

ADAPTIVE DESIGN ANALYSIS OF CHEMICAL PROCESSES AND CHEMICAL EQUIPMENT

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Abstract: With the further development of social economy, most business units and professionals are gradually realizing the important value of chemical production safety. In the structure of chemical process equipment, the quality of many chemical products is affected by external factors. Due to the influence of external factors, process design is one of the links that cannot be ignored during the construction of modern factories. The adaptive design of equipment structure can ensure equipment safety and reliable operation, and improve the production efficiency and quality of chemical products. Based on this, the article outlines the connotation of chemical process and chemical equipment, divided into The importance of adaptability design of chemical processes and chemical equipment was analyzed, and the adaptability design problems existing in current chemical enterprises were summarized. And an effective adaptive design plan is proposed for reference.

Keywords: Chemical process; Chemical equipment; Adaptive design

1 OVERVIEW OF CHEMICAL PROCESSES AND CHEMICAL EQUIPMENT

During the production of chemical processes, the adaptability of chemical processes and chemical equipment is very important. Workers need to combine the specific conditions and parameter values, Maintaining the internal pressure and temperature within the standard range will provide sufficient guarantee and support for the integrity, safety and operational stability of the equipment structure, and promote the sustainable development of the industry as a whole.

1.1 Chemical Process

Usually, chemical process refers to the chemical process of chemical raw materials. Methods and processes by which reactions are transformed into products. Typically, the chemical industry The art fair involves the following aspects: First, the simplified processing of chemical raw materials. This step is mainly embodied in the purification and crushing of chemical raw materials. Secondly, the initial reaction of chemical raw materials. Simply put, chemical raw materials are After a series of special processes, it is successfully transformed into chemicals that meet standards[1]. During this process, relevant personnel need to consider the actual situation Regulate and optimize the overall process temperature, also by adding appropriate amounts of catalyst to shorten the reaction time. Finally, for chemical products Carry out preliminary processing and post-reaction processing to ensure that it meets the corresponding requirements Project requirements. Chemical processes can also perform fine processing on rough-processed products. processing to ensure that the quality of the product meets the corresponding needs.

1.2 Chemical Equipment

Chemical equipment refers to the tools and equipment needed to produce chemical products. Prepare. There are many types of chemical equipment, which can be divided into heating furnaces, Chemical equipment such as crystallization equipment, separation towers, heat exchangers and chemical containers.

2. DO A GOOD JOB IN ADAPTABILITY DESIGN OF CHEMICAL PROCESSES AND CHEMICAL EQUIPMENT NECESSITY

Adaptable design of chemical processes and chemical equipment can comprehensively improve the practicality of chemical equipment. It is not difficult to see from the current status of traditional chemical production that the lack of adaptive design of equipment and chemical processes may prevent chemical equipment from fully exerting its production advantages. With the help of adaptive design, the practicality and reliability characteristics of chemical equipment can be brought out. Chemical enterprises can carry out diversified adaptive design work according to their own conditions and production conditions to ensure that they can be integrated with production activities. move to connect [2].

Adaptable design of chemical processes and chemical equipment can significantly Improve the efficiency and quality of chemical maintenance.

Doing a good job in the adaptive design of chemical processes and chemical equipment can comprehensively Improve chemical production efficiency. Designers can develop Carry out design work and abide by the principle of adaptability to ensure the effectiveness of chemical engineering design nature and scientificity, further improve and optimize the

equipment operation process, and comprehensively Improve the performance of chemical equipment to ensure that chemical companies can continue to Consolidate its position in the fierce and severe market competition environment [3]. During the practical application of chemical processes, the design procedures involved are cumbersome and involve certain production risks. Therefore, in order to ensure that the chemical production process is safer and more reliable, it is necessary to start with the adaptive design of chemical processes and chemical equipment.

3 PROBLEMS IN THE ADAPTABILITY DESIGN OF EQUIPMENT IN CHEMICAL PROCESSES

3.1 Installation Design Issues

During the installation and design of chemical process equipment, it is very important to make a good overall layout. In order to fully meet the needs of safe production, the most important thing is to strictly Carry out equipment operation in compliance with safety regulations and systems. According to the current development situation, it is not difficult to see that many enterprise production workshops have basic problems such as lack of rationality in design. Problems of random placement of equipment are very common, and various types of safety issues are common. Hidden dangers also have a negative impact on the efficient production of business units.

Many companies will experience excessive confusion during installation and design. There is no attention and emphasis on the overall sequence of operations. During the construction stage, some enterprises and units did not strictly follow the corresponding standards and specifications, and the construction environment There are more or less potential safety hazards in the section, and it is unable to provide sufficient guarantee and support for its overall safety and reliability. Although the enterprise unit has created a corresponding equipment maintenance system based on the actual situation, the staff The staff did not carry out maintenance in accordance with specific specifications and standards, which fundamentally reduced the The safety and stability of equipment operation.

3.2 Equipment Console and Bracket Design Issues

Relevant personnel need to focus on supporting and stabilizing the equipment. This method ensures smooth and stable operation of the equipment. Normally, There are relatively many factors that have a negative impact on equipment supports, such as self-weight, equipment appearance, etc. During the design and planning stage of the operating console, many factors need to be fully considered to ensure that the operating console is sufficiently sensitive. sex. At present, the equipment racks of most enterprise units are too old and have no Without timely updates and upgrades, even the most basic fixing and support cannot be guaranteed. The equipment may experience significant vibration or vibration during actual operation. Displacement, these will leave potential safety hazards for the normal use of chemical processes. In addition, because the operating platform is too old, it cannot meet the various needs of the staff and cannot be operated flexibly, which fundamentally affects the operating efficiency. [4].

3.3 Anti-corrosion Design Issues

Most chemical raw materials are highly corrosive and can easily affect equipment. In this case, it is necessary to design anti-corrosion equipment and pay attention to daily maintenance to ensure that the equipment is in safe and reliable working condition. At present, most chemical companies do not pay enough attention to the anti-corrosion design of equipment. The corrosion damage caused by chemical raw materials to equipment is ignored, and maintenance is not performed until the equipment fails, which seriously affects production efficiency and safety.

4 ADAPTABLE DESIGN METHODS FOR CHEMICAL PROCESSES AND CHEMICAL EQUIPMENT

4.1 Adaptable Design of Chemical Processes

4.1.1 Process parameter optimization

Parameter control refers to controlling various production conditions within the standard range and maintaining the error within the standard range, in order to save energy and improve chemical production. Provide sufficient protection efficiently. Parameter control is the key to smooth chemical production The key is that the production quality and production efficiency of chemical products are often negatively affected by parameter control. In this case, relevant personnel need to optimize parameter control based on the actual situation. [5].

Normally, the management and control of process parameters in chemical production Production often involves the ratio of chemical raw materials, production pressure, temperature and Control conditions such as humidity; chemical equipment parameter control generally involves equipment temperature, operating speed, power, etc. According to the basic chemical production It is not difficult to see from the current situation that the lack of rationality in parameter control is the reason why chemical products The key is that the quality cannot reach the standard value, especially for large-scale chemical equipment For equipment, if parameters are not scientifically controlled, problems will occur. A series of safety accidents have seriously affected the lives and safety of operators and workers. threaten.

In order to control process parameters, it is necessary to monitor changes in process parameters in real time and establish an effective monitoring system, including sensors and monitoring instruments. To ensure timely detection and adjustment of

parameters. At the same time, it is necessary to ensure that the accuracy of the equipment for monitoring process parameters meets the requirements and the reliability of the monitoring results.

4.1.2 Anti-corrosion process optimization

In chemical processes, it is not only necessary to utilize process equipment to maximize benefits, but also to equipment, it is also necessary to provide certain protection to the equipment and apply various technical methods. method to ensure equipment integrity. For example, in corrosive chemical production Among them, the method of chemical raw materials reacting with each other can be used to solve the problem of Material corrosion problem.

The countercurrent falling film process is a process that is frequently used in caustic soda evaporation operations. Workers wrap a degradation film inside the evaporator. In turn, the solution with an unstable pH value can flow completely against the wall of the tube. This shows good heat transfer advantages and efficiency. In this type of process, relevant workers can use corresponding molds to absorb most of the energy to protect the material while achieving basic operating goals. [6].

In the chemical production stage, many chemical raw materials are corrosive. This requires relevant enterprises and units to fully take the anti-corrosion performance of the equipment into consideration during the application of chemical processes and chemical equipment design work, and put production safety first in the anti-corrosion design process. For example, Reactors used during chemical production will produce defects such as cracks, deformation, and blisters due to material corrosion or high temperature and high pressure. therefore, It is necessary to scientifically monitor and manage changes in various parameters, conduct in- depth analysis and exploration of the corrosiveness of chemical raw materials, high temperature and high pressure conditions, etc. during the design stage, and adopt chemical processes that can weaken corrosiveness to ensure the chemical industry Safety and stability of equipment operation [7].

4.1.3 Strengthen equipment maintenance, inspection and audit

When using highly corrosive chemical raw materials for production operations, Cause serious damage to the inner wall of the pipeline, if not treated at the first time Checking and handling may cause serious failure. Therefore, it is necessary to dispatch professional technical workers to inspect various key tools during the production stage. Repair and maintenance to ensure the safety of equipment and facilities performance and reliability; optimize and improve the original production plan based on basic factors such as specific production conditions, raw material characteristics, and chemical equipment structure, Through this method, the probability of damage to chemical equipment is minimized, the production speed is comprehensively increased, equipment safety is strengthened, and the production process is provided with more guarantee and support. [8].

In addition, safety inspection and audit work on chemical processes and equipment structures Occupying a vital position in the field of chemical technology, it is the chemical industry A key approach to art adaptive design. Relevant staff need to combine practical Carry out comprehensive and dynamic examination of chemical processes and equipment structures based on actual conditions Conduct inspections and surveys, and strengthen the equipment structure based on local environmental conditions and climatic factors. To test and analyze. Once key components are missing in the chemical process, it will It may cause material damage, etc. For example, in pressure vessels, such as If the internal components are affected by damage, the overall pressure will change in a short period of time. force coefficient. Therefore, relevant staff need to make arrangements based on the actual situation Check and adjust the equipment structure within a certain time range, and actively screen out Equipment and processes with high adaptability, high safety and low energy consumption [9].

4.2 Adaptable Design of Chemical Equipment

4.2.1 Simplify equipment structure

In chemical production, when using polyester equipment, it is often necessary to prepare Equipped with horizontal heat exchanger, The advantage of horizontal heat exchangers is that the tube bundle has no branching Holding the plate, relevant personnel can arrange a negative pressure outlet at the shell position. Zaihua Actively using this outlet during industrial process applications will attract a small number of media to circulate or change the overall flow direction, reduce baffles on the structure, and simplify the whole frame [10].

4.2.2 Strengthen equipment protection

During chemical production, equipment is often exposed to high corrosion, high pressure operating under conditions such as force and high temperature. In this case, relevant personnel need to It is necessary to do a good job in equipment protection based on the actual situation, and when applying special processes Under such circumstances, equipment structural stability and corrosion protection issues should be fully considered, and then Ensure that the chemical process can give full play to its own advantageous value and achieve Chemical process production targets.

For example, caustic soda is used during most chemical production, which can cause into a violent exothermic reaction. Therefore, it is necessary to use effective protective materials when manufacturing chemical equipment to avoid corrosion damage caused by caustic soda reaction. [11]. For example, metal nickel is added to the production materials of chemical equipment. Nickel is a material that is resistant to high temperatures and alkali corrosion, which can ensure that chemical equipment is not corroded.

4.2.3 Green environmental design

Nowadays, our country has always implemented the concept of sustainable development to the end. Therefore, chemical companies need to focus on the development needs of the times and keep up with the trends of the times during the actual production stage. In this case, during the implementation of the adaptive design project, relevant personnel need to fully consider the environment such as high temperature and high pressure. Reduce the negative impact on chemical equipment,

fully grasp and understand the basic structure of chemical equipment, and use this to carry out high-quality, comprehensive green environmental protection design [12].

For example, during the design of chemical equipment and processes, replacing heat pipes Beams can cause serious noise pollution, etc. In this regard, relevant personnel need to The overall size of the parts is adjusted and optimized to complete the improvement of various parameters. One-step management and control. In addition, during actual production and processing, we actively adopt Use new environmentally friendly materials to replace polluting materials to further improve the company's Ecological benefits bring more development impetus to my country's environmental protection cause.

5 CONCLUSION

In summary, when considering chemical process equipment, various types of Pay attention to and attach importance to the influencing factors, and combine the occurrence of the problem and safety identify the types of hidden dangers, conduct analysis and discussion, and then improve the overall chemical industry Efficiency and quality of production activities.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

REFERENCES

- [1] Zhang Kefei. Application of fine chemical reaction safety assessment methods in high-risk chemical processes. Beijing: Beijing University of Chemical Technology, 2021.
- [2] Wang Shigang. Research on safety management strategies of chemical equipment. Papermaking Equipment and Materials, 2022, 51 (5):195-197.
- [3] Yang Wenyu. Design of virtual experimental system for hazardous chemical process control. Yinchuan: Ningxia University Science, 2022.
- [4] Luo Yayue. Research on identification and assessment of risk associated with chemical production equipment. Beijing: Beijing Institute of Petrochemical Technology, 2022.
- [5] Bai Baoqi. Research on quality management of chemical process pipeline design. Chengdu: Sichuan University, 2021.
- [6] Zhang Jiakang, Zhang Yuecheng, Zhao Jiquan. Hazardous Work in Fine Chemical Synthesis in Microchannel Reactors Art research progress. Fine Chemicals, 2023, 40(4): 728-740.
- [7] Hu Jianhua.W Research on improvement of full life cycle management of company's chemical equipment. Nanjing: Nanjing University of Science and Technology, 2020.
- [8] Luo Junwei, Yang Wenhai, Zhu Wenbing, et al. Flow and combustion characteristics in the cyclone combustion boiler Numerical simulation research. Boiler Technology, 2022, 53(4):44-51.
- [9] Yin Changjie, Zheng Hong, Zhang Qiuyu, et al. Development of chemical reaction heat measuring instrument and experimental influencing factors elemental discussion. Laboratory Research and Exploration, 2022, 41(7): 80-83.
- [10] Zeng Wei, Dewey, Teng Botao, etc. Chemical engineering and technology featuring salt production and salt chemical industry Professional renovation and upgrade. Chemical Education (Chinese and English), 2022, 43(24): 90-94.
- [11] Liu Jin, Cheng Yanbin, Qi Dongchuan, wait. Chemical process safety assessment based on support vector machine Model construction and optimization research. China Production Safety Science and Technology, 2022,18(12): 154-161.
- [12] Li Xiaowei, Du Chenyang, Liu Wen, et al. Cause of leakage of steam heat exchanger tube bundle in a coal chemical plant. Corrosion and Protection, 2022,43(11):110-113, 118.