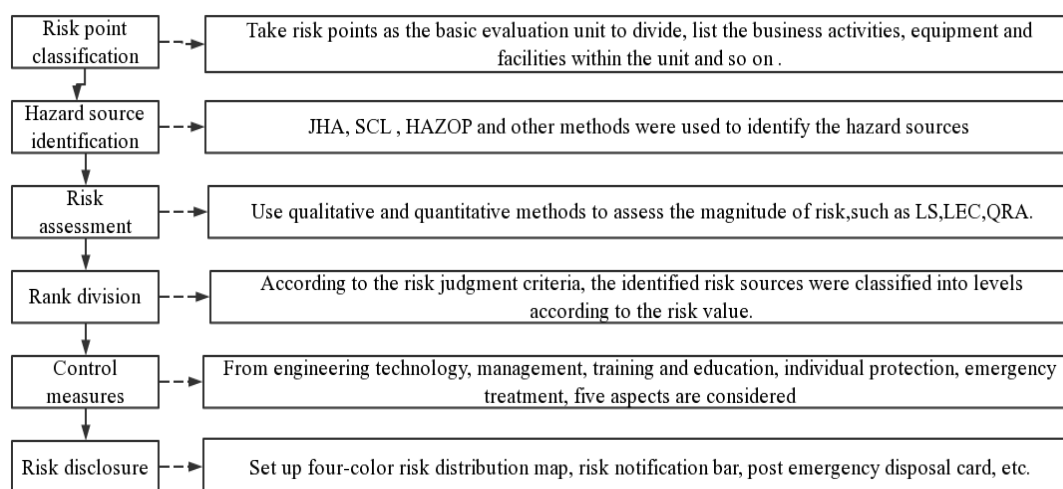


Figure 2: Flow chart of risk hierarchical control system



2.2 Implementation Plan

With the assistance of security personnel, the heads of all departments and workshops of the enterprise shall lead the staff of their departments and workshops to organize and carry out risk identification and assessment.

(1) Risk identification. Firstly, the risk points in the fertilizer production plant area are divided, the list of equipment and facilities and the list of operation activities are listed, the hazardous substances and energy in each risk point are analyzed, and what accidents may occur under what circumstances are identified mainly from the four aspects of human, physical and environmental management.

(2) Risk assessment. Analyze whether the existing risk control measures of the risk point are intact and effective, and use the risk assessment criteria to evaluate and grade the risks, such as the risk matrix evaluation method (LS)(R=L*S) [8]. According to the evaluation value R, the risk level is divided into low risk, general risk, large risk and major risk. The four colors of blue, yellow, orange and red are used to mark the general layout of the production area of a chemical enterprise, where R represents the risk degree of the risk point, L represents the possibility of an accident, and S represents the severity of the accident consequences. The evaluation scores [9] are shown in Table 1~3.

Table 1: Probability of accident (L) judgment criteria

score	The likelihood of an accident	Mean time between accidents/year
5	It happens every year in the workshop	1 (Frequent) It is expected to occur more than once a year
4	Occurs throughout the production site	1~3 (Possible) is expected to occur once a year
3	It happened within the company	3~10 (accidental) How many times are expected to occur during the life of the device
2	It has happened in the industry	10~32 (Perhaps possible) More than one occurrence is expected during the lifetime of the device
1	Never happened	32~100 (unlikely)

Table 2: Criteria for judging the severity (S) of accident consequences

score	Casualties/person	Property damage/ten thousand yuan	Shutdown situation	Degree of consequence
1	<1Minor injury	<1	The equipment or device is shut down for 1 day	Corporate influence
2	1~2Seriously injured	<15	The equipment or device is down for > 2 days	Group companies and surrounding impact
3	3Seriously injured	100	Shutdown of other installations	Industry impact
4	1~2Die or3~9Seriously injured	200	2 units	Significant domestic impact
5	3~9Die or) 10Seriously injured	>500	>2units	Major international influence

Table 3: Risk rating Criteria (R)

R-value	Risk level	color
1-6	Low risk	blue
8-12	General risk	yellow
15-16	Greater risk	orange
20-25	Major risk	red

(3) Risk control. According to the principle that the higher the risk degree, the higher the level of management and control, the management and control level is determined. Personnel at different levels propose improved control measures, and then the specific control and control measures are implemented step by step to ensure the safety control and control measures at risk points are intact and effective.

2.3 Establish a risk management ledger

Combined with the actual situation and characteristics of the production site of the chemical enterprise, summarize and sort out the process data and compile the risk point ledger. As shown in Table 4, post



identification-analysis-evaluation-grade-control ledger is made for the operation activities in restricted space of a fertilizer enterprise. Risk is dynamic and will increase when control measures fail or weaken. Therefore, a new round of risk identification and assessment should be carried out timely to discover and control.

Table 4: Operating activity risk classification control ledger

Operational activity	Dangerous and harmful factors (human, material, environment, management)	L	S	R	Evaluation level	Control level	Level of responsibility	New improvement measures
Open the manhole for ventilation	Insufficient ventilation, wrong sampling analysis	2	3	8	4	blue	Post level	
Identification of hazardous and harmful factors	Insufficient identification, missing items	2	3	6	4	blue	Post level	
Develop operational safety measures	Safety precautions are not in place	2	4	8	4	blue	Post level	
Safety confirmation	Not confirmed on site, no guardian or supervision is not in place	2	4	8	4	blue	Post level	Implement the safety confirmation table
Work in confined space	Violation of restricted space safety certificate content	3	4	12	3	yellow	Workshop level	
Completion and acceptance	Failure to go to the site for acceptance or acceptance in accordance with standards	2	2	4	4	blue	Post level	

3. Establishment of hidden danger screening and management system

3.1 Work flow

Hidden trouble screening and management is to conduct comprehensive control of the control measures of risk points through hidden trouble screening, timely discover the potential hidden trouble caused by the failure of the control measures of risk points, timely eliminate the hidden trouble, reduce the risk, is a supplement to the hierarchical risk control, is the second line of defense to prevent accidents [10]. The construction process of hidden danger screening and governance system is shown in Figure 3.

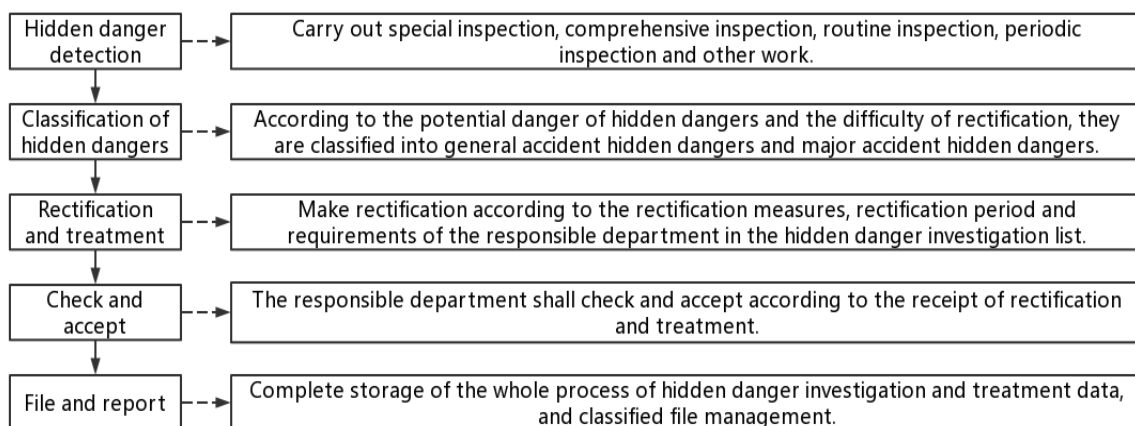


Figure 3: Flow chart of hidden danger troubleshooting and management system

3.2 Implementation Procedure

The leading group of double-department work will organize and carry out hidden danger investigation, the steps are as follows:

(1) Hidden danger investigation. First, determine the personnel in charge of the investigation team of the department, use the safety check list to divide and subdivide the objects such as the control measures of each risk point in the production site of the enterprise and the requirements of the standard regulations. The investigation list is compiled into a table according to the sequence of the subsystems of the inspection project system to avoid omissions.

(2) Hierarchical control of hidden dangers. The hidden dangers found in the chemical fertilizer production site are divided into major hidden dangers. General hidden dangers troubleshooting personnel shall issue rectification notice to deal with the hidden dangers that cannot be solved immediately within a time limit, and the responsible organization shall put forward rectification or disposal opinions after investigation and evaluation, and then implement management step by step.

(3) Review and acceptance. The governance situation will be reported back to the department that sends the rectification notice, and the inspection team will conduct the acceptance according to the principle of whoever investigates.

Hidden dangers are continuous, need to be discovered and eliminated in time, combined with the production characteristics of enterprises need to carry out regular or timely hidden dangers investigation, enterprises from the investigation type of personnel time arrangement and other aspects of consideration, to develop the investigation plan. The restricted space operation of fertilizer enterprises is taken as an example in Table 5.

Table 5: Troubleshooting plan

Risk point	Control measures	Routine inspection		Special investigation			Comprehensive investigation			Hidden danger level
		Post level	Workshop level	Department level			Company level			
		Once per shift	Once a day	Once a week	Once a week	Once a month	yearly	Once a month	quarterly	
Confined space operation	Engineering technology				√					
	Management measure		√							
	Training and education						√			
	Personal protection		√							
	Emergency disposal						√			

Conclusion

(1) Based on the characteristics of chemical enterprises, this paper clearly divides the main body and scope of responsibility, and relevant departments perform their regulatory duties, actively guide all employees to participate in the construction of the dual prevention system, and fully implement the work to the leaders, departments, workshops and posts at all levels of the enterprise.

(2) Establish a "four-level" organization of a chemical fertilizer enterprise's dual prevention system, carry out "hierarchical" training for employees, and carry out on-site application in chemical fertilizer enterprises. Carry out hierarchical risk control and hidden danger screening and treatment, and achieve the expected effect, improve the efficiency of enterprise safety management, and ensure enterprise safety production.

(3) To ensure the effective operation of the safety dual prevention system of chemical enterprises, continue to carry out risk hierarchical control and update and improve, continue to carry out hidden danger screening and management, realize the continuous deepening of the dual prevention system, chemical enterprises will continue to improve the safety management level.



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