

Original Research Article

Analysis of Fire and Explosion Prevention Safety Technical Measures in Chemical Enterprises

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Abstract: The chemical industry plays a significant role in the overall economic development of China. However, due to the particularity of chemical enterprises, how to ensure production safety in chemical enterprises is a serious topic. On the basis of a brief explanation of fire and explosion prevention in chemical enterprises, this study analyzes the fire and explosion prevention safety technical measures in chemical enterprises from several aspects: controlling fire and explosion hazards, setting up explosion-proof safety measures, ensuring essential fire and explosion protection devices, and keeping fire and fire safety in mind. We look forward to making more people understand and understand the fire and explosion safety technical measures of chemical enterprises, and drawing attention to them, in order to ensure the safety and efficiency of production in chemical enterprises.

Keywords: chemical enterprises; Fire and explosion prevention; Security technology

For any enterprise, security is no small matter. Especially for chemical enterprises, safety is even more important, and fire and explosion prevention are of utmost importance. Any problem at any stage can bring serious safety hazards or accidents. The significant personnel and economic losses caused by major safety accidents in chemical enterprises in recent years are still vivid in people's minds. Therefore, it is necessary to attach importance to and implement fire and explosion safety technical measures in chemical enterprises. While improving the safety management level of chemical enterprises, it is also necessary to enable them to achieve safe production and reduce the probability of safety accidents.

1. Overview of Fire and Explosion Prevention in Chemical Enterprises

Chemical enterprises are different from many other enterprises. Due to the particularity of their production products, fire and explosion safety management is extremely important in both the production process and product storage process. Many substances in raw materials, intermediate products, and finished products used in chemical production have flammable and explosive properties. Often, the production environment is carried out under conditions such as high temperature, high pressure or low temperature, chemical corrosion, and many complex chemical reactions. This further increases the likelihood of major safety issues such as fires and explosions occurring in chemical enterprises. Due to production and operation needs, chemical enterprises cannot completely use non-toxic, harmless, non explosive, and non flammable substances. Therefore, it is necessary to do a good job in fire and explosion prevention. Adopting fire prevention and fire safety technical measures suitable for chemical enterprises, setting up defenses from multiple aspects. In addition to strictly following the operating procedures and requirements, various fire and explosion safety technical measures should be applied to reduce necessary conditions that may cause danger, and minimize the area and degree of damage as much as possible to prevent uncontrollable spread of fire or explosion accidents, Maximize the

operational safety of chemical enterprises.

2. Fire and Explosion Prevention Safety Technical Measures for Chemical Enterprises

2.1. Control the sources of fire and explosion hazards well

2.1.1. Hazardous material control

From the characteristics of production in chemical enterprises, many raw materials and products have flammable and explosive characteristics. Strengthening the management and monitoring of these hazardous materials is crucial to eliminate the danger of fire and explosion accidents from the source. When choosing to store chemical raw materials, products, etc., it is advisable to choose materials with flame retardancy and non flammability for packaging. Generally, wood packaging is preferred, and wood should have flame retardancy. The current advanced instrument - the wood stack method wood flame retardant combustion tester - can be used to test the flame retardancy of wood packaging. Under specified combustion conditions, inspect the actual combustion quality loss rate and flame burning time of various production and engineering wood with a thickness of 20mm or more after flame retardant impregnation treatment. If the flame combustion time is less than or equal to 6 minutes, it is qualified, and if it exceeds 6 minutes, it is unqualified. After testing, the combustion quality loss rate is less than or equal to 60%. Wood with a flame burning time of less than or equal to 6 minutes can be identified as flame-retardant wood and can be used in some chemical products and raw material packaging. To play a positive role in fire and explosion prevention. At the same time, try not to use strong oxidants to prevent the danger caused by excessive accumulation of products and raw materials, as well as the potential risk of fire and explosion caused by contact between products and reactor materials. In the process of chemical production, comprehensive monitoring should be carried out strictly according to the chemical operation process. It is strictly prohibited to come into contact with flammable, explosive or strongly oxidizing substances. During product production and storage, it is necessary to ensure good sealing and no leakage. Regular and irregular comprehensive inspections should be conducted to prevent fire and explosion risks at the source. The working conditions of the wood stack method flame retardant combustion tester are shown in the table below:

Table 1. Working conditions of the flame retardant combustion tester for wooden pallets.

ambient temperature	room temperature-°C
ambient humidity	≤70%
working voltage	exchange220±10V
Timing accuracy	3min±GA/T
temperature error	310°C≤±10°C

2.1.2. Control of ignition sources

Fire and explosion prevention are extremely important in chemical enterprises, as there are many ignition sources in chemical enterprises. There are several specific categories (as shown in Table 2) that must be effectively addressed in conjunction with the actual situation of the enterprise. If heating materials, maintenance equipment, etc. need to be used, open flames should be used as much as possible. Reasonable division of production areas should be made, and potential hazards should be fully considered. Areas that frequently use

open flames must be classified as no fire zones.

Table 2. Classification of ignition sources in chemical enterprises.

classification	cause
chemical heat source	Produced due to the release of heat from chemical reactions
Heat source	Caused by heat conduction
Mechanical fire source	Produced by physical work done by mechanical equipment
Electric ignition source	Caused by electric sparks

2.2. Make good explosion-proof safety settings

2.2.1. Install explosion-proof walls

In terms of fire and explosion safety measures in chemical enterprises, the installation of explosion-proof walls is an important technical content. It refers to isolating production areas with fire and explosion hazards with explosion-proof walls, avoiding secondary damage caused by explosions in the event of danger, and reducing losses to chemical enterprises. When entering the area, explosion-proof door buckets should be installed to help solve traffic and explosion-proof problems. Generally, the first door can be an explosion-proof door, which is made of special steel materials to ensure the explosion-proof effect. It should be noted that a certain volume should be retained inside the explosion-proof door hopper, so that the concentration of combustible gases entering the hopper is lower when the door is opened. For chemical enterprises, explosion-proof door buckets not only have explosion-proof functions, but also serve as safety exits for buildings. They are very important safety settings and must be taken seriously.

2.2.2. Set up a pressure relief device

The importance of production safety in chemical enterprises is self-evident. For factories with explosion hazards, pressure relief devices should be installed. Lightweight roof pressure relief, door and window pressure relief, and lightweight exterior wall pressure relief can be adopted. It should be noted that the weight of color steel plate composite wall panels and roof panels is relatively light, and they need to be disconnected and overlapped at a certain length to achieve pressure relief effect. This should be noted. When arranging the pressure relief surface, it should be as close as possible to the explosion site. If it is a side pressure relief, it should be avoided as much as possible from outdoor equipment, places with concentrated personnel, and main roads. The pressure relief ratio should meet the relevant requirements, as shown in Table 3 of the "Code for Fire Protection Design of Buildings".

Table 3: Factory explosion hazard level and pressure relief ratio table (refer to the United States)

Explosion hazard level of factory buildings	Pressure relief ratio (m ² /m ³)
Weak level (particulate dust)	0.0332
Intermediate (coal powder, synthetic resin, zinc powder)	0.0650
Strong grade (in dry indoor paint, solvent vapors, aluminum powder, magnesium powder, etc.)	0.2200
Premium (acetone, natural gasoline, methanol, acetylene, hydrogen)	As large as possible

2.3. Fire and explosion safety protection devices are essential

2.3.1. Automation security protection device

When conducting chemical production operations in chemical enterprises, many dangerous signals are difficult to distinguish clearly with the naked eye, so it is necessary to set up automated devices for safety supervision in possible hazardous areas. When a dangerous state occurs, these automated safety protection devices will release some signals, giving people strong auditory and visual stimulation, which can timely remind workers of the danger, so that they can handle the safety warning area or stay away from the dangerous area. In the process of continuous progress in modern technology, the application of automated safety protection devices in chemical enterprises is becoming increasingly common, such as automatic fire alarm systems, sprinkler systems, etc.

2.3.2. Safety device

Safety devices such as safety valves installed on boilers and pressure vessels, and backup power sources that can be automatically put into operation in case of sudden power outages. These are common safety devices in chemical enterprises. It can effectively avoid the occurrence of some dangers and also ensure the smooth progress of chemical production.

2.3.3. Fire and explosion safety devices

The installation of fire and explosion-proof safety devices in chemical enterprises is a routine operation and an indispensable link. Common flame arresters include flame arresters, safety liquid seals, water sealed wells, one-way valves, and fire extinguishers, mainly to prevent external open flames from entering equipment containing flammable and explosive substances, and to prevent flames from spreading through pipelines.

2.4. Fire safety must be kept in mind

According to different fire types and functions of facilities, the chemical plant shall be equipped with different fire-fighting facilities, such as fire monitoring and alarm system, fire water supply system, foam extinguishing system, dry powder extinguishing system, carbon dioxide extinguishing system, fire station, etc. Among them, in the chemical plant area, the setting of the fire water supply system is relatively complex. For areas with intensive work activities such as process equipment areas, fire hydrants can be placed around the area, but the distance between adjacent fire hydrants should not exceed 60m. For Class A process equipment with a height of 20-40m from the ground inside the process equipment, it is necessary to place fire water cannons in a close position and avoid placing objects that may obstruct the fire water flow between the two. When it is not possible to set up fire water cannons or equipment outside the protection range of fire water cannons, fire water supply vertical pipes can be installed. For equipment with a height of more than 40m and difficult to cool after being heated, the protective effect of mobile fire-fighting equipment is not obvious, and fixed and semi fixed water spray or water spray cooling systems can be set.

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