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Application Analysis of Oil Depot Control Valve

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Abstract: As an independent facility for storing, sending and receiving oil products, oil storage tanks often have the characteristics of major dangerous sources--with the characteristics of high risk and danger. Thus, once it's out of work, the consequences will be unthinkably serious. Controlling valves are the important equipment of storage tank. Hence, the design and type selection, safety quality and design scheme of vales have an important impact on the normal operation of storage tank. Based on the current situation of the tank control system in the petroleum storage industry, this paper analyzes and discusses the application of the tank control valve system from the aspects of design, construction and later operation, and refers to the wide use of the automatic control instrument system, and puts forward reasonable suggestions.

Keywords: Oil Depot; Control Valve; Application Analysis; Instrument; Automatic Control.

1. Current Status of Oil Storage Tanks and Control Valves

Today, with the continuous development of ecological industry and the upgrading of industrial structure, in order to facilitate the intensive use of land and resources, centralized environmental governance, unified safety supervision, and the agglomeration development of oil depots are important directions. As an independent facility for storing and receiving oil products, oil storage tanks in oil depots often have the characteristics of a major hazard source and high risk. Once they lose efficiency, the consequences will be very serious.

As the main equipment of the storage tank control system, control valves play an immeasurable role in production processes and safety supervision. In order to ensure the safe operation of in-service storage tanks, it is necessary to ensure that the control valves have reliable switching or emergency cut-off functions. Therefore, valves with good sealing and strong fire resistance are widely used at the inlet and outlet of storage tanks. With the diversity and increasing frequency of storage tank media, problems such as valve wear, internal leakage, and corrosion continue to occur, result in an increasing number of uncontrollable accidents. In recent years, with the gradual promotion and popularization of automatic control instrument systems, the rate of misoperation has also increased. From the perspective of practicality and availability, designing an effective tank front valve control system is more conducive to safety management. Therefore, the design and construction of oil depots, especially the design, construction, and operation requirements of tank control valve systems, have been gradually improved. Relevant personnel need to have a deeper and more systematic understanding.

2. Design Concept of Tank Control Valve System

With the enhancement of domestic economic vitality, the content of safety and environmental protection has once again risen to a high level, and has become an important indicator for park assessment. The inspection efforts of departments at all levels are also further strengthened. In the early stages of hazardous chemical project review, on the premise of meeting current standards, designers must have a certain level of foresight and adhere to the principle of design philosophy being top-down for major hazardous facilities such as storage tanks. For the operation of the construction unit, it is also more beneficial and less harmful, as shutdown, major repairs or accident recovery face high investment, especially referring to historical experience and lessons, The safety hazards during the technological transformation process are even greater.

The foresight of design is directly related to the stability and safety of the enterprise's operation stage. With the emergence of new standards, new institutions and new systems, the tank control system, as a key part of the oil depot management system, is particularly important in design. For example, the promotion of safety instrument systems and process control systems in recent years has had a significant impact on the production and operation of enterprises.

3. The Main Functions of the Tank Control Valve System

When it comes to tank control valve systems, it is necessary to first familiarize yourself with the two main factors of tank monitoring:

(1) Continuously monitor data such as liquid level, temperature, and pressure, and conduct summary analysis;

(2) When the operating parameters operate within the safe operating limit, the storage tank has the function of emergency interlocking, which is also a prerequisite for the action of the control valve.

Although regulations and standards at all levels have requirements for control valve systems, various types of information are fragmented and scattered, not systematic and comprehensive, and there may still be inconsistencies between them. During the inspection or execution process, inconsistent understanding can also lead to varying degrees of deviation. In fact, the tank control valve is mainly divided into two functions, process control and emergency control, which correspond to two levels of valves, such as emergency shut-off valve and process control valve, as shown in Figure 1.

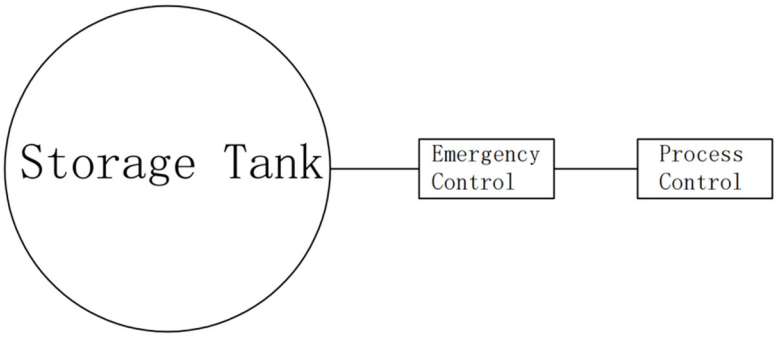


Fig 1. Emergency shut-off valve and process control valve

Due to the promotion of automation control systems in the hazardous chemical industry, it is necessary to avoid on-site personnel operations as much as possible, in order to reduce the impact on activity personnel, and to extend process control valves. Due to the further improvement of the functional status of the emergency interlocking shut-off valve at the tank root, regular maintenance and testing are required. When equipment problems occur, it has a significant impact on business operations. Therefore, it is once again extended to repair valves before the tank, and maintenance valves should be selected with a low failure rate to ensure that all levels of automatic control valves can be cut off in a timely manner during electronic system or valve body problems, and maintenance operations can be carried out.

In summary, in order to effectively cut off the import and export of materials, improve automation and emergency management capabilities, and enhance equipment failure maintenance capabilities, in the design or construction stage, it is necessary to divide the control valve system of the storage tank into four levels of valves, namely: tank root maintenance valve, emergency cut-off valve, automation process control valve, and tank rear maintenance valve, as shown in Figure 2.

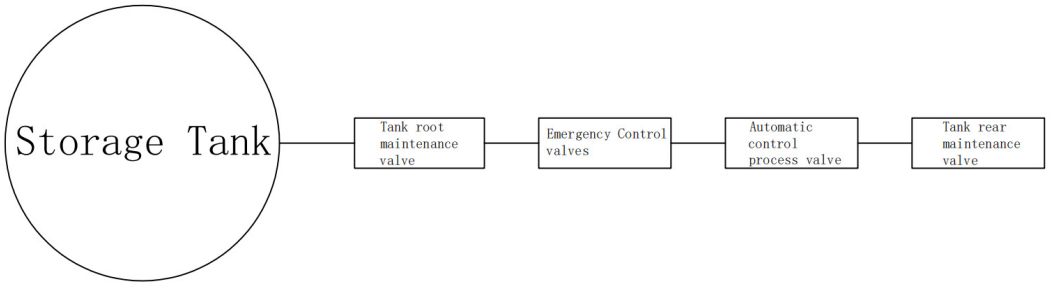


Fig 2. Four levels of valves

4. Brief Description of the Main Types and Functions of Tank Control Valves

Although the oil storage tank frequently receives and sends go oil, its operational function is relatively single. Based on the principles and structural forms of some existing valves, the main reference is commonly used valves, which are gate valves, globe valves, ball valves, and butterfly valves. The functions are briefly described as follows.

(1) The gate valve controls the flow of fluid through the up and down movement of the gate plate. It has a simple structure, large volume, tight closure, and low price, but it has a long closing time. The purity of the medium and impurities have a certain impact on normal use, and the technology is mature;

(2) Ball valves cut off fluid flow through a ball, usually fixed ball valves, which have the advantages of small stroke, small resistance, small volume, and fast cutting. However, they are expensive and not suitable for larger pipelines, and are not suitable for wear and heat situations;

(3) The shut-off valve uses the pressure of the valve stem to make the sealing surface adhere to the sealing surface of the valve seat, thereby achieving the function of closing the valve. It has the advantages of simple structure, convenient operation, and suitability for low, medium, and high-pressure pipelines, but it has a large volume, high resistance, and cannot be sealed for long periods of time;

(4) Butterfly valves achieve flow regulation and valve opening and closing through disc rotation, with the characteristics of small size, low resistance, and simple structure. However, they require high processing level, high failure rate, low availability, and often accompanied by loose sealing and internal leakage, which cannot effectively complete the cutting and closing functions.

5. Discussion on the Application Scheme of Tank Control Valves

The author believes that the forward-looking awareness of design does not represent an unrealistic increase in the safety level or quantity of valves. Although the valve structure is relatively simple, the functions and requirements for controlling valves increase. In the specific selection process, it is necessary to combine reliability, technology, fire prevention, and installation space requirements. And it also should be considered from multiple units and perspectives such as design, construction, and enterprise production management. The economic cost of valves is also an important factor.

This article combines relevant oil storage construction projects or oil storage management experience to analyze and

explore, provide rough understanding and share for reference, criticism, and correction.

Referring to the preliminary plan in Figure 2, as the maintenance valve is in a normally open state, it is only used during tank overhaul or equipment troubleshooting, mainly considering sealing and economic costs. It is recommended to choose a manual flat gate valve as the preferred choice; The basic requirements for emergency shut-off valves are fault closing and fire prevention functions, which are mainly divided into three forms: electro-hydraulic, pneumatic, and electric. Due to the inability of mainstream enterprises to achieve fault closing functions in the production of electric actuators, the piping and wiring engineering related to pneumatic actuators is large, and separate pressure storage tanks and pressure stabilizing facilities are required, which is not conducive to later management. Therefore, electro-hydraulic actuators are preferred, although the price and cost increase. However, selecting mature mainstream technology products with low maintenance costs and favorable management is also an economic way; The automatic control process valve is accompanied by a normally open and normally closed function, with extremely high frequency of use and high sealing requirements. Considering cost, it is recommended to choose an electric actuator valve with a low failure rate.

In addition, there are various regulations describing the fire protection function of emergency control valves. For example, according to the description in AQ3053-2015, when the actuator is electric, the power and signal cables as well as the actuator should be protected against fire; According to UL1709 requirements, it is necessary to adopt fire protection measures for all types of valves, with a preferred fire hood that can withstand hydrocarbon fires for 30 minutes at 1093 ℃; According to the requirements of SH/T3005-2016, the valve body should comply with the API607-2016 fire resistance standard, and the specific details need to be discussed in conjunction with the storage medium. After a comprehensive comparison between the oil depot industry and venture capital, the selection of a fault shutdown function with a fusible plug is more practical.

Based on the above analysis, after refining the tank control valve system scheme, they are: tank root manual flat gate valve - electric hydraulic emergency cut-off flat gate valve - electric process flat gate valve - tank rear manual flat gate valve. Due to the stable oil period of the liquid level after the oil storage tank is fed in and out, the tank root manual flat gate valve and electric hydraulic emergency cut-off gate valve can also be combined for use. As shown in Figure 3:

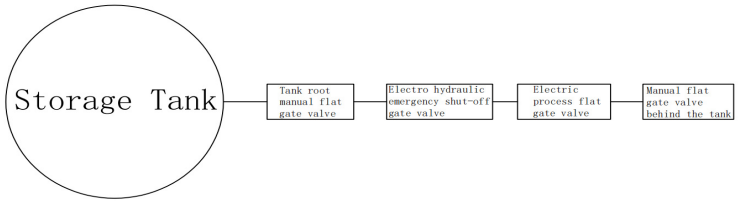


Fig 3. Tank control valve system scheme

6. Conclusion

The above content mainly describes the storage tanks in the petrochemical industry, especially the suggestions for the control valve system in front of the storage tanks in the oil depot. With the continuous improvement of safety management concepts and the advancement of manufacturing processes and control system technology, practical application plans will also continue to change. Only by better applying valve control systems in process production can the overall safety management ability be improved.

The safety management of tank farms has always been an important component of chemical safety production, and it is necessary to carefully implement relevant regulations of various industries in order to ensure the lasting stability of safety work.

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