

Chemical process and equipment safety analysis

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Abstract: In today's era, the chemical industry is an important component of the national economy, and in the rapidly changing market process, the position of chemical equipment is crucial. The chemical process is closely related to the processing effect of chemical products, which determines the degree to which the target value of chemical products is achieved. If chemical equipment malfunctions, the production organization and operation mode of chemical enterprises and the processing activities of chemical products cannot be smoothly carried out, and chemical enterprises will be in a weak position in the technical competition in domestic and foreign markets. Therefore, it is very important to analyze the safety of chemical processes and equipment. In view of this, the article will analyze the safety issues and corresponding countermeasures of chemical processes and equipment, with the aim of preventing potential problems and creating a safe production environment for chemical processes and equipment.

Keywords: Chemical process; Equipment safety

Introduction

The production of chemical processes and equipment covers a wide range of fields, from basic chemicals to high value-added products, meeting various social demands for chemical products, promoting social progress, and promoting economic growth. However, chemical processes are diverse and complex, with high risks. Therefore, chemical process and equipment production are areas that require special attention, and ensuring safety is the primary task. Only in this way can the safety of personnel, sustainable development of enterprises, and environmental protection be guaranteed.

1. Chemical process and equipment safety issues

1.1 Hidden dangers in chemical process flow

In the safety issues of chemical processes and equipment, the problem of chemical process flow is a major hidden danger. The unsafe factors in chemical process flow may come from incomplete chemical process design or overly complex chemical process flow. Specifically, firstly, there may be deficiencies in the design of chemical processes, such as chemical personnel not taking into account the characteristics of hazardous substances, or insufficient safety devices being installed. Secondly, the complexity of the process flow places high demands on the professional quality of operators. If chemical workers do not consider a particular detail, it increases the risk of operation. Thirdly, the chemical process itself may have unstable factors, such as uneven mixing of chemical raw materials and the possibility of accidents.

1.2 Subjective issues of chemical personnel

The subjective problem of chemical personnel is another factor that threatens the safety of chemical processes and equipment. On the one hand, chemical personnel do not pay enough attention to safety issues and do not pay enough attention to them in chemical process design, resulting in unscientific design schemes. As a result, chemical reactions may pose risks during the process; Neglecting importance in chemical equipment can lead to changes in the environment and conditions in which the equipment is located, which can have an impact on the equipment itself. The lack of safety awareness in both aspects can pose a threat to people's life and property safety. On the other hand, the quality of chemical process personnel is relatively low, lacking certain theoretical knowledge and practical experience, which makes it difficult for the safety evaluation of chemical equipment to proceed smoothly. In summary, humans are not machines and there may be subjective factors. From a certain perspective, humans are unreliable and need to rely on online monitoring of production data, such as temperature, pressure, pH values, and other easily detectable data, to automatically monitor and establish automatic control and sequence control programs. This allows fine production to self feed, detect, and control reactions, and after the reaction is completed, it can be self processed, such as intelligent layering, dissolution, and material transfer.

1.3 Chemical process safety issues

Chemical engineers need complete basic information when designing chemical process safety. However, in reality, the basic information is not complete enough and there is a lack of accurate data, such as data on reaction mechanisms, raw material properties, etc. This situation leads to chemical designers being unable to fully understand hazardous factors and develop effective safety facilities. At the same time, chemical personnel need similar process reference cases to provide reference for chemical process safety design. However, in reality, certain chemical processes have unique characteristics and do not have similar processes, which poses greater challenges to chemical designers. To address this issue, chemical designers need to conduct more in-depth and detailed risk assessments and simulation simulations. In addition, in fierce market competition, designers may be required to shorten the design cycle and accelerate the design progress in order to take the initiative in the competition. However, short time can lead to the neglect of critical and detailed safety issues, and insufficient time for safety testing to verify.

1.4 Management and maintenance issues of chemical equipment

Many chemical factories face certain equipment safety issues during the production process, and the construction of chemical

equipment is complex, resulting in various types of faults. Therefore, the overall management and maintenance of chemical equipment is difficult. In view of this, firstly, chemical equipment enterprises can improve their technology, enhance the application performance of chemical equipment, improve the existing problems of chemical equipment, and strictly manage some parts that often have problems. Secondly, there are problems with equipment management in enterprises, which have not been in line with ideals. For example, many chemical equipment management personnel have not strictly followed the norms and standards for equipment maintenance, and have operated according to their own wishes and inherent experience, which has instead increased the problem of equipment failures during operation. Once again, equipment maintenance work is complex and requires companies to arrange personnel with professional technical skills. However, many chemical equipment companies have not strictly followed this employment standard, resulting in emergency situations during equipment operation that equipment maintenance personnel cannot handle in a timely manner.

2. Chemical process and equipment safety response measures

2.1 Optimize chemical materials and strengthen electrical management

The hazardous factors of chemical processes and equipment refer to the safety hazards that exist in the production process and the conditions that may cause safety hazards. The safety analysis of chemical processes and equipment is not only an analysis of chemical production, raw materials, and equipment, but also needs to identify the possible causes and types of safety hazards, summarize them together, and develop relevant measures to prevent potential hazards. So from the source, chemical enterprises and production personnel must understand the characteristics of chemical production raw materials, store them in different categories, and formulate relevant rules. For example, in areas where liquids and gases are stored, prominent warning signs should be set up to remind passing personnel to pay attention to safety. In addition, there are numerous chemical process production routes in the production lines of chemical enterprises, and relevant personnel need to strictly follow the national and enterprise regulations to optimize the production lines and reduce air pollution. For example, in electrical design, adhering to the principles of green development and sustainable regeneration, combined with new era processes and technologies, reducing potential hazards in electrical equipment, optimizing the production environment, and installing explosion-proof facilities on electrical devices. Special attention should be paid to conducting pipeline inspections before electrical circulation, such as checking whether the pipelines are properly sealed and whether the valves are secure, to ensure the safety of workers and the production environment.

2.2 Strengthen protective equipment to defend the final line of defense

In chemical reactions, protective devices are prone to high temperatures or pressures. In such cases, chemical personnel need to choose detection methods or alarm measures to ensure the safety of protective devices in chemical reactions and reduce safety hazards. Firstly, staff can install emergency control equipment on top of protective devices to reduce the risk factor in chemical production processes. Secondly, set up corresponding sewage pipe facilities. It is inevitable for chemical enterprises to encounter waste during production. Waste is generally harmful substances, and it is crucial to handle hazardous substances safely. Thirdly, chemical workers should enter the production site, take protective measures, wear safety masks, protective gloves, protective shoes, etc. because the chemical production site is complex, and workers need to use scientific, legal, and rigorous methods to ensure safety and ensure the quality and efficiency of production. Fourthly, chemical enterprises should place certain fire extinguishers, alarms, etc. based on production scale and equipment quantity, and set corresponding protective measures for possible problems on the production site to ensure safety and orderly production processes. For example, remote monitoring and intelligent safety control technologies should be adopted to improve safety management efficiency. In the future, safety protection devices will gradually achieve automation and intelligence, providing reliable solutions for chemical production.

2.3 Emphasize safety training and enhance safety awareness

Chemical equipment designers play a crucial role in chemical processes and equipment safety management. Their designs and decisions will affect the safety of the entire production process. Therefore, chemical equipment designers must receive professional training and education. The training content for chemical equipment designers is multifaceted. Firstly, the training enables designers to understand the principles of chemical equipment safety design and the latest safety technologies, update their knowledge base, and keep up with the latest trends of the times. Designers will understand how to identify hazardous factors, assess risks, and develop corresponding safety measures. Secondly, training enables designers to master safety regulations and standards, and ensure that the design meets legal requirements. Designers will learn how to evaluate the toxicity, flammability, and corrosiveness of chemicals, in order to better understand the dangers of chemical reactions. Thirdly, training will enhance the emergency response capabilities of designers. Designers will understand how to take appropriate measures in emergency situations, such as emergency evacuation, shutdown procedures, etc., to protect the safety of on-site personnel and the environment.

2.4 Introducing safety equipment to improve safety performance

Automation control can avoid subjective hazards caused by chemical workers, and with the rapid development of computer, electronics, and automation technology, it has been widely used in various industries. Therefore, automatic control and sequential control of chemical production are inevitable trends. Introducing advanced technology into chemical process production can help improve the efficiency of chemical process technology and equipment production, enhance the quality and output of chemical products, greatly promote the development of the chemical industry, and enhance the safety of chemical production. On the one hand, automation systems and monitoring equipment enter chemical enterprises and play an important role in chemical production lines. They can monitor key parameters in real

time, such as temperature, pressure, liquid level, and the progress of chemical reactions. When the system detects abnormalities, they can automatically take measures, such as starting and stopping devices, timely shutting down equipment, preventing accidents, and facilitating safety inspections by chemical personnel. Advanced technology has improved the controllability of chemical production, reduced the burden on chemical personnel, shared their responsibilities, and reduced the possibility of human errors. On the other hand, the application of digital factories and the Internet of Things in chemical production can improve the visualization and management of the chemical production process. Through advanced technology, management personnel can monitor equipment status, better grasp production process data, identify potential problems in advance, and take measures in advance. In addition, adopting advanced materials in chemical equipment can improve its reliability, such as using corrosion-resistant and high-temperature resistant materials to extend the service life of chemical equipment. In summary, introducing automation technology and advanced safety equipment can improve the safety of chemical production, enhance the technicality and accuracy of decision-making, and reduce the risk factor of the production process.

2.5 Adopting innovative management and implementing management systems

The safety of chemical processes and equipment cannot be separated from people, so it is necessary to manage chemical personnel to ensure the safety of chemical processes and equipment. Firstly, the traditional social management model is no longer suitable for today's era and enterprises. Adopting traditional social management methods will affect the effectiveness of management work. Therefore, chemical enterprises need to adopt innovative management strategies and develop new standardized strategies to meet current production requirements, ensure stable operation of chemical equipment, and reduce the occurrence of failures. Secondly, by introducing intelligent equipment, chemical enterprises can utilize information technology to strengthen equipment maintenance and management, and improve the efficiency of chemical equipment maintenance and management. Thirdly, the structure of chemical equipment is complex. In order to improve equipment productivity and ensure orderly equipment management, chemical enterprises can adopt a modular management strategy. By dividing modules, various parts can be effectively maintained to avoid the recurrence of chemical equipment failures and extend the service life of the equipment. Fourthly, chemical enterprises should establish a sound equipment management system, implement the management system, strictly supervise some maintenance processes in daily life, ensure that each task can be implemented on an individual basis, and ensure that chemical personnel can actively respond to potential safety issues.

3. Conclusion

In summary, as the times progress and society develops, chemical processes and equipment safety management also need to be updated and maintained in accordance with specific circumstances and changing times. The article aims to improve the overall safety of chemical equipment, ensure the full utilization of equipment value in the production process, improve production efficiency and quality, and lay a foundation for the long-term development of chemical enterprises by proposing safety issues in chemical processes and equipment and analyzing corresponding strategies.

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