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Safety Management Strategy of University Laboratory

Yun He, Zhanfeng He, Fan Zhang, Quantang Fang

State Key Laboratory of Oil and Gas Reservoir Geology and Development Engineering, Southwest Petroleum University, Chengdu, China

Email: 9518192@qq.com

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Abstract

The university laboratory is the main place for personnel training and scientific research. With the increasing of national support for scientific research, the experimental tasks undertaken by the university laboratory are getting heavier and heavier. The Laboratory personnel and equipment are also increasing, and the laboratory safety problems are becoming more and more prominent. This paper first analyzes the current situation of laboratory safety management in colleges and universities, such as unreasonable laboratory layout and weak safety awareness, and then summarizes and analyzes some common inducing factors of laboratory safety problems in colleges and universities and gives corresponding preventive measures; Finally, the corresponding countermeasures on how to efficiently manage the laboratory were put forward, such as strengthening laboratory safety education, implementing laboratory safety access system, strengthening management and implementing inspection system.

Keywords

University Laboratory, Laboratory Safety, Laboratory Management

1. Introduction

Colleges and universities are important places to cultivate scientific and technological innovative talents, and laboratories are the main positions for personnel training and scientific research (Zuo, 2011), which play a vital role in the development of science and technology. Especially in recent years, the state has increased its support for the construction of "first-class universities and disciplines", with more and more scientific research projects and funds, and the number of laboratories (Wang, Zeng, Pan, & Wang, 2020). This poses a severe chal-

lenge to the safe and efficient management of university laboratories, and the safe operation of laboratories is the prerequisite for all scientific research, without laboratory safety, scientific research is out of the question. In recent years, a number of safety accidents have occurred in colleges and universities, and quite a number of accidents have occurred in laboratories. Therefore, how to control some dangerous factors in university laboratories, such as fire, dangerous chemicals and explosive sources, has become the top priority of the current university laboratory managers.

This paper takes the author's university laboratory as the background, through the collection, induction, summary of the current situation of university laboratory safety problems, and combined with the actual situation of the laboratory to conduct in-depth analysis, points out some common inducing factors of university laboratory safety problems, and puts forward targeted measures on how to efficiently manage the laboratory.

2. Problems and Current Situation of Laboratory Safety Management in Colleges and Universities

2.1. Laboratory Layout Confusion

As we all know, colleges and universities in our country have been established for a long time. Although some colleges and universities have established new campuses due to economic development, which has improved the laboratory environment to a certain extent, there are still quite a number of old laboratories, which were not designed according to the needs of the discipline construction of the whole school when they were built (Zhu, Peng, Wang et al., 2018). There is a common phenomenon that laboratories of different disciplines are in the same building, and even many researchers share a laboratory. Some laboratories are complex, and the personnel engaged in experiments cover undergraduates to doctoral students. The safety awareness of personnel is different, and the way to deal with some emergency accidents is also different. There are also some old laboratories because of the defects in architectural design. So far, it has not been equipped with sufficient and complete fire safety facilities.

2.2. Weak Safety Awareness

For a long time, teachers and students in colleges and universities have focused their attention on teaching and scientific research, and on how to use laboratory facilities and equipment to publish high-level papers and scientific research results, which has led to the long-term neglect of safety issues in laboratories, and the lack of corresponding safety knowledge popularization education before laboratory personnel enter the laboratory. Although China has repeatedly emphasized the safety education and management of laboratories, most of them are mere formalities, difficult to persist for a long time, and lack of practical and feasible specific measures to ensure that safety education is deeply rooted in the hearts of the people. In the process of experimental operation, most of the expe-

rimenters do not abide by the operating rules, and laboratory managers generally do not formulate safety plans for some safety risk points (Yan, 2014), most of them hold the idea of "nothing to do with themselves", and do not establish the idea that safety responsibility is more important than Mount Tai.

2.3. Emphasis on Inspection Rather than Implementation

For a long time, many laboratory managers in Colleges and universities belong to part-time staff, and the specific responsibilities of laboratory managers are not very clear (Song, 2017), there is no regular inspection plan, many colleges and universities pay attention to the surface of laboratory safety inspection, there is a mere formality, there is no list of problems found, even if the list of problems is made, there will be no rectification. The same problem is found in many inspections, so that the problem can not be found in time, let alone play a preventive role.

2.4. The Hazards of Waste Materials Are Increasing

With the increasing scientific research tasks in university laboratories, there are more and more experimental projects, and more and more people enter the laboratory to participate in the experiment, which inevitably produces more and more waste materials (solid waste, waste liquid, waste gas) (Wang, Zeng, Pan, & Wang, 2020), and some empty bottles of reagents are discarded at will in some laboratories; Some solid chemical substances are randomly packed in plastic bags without any labels and instructions; for some laboratories with fume hoods, many toxic and harmful gases are directly discharged into the atmosphere through the fume hoods, which has the potential risk of polluting the atmosphere; when some laboratories wash some reaction vessels, the wastewater is directly discharged from the sewer; However, in some laboratory waste liquids, the phenomenon of unclear identification of components and unclear identification is widespread. In a word, the problem of laboratory waste hazards has become increasingly prominent, and the hazards are widespread.

3. Inducing Factors of Potential Dangers in University Laboratories and Preventive Measures

The university laboratory security accident is refers to all sorts of unsafe factors to initiate in the laboratory, it often is the paroxysmal, occurs in the inadvertent, causes the experiment process to interrupt, out of control or permanent stop, and creates the certain life property loss the accident, according to the accident reason may divide into the fire accident, the chemical drug poisoning accident, the explosive accident and the radioactive accident and so on. Different dangerous accidents can accompany each other, and the same accident can be caused by different reasons, but all of them can lead to casualties and property losses. Table 1 lists different types of potential hazards and inducing factors in university laboratories (Liu, Feng, Jiang, & Zhang, 2021), and puts forward some preventive measures.

Table 1. Types of potential hazards and inducing factors in university laboratories

Project	Project Content
Hazard Category	1. Poisoning caused by toxic and harmful gases or chemicals 2. Fire caused by aging of electrical equipment or circuit 3. Explosion caused by high pressure container or chemical 4. The environmental pollution caused by the waste liquid after the experiment 5. Various personal injuries caused by improper human operation
Inducing factor	1. Early warning and alarm facilities did not play a role 2. Volatilization of toxic and harmful gases 3. Improper experimental operation 4. Leakage of containers storing chemicals, etc. 5. Improper handling of dangerous moments 6. Caused by unknown information such as missing chemical labels 7. Leakage caused by damage to containers containing flammable and explosive substances 8. Fire caused by overload and short circuit of electrical equipment 9. Physical Explosion Caused by Overpressure of High Pressure Gas Vessel 10. Artificial use of fire or improper operation in the laboratory 11. During the experiment, the experimenters were not on the spot, and there was a lack of first time disposal opportunities. 12. Laboratory personnel use electrical appliances in violation of regulations
Possible consequences	Personnel poisoning, even death and property loss
Precautionary measured	1. Strengthen the operation training of laboratory personnel 2. Regularly check the safe use of electricity in the laboratory 3. Regular maintenance of fire safety facilities 4. Easy to send for inspection regularly 5. Strengthen the Control of Precursor and Explosive Chemicals 6. The system of holding safety certificates shall be implemented for the laboratory personnel.

4. Countermeasures of Laboratory Safety Management in Colleges and University

4.1. Strengthen Laboratory Safety Education and Implement Laboratory Safety Access System

Although different laboratories may have different research contents, laboratory safety should be put in the first place. At present, some experimenters do not know enough about the harmfulness of chemicals and experimental procedures used in the experimental process. For those who are about to enter the laboratory to carry out experiments, they can be trained by laboratory managers. Make sure that the safety risk points and necessary escape skills of the laboratory are memorized, or take the way of compulsory courses, so that everyone can systematically learn the safety knowledge of the laboratory, and cover the toxicity and

safety protection measures of some common reagents used in experiments, as well as the characteristics of some dangerous chemicals (such as flash point, flammability, etc.). Teratogenicity, etc. may cause harm, so as to have a clear idea. In order to hold regular lectures on laboratory safety knowledge, experts from universities can be invited to hold special reports on the theme of "laboratory safety management" and "laboratory system construction and practice" (Yu, Ye, & Chen, 2021), and some typical cases of laboratory safety accidents can also be analyzed, and the combination of online and offline can also be adopted. Through online laboratory safety education learning, safety education warning and Wechat public number, a number of laboratory safety education leaflets, safety education manuals and safety education exhibition boards are regularly produced.

4.2. Strengthen Management and Implement Inspection System

It is necessary to strengthen the supervision and management of dangerous chemicals in laboratories, issue Regulations on the Management of Dangerous Chemicals in Laboratories, Regulations on the Registration of Dangerous Chemicals in Laboratories, Regulations on the Disposal of Dangerous Chemicals in Laboratories and Accounts for the Use of Dangerous Chemical Products in Laboratories, and establish laboratory pressure vessels, special equipment, large-scale instruments and equipment, heating equipment and refrigerators. Establish a safety inspection desk account for all kinds of equipment, and implement the system of using special equipment with certificates. To carry out special investigation of special equipment in laboratories, strengthen the source management of gas cylinders, and promulgate regulations on the safety management of gas cylinders, requiring regular quality inspection of flammable and explosive cylinders such as hydrogen, methane and acetylene in laboratories. From time to time, the types of dangerous chemicals, responsible persons for management, storage and storage, and use of accounts in various laboratories should be inspected in detail. Personnel and laboratories that do not meet the safety requirements should be publicized and notified on the Internet, and a notice of rectification should be issued to rectify within a time limit. Units and individuals that have not been rectified within the prescribed time limit can take compulsory measures such as closing doors. Regular reviews should be conducted to prevent old problems from becoming new ones. The three-level inspection system of school, college and individual can be implemented (Qin, Huang, & Yuan, 2017). The school sets up an inspection team led by the school leaders, which inspects once a month, and publicizes and notifies the inspection results on the Internet, and rectifies them within a time limit. The college is mainly established by the leaders in charge.

4.3. Continuously Improve the Hardware Conditions of the Laboratory

Therefore, continuous improvement of laboratory hardware conditions can ef-

fectively improve the safety situation of laboratories, which can be equipped with adequate fire safety facilities, such as fire extinguishers, smoke and gas alarms, in some dangerous places. Some professional laboratories should be equipped with some personal protective devices for experimenters, such as goggles, anti-virus area, etc. Of course, they can also make full use of artificial intelligence equipment to monitor the operation of water, electricity and gas in the laboratory in real time, which can effectively reduce the safety of the laboratory. The functional attributes of the laboratory should be fully considered in the design and construction, and the functional zoning of the laboratory should be realized according to different functional attributes, so as to minimize the safety risk of the laboratory.

5. Conclusion

University laboratory safety work is a systematic and long-term work, involving a wide range of complex relationships, which requires university laboratory managers to strengthen management with heart, emotion and wisdom, only through the prevention of potential risk factors in the work. Actively strengthen laboratory safety education and implement safety access system; In order to push forward this work and escort the development of colleges and universities, we should persevere in the daily inspection of laboratories, implement rectification and continuous investment in laboratory hardware and software, overcome some careless ideas, make unremitting efforts and rely closely on all teachers and students.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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