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Establishment and Research of Graded Safety Evaluation Index System for Chemical and Chemical Engineering Laboratories

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Abstract: In recent years, with the improvement of scientific research level and the increase of scientific research investment in Colleges and universities in China, the equipment of chemical laboratory has been greatly improved. However, many safety problems have also been encountered in the test process. This paper takes chemistry and chemical engineering laboratories as the research goal. A safety index system based on hierarchical management is designed. It is used to prevent potential safety hazards in the laboratory. Provide reasonable basis and reference for laboratory safety inspection in the future.

Keywords. Chemical engineering laboratory; Safety Evaluation Index System; Hierarchical management

INTRODUCTION

In recent years, with the rapid growth of China's economy, the level of education is also improving day by day. Due to the importance of education and scientific research and the increase of investment in laboratory construction projects in Colleges and universities, many colleges and universities have also added chemical laboratories, and the facilities and drugs in the laboratories are becoming more and more perfect and abundant. There are various potential unsafe factors in the laboratory, especially the chemical and chemical laboratory is a complex place, which often uses various chemicals and equipment, as well as water, electricity and gas [Wang, et. al., 2014]. It also encounters dangerous factors such as high temperature, low temperature, high pressure, vacuum, high frequency and radiation sources. With the progress of society, people have a deeper understanding of the priceless of life, which is also the most important and basic of people's different needs [Zhou, et. al., 2018]. Establish a safe experimental environment, reduce the dangerous and harmful factors in the experimental process, reduce the risk of accidents, and ensure the life, health and safety of teachers and students, so as to meet the basic needs of people's sense of safety. This is the purpose of safety evaluation and classification of chemical and chemical engineering laboratories [Zheng, et. al., 2012]. Through safety risk assessment, this paper can systematically analyze accidents and hidden dangers in the experimental process, implement safety control in the whole process, make safety management more standardized and scientific, and provide basis for further measures to reduce the risk of chemical and chemical engineering laboratories.

CONSTRUCTION OF SAFETY EVALUATION INDEX SYSTEM FOR CHEMICAL AND CHEMICAL ENGINEERING LABORATORIES

At present, the safety problems of university laboratories occur frequently, especially in chemical laboratories. Only by establishing a set of index system for safety evaluation of chemical and chemical engineering laboratories can we better analyze and predict them, find out the problems and strengthen the management of colleges and universities [Zhao, et. al., 2013]. Therefore, the construction of laboratory safety evaluation system has important theoretical and practical significance for chemical and chemical engineering laboratories.

Function of indicators

(1) Reflection function

Reflection function is the most basic function of indicators. It describes and reflects the level or status of chemical and chemical engineering laboratories in all aspects at any time point (or period).

(2) Monitoring function

The monitoring function is the extension of the reflection function and the reflection function in the dynamic. The monitoring function can be divided into two categories: one is the monitoring of the operation of the system itself; The second is to monitor the implementation of the policy plan.

(3) Comparison function

When the index is used to measure two or more cognitive objects, it has the function of comparison. The comparison function can also be divided into two categories: one is horizontal comparison, that is, comparing different cognitive objects in the same time series, such as the comparison between regions and countries in the same period, the comparison between countries and so on; The second is vertical comparison, that is, the comparison of the development of the same cognitive object in different periods. Horizontal comparison helps to understand their own characteristics and positions, and clarify their strengths and weaknesses; Vertical comparison helps to understand their own situation and development trend, and make it clear that they are moving forward, backward or stagnant. They all help to make a correct judgment on social phenomena.

Basic structure

Chemistry and chemical engineering laboratory is a multi-level and fuzzy relatively complex system. Therefore, to scientifically and reasonably evaluate the construction effect of chemistry and chemical engineering laboratory, it is necessary to determine the relevant factors reflecting the comprehensive situation of the system at the beginning, so as to establish a scientific and reasonable evaluation index system. In this paper, 8 primary indicators and 36 secondary indicators are determined to build the evaluation index system of chemical and chemical engineering laboratories.

Basic level

Combined with the analysis of the characteristics of chemistry and chemical engineering laboratories, and based on the further collected survey data and relevant research data of university laboratories, comprehensively consider the discipline classification of chemistry and chemical engineering laboratories, the environment where the experiment is located, the flow and change of relevant personnel, instrument reliability and other relevant indicators, Therefore, according to the availability and operability of the selected indicators, the evaluation indicators are selected together to construct the experimental index system of chemical colleges and universities. The basic level of chemical safety index system in university laboratory is divided into three levels: target level, restriction level and index level.

As the comprehensive index of the target layer, it is used to measure the system (control layer B1), safety education (control layer B2), safety inspection (control layer B3), experimental site (control layer B4), safety measures (control layer B5), basic safety (control layer B6), chemical safety (control layer B7) and equipment management (control layer B8).

The control layer B1 is composed of three parts: index layer organization system (index C11), rules and regulations (index C12) and management department archives (index C13).

The training index (C23) is composed of safety index (C21) and safety education index (C23).

The control layer B3 consists of five parts: safety hazard identification (indicator C31), safety inspection (indicator C32), hidden danger rectification (indicator C33), safety report (indicator C34) and inspector specification (indicator C35).

The control layer B4 is composed of three parts: site environment (index C41), pipeline basic safety (index C42) and daily management (index C43).

The control layer B5 consists of five parts: fire-fighting facilities (indicator C51), emergency devices (indicator C52), ventilation system (indicator C53), access control monitoring (indicator C54) and explosion-proof measures (indicator C55).

The control layer B6 is composed of three parts: Power Safety (indicator C61), water safety (indicator C62) and personal protective measures (indicator C63).

The control layer B7 is composed of eight parts: the procurement, acceptance and distribution of hazardous chemicals at the index layer (index C71), the storage of chemical reagents (index c72), the safety of experimental operation (index c73), the management of highly toxic substances (index c74), the management of other controlled chemicals (index C75), the management of experimental gas (index C76), the management of chemical waste disposal (index C77) and other chemical safety (index C78).

The control layer B8 consists of four parts: pressure vessel (indicator c81), refrigerator Management (indicator C82), oven and resistance furnace Management (indicator C83) and other equipment management (indicator C84).

SAFETY CLASSIFICATION AND RISK CONTROL OF CHEMICAL AND CHEMICAL ENGINEERING LABORATORIES

Risk classification

The risk matrix method is mainly used to grade the safety of chemical and chemical engineering laboratories. The risk matrix method mainly measures the risk from the product of two aspects, one is the possibility of accident, the other is the possible loss after accident.

Risk matrix method

The risk matrix method is widely used in many fields in China. The core theory of the risk matrix method is to establish a rectangular coordinate system. The two dimensions of the coordinate are the possibility of the event and the severity of the accident, and then conduct risk evaluation to form the risk evaluation matrix we need.

Application steps of risk matrix:

(1) List all goals that need to be graded.

(2) There are generally five levels to estimate the possibility of danger. The levels from low to high are "very low", "low", "medium", "high" and "very high".

(3) The impact caused by the occurrence of risks is estimated in turn. The impact is not necessarily reflected from one aspect. Sometimes, different methods are applied in several aspects and different situations. According to the set pair analysis method in the previous chapter, the influence degree is divided into five levels, corresponding to the set pair analysis method, which are "slightly", "mild",

"significant", "high" and "extremely".

(4) Finally, the risk matrix is drawn to evaluate the safety risk of chemical and chemical engineering laboratories. After selecting analytic hierarchy process (AHP) and set pair analysis (SPA) for risk assessment and classification, the chemical and chemical engineering laboratories are divided into major risk, major risk, general risk and low risk through the risk level of matrix analysis method, which are marked with four colors of "red, orange, yellow and blue" respectively and controlled at different levels.

Risk grading control

When analyzing, evaluating and judging the risk level of chemical and chemical engineering laboratories, we should determine the feasibility of classification and the effectiveness of implementation. When there are problems that cannot be solved, we should constantly improve the measures and reduce their risks. For colleges and universities, the school level or college level is responsible for risk control, while the laboratory and laboratory related personnel should be responsible for control at the same time and implement specific measures. The risk control level should be reasonably determined in combination with the relevant equipment and environment of university laboratories.

CONCLUSION

Taking chemical and chemical engineering laboratories as an example, this study systematically investigates and analyzes the current situation of chemical and chemical engineering laboratories for the first time, and constructs an evaluation system based on extensive collection of relevant data to ensure the intrinsic safety of chemical and chemical engineering laboratories. According to the relevant procedures of safety evaluation and considering the actual situation of chemical and chemical engineering laboratories, the experimental risk evaluation index system of chemical universities with 8 primary indexes and 36 secondary indexes is planned and designed. It lays a theoretical foundation for the evaluation of chemical and chemical engineering laboratories.

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