

Lesson Learn



Laboratory safety knowledge sharing

2021. April.

1. Brief description

According to major domestic media reports, a laboratory safety accident occurred at the Institute of Chemistry of the Chinese Academy of Sciences on March 31, 2021, resulting in one death. The cause of the accident seems to be that the student **opened the reactor without cooling down to appropriate temperature**, which eventually caused the reactor to explode.



According to relevant statistics, from 2006 to 2017, there were 14 explosions in university chemical laboratories, 9 of which involved casualties.

2. Brief introduction of Reactor

Reactor is a reactor provided for the synthesis of chemical substances under certain temperature and pressure conditions. It is widely used in scientific research experiments in the fields of new materials, energy, environmental engineering, etc. It is a common small reactor for scientific research in university teaching and research units. In the laboratory, we usually use the hydrothermal kettle,



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that is, the **hydrothermal reactor**. Hydrothermal synthesis reactor, also known as high-pressure digestion tank, pressure melting bomb, polymerization reactor, crystallization kettle, is a small-scale reaction vessel commonly used in laboratories, which can be used for small-dose synthesis reactions, and also used for strong acid or alkali and high temperature in the tank. **High-pressure closed environment** to achieve the purpose of rapid digestion of insoluble substances.

Regardless of just such a small reactor, the internal pressure can reach several Mpa during the reaction. High pressure means that it is prone to danger if the operation is not standardized. You can imagine the scene of popcorn. The reaction kettle is **opened without cooling**, the reaction kettle explodes, or the reaction products in it explode, which can cause a great impact.

3. Possible causes of accidents

Based on the statistics of 100 lab accidents from 2001 to 2013, the human causes of accidents include **violation of operating procedures** (27%), improper operation (12%), and careless operation or improper use (11%), which together account for half of the total number of accidents.

In fact, most of the lab accidents are traceable to the following reasons.:

1. Experimental operation is not standardized

For example, not waiting for the reactor to cool down before turning on, thus causing an explosion. When using the reactor, the high-pressure reactor **must be equipped with a pressure gauge**, but there are many kinds of pressure gauges in China, such as



Mpa gauge, pa gauge, 10Mpa gauge and so on. When performing pressurized reaction, you must make sure to **check the unit of measurement of the pressure gauge which is in on range of the reaction!**

Pressure reactors have a safety rupture disc, which will rupture when the pressure is too high to prevent the reactor from blowing up. When the rupture disc ruptures, a warning "siren" will be sounded and the surrounding personnel must be **evacuated immediately!**

2. Laboratory hazardous materials are not properly placed

Laboratory-related hazardous chemicals (including intermediates and waste) are not disposed of in the full process as required, which is also an important cause of laboratory accidents. In the deadly explosion at Beijing Jiaotong University in 2018, the illegal purchase and illegal storage of the dangerous chemical magnesium powder by the people involved was one of the major causes of the accident.

3. Laboratory safety management negligence

Of course, among all the causes, there is always a main reason: the lack of laboratory safety management, and the neglect and paralysis in the minds of managers, which have led to accidents in many cases. In the face of blood lessons, many universities have established appropriate laboratory safety management systems, such as the implementation of a responsible person system for laboratory safety, regular safety training for students, regular ranking and random inspection of safety facilities, etc.

But in fact, the establishment of the system does not mean that the problem is solved, for laboratory safety, we have to do a lot more, the most important of which is to **raise safety awareness from the top down, each person from themselves, adhere to the experimental norms.**

4. How to prevent

1. Strictly follow the safety operation guidelines

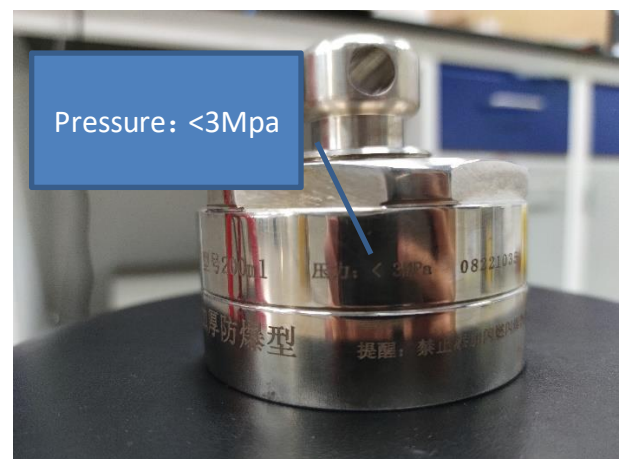
Strictly standardize the operation process, which is the most basic requirement for the operation. Before operating the reactor, you should be familiar with the standard operating procedure of the equipment. Before conducting experiments, you must pass the **relevant laboratory staff or school-related safety training** and strictly comply with the relevant systems and operating procedures in order to ensure the safety of equipment operation.

2. Pre-operation inspection

Check before operating the reactor, check whether the equipment has **any abnormalities**. Find out the **test pressure, use pressure and maximum use temperature and other conditions** engraved on the main vessel, and use it **within its allowable conditions**. If you use the equipment in normal operation, it is **strictly forbidden to operate with pressure**, which not only damages the equipment, but also has safety risks.

3. Focus on observation

When operating the reactor, pay more attention to observation and execute each operation step as required, especially when the reactor is heated to the specified stable temperature, **contact with the body is prohibited** to avoid scalding and also to avoid damaging the reactor balance. After the experiment is finished, first of all, **cool down** and wait



for the temperature to cool down to the specified temperature **so as not to cause damage to the equipment and cause explosion due to high pressure**, in addition to turning off the power of the heater in time.

4. Maintenance

Equipment should not only focus on the operation process, but also need to pay attention to **equipment maintenance**. Only effective maintenance can make the equipment play its better performance, while extending the service life of the equipment. Otherwise, it will seriously affect the safety of the equipment operating performance. The reactor should be used in accordance with the manufacturer's instructions, and the choice of manufacturer should be rigorous, so as to choose a product of high quality for purchase.

Always remember: refuse to take a chance, avoid anxiety and impatience!

Nothing we do is worth getting hurt for !