A detachable portable laboratory harmful gas purification device

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Abstract. This paper designs a new type of detachable and portable gas purification treatment device for the defects of traditional chemical laboratory for the absorption and purification of harmful gases. The device is easy to disassemble, can fully absorb the purified gas, is easy to operate, and is recycled as much as possible, and realizes the concept of low-carbon treatment of green chemistry. It is suitable for use in chemical experiments.

1. Preface
Chemistry experiment is an indispensable part of chemistry teaching in colleges and universities. With the rapid development of national education, the pollution caused by the discharge of laboratory exhaust gas can not be ignored. Although these gases are not abundant, the composition is extremely complicated, which not only causes pollution to the environment, but also destroys the ecological balance and even has a certain impact on human health. The traditional fume hood has a large space and low utilization rate, and the experimentally generated gas is directly discharged into the atmosphere, and the harmful gases generated by the experiment are not fundamentally processed. Therefore, a detachable and portable gas purification treatment device is specially designed.

2. Equipment design

2.1. Design ideas
The device consists of detachable transparent plexiglass, with reusable operation gloves, which reduces the use of disposable gloves. The venting port is connected to prevent the exhaust gas from being sucked up. The solution in the bottle can be replaced according to the experiment being operated. Harmful gases after absorption are completely released into the air to reduce air pollution. After the end of the experimental operation, the solution in the treatment bottle can be treated for secondary recycling. The device isolates the experimental tool from the laboratory, so that the generated harmful gas is isolated in the outer cover and discharged in time to prevent it from spreading to the laboratory and causing pollution to the laboratory. The device is provided with a scraper. When hot air is generated during the experiment or colored gas adheres to the inner wall of the outer cover to affect the visual line of the experimenter, the right side of the outer cover can be scraped off by the scraper to ensure the smooth progress of the experiment. The device occupies small space, simple structure, improves utilization rate, convenient fixed operation, reduces air pollution, recycles resources, and is suitable for use in university physical and chemical laboratories.
2.2. Design scheme
Ether is a colorless transparent liquid at room temperature, with a special pungent odor, boiling point of 34.6 °C, very volatile. It will slowly oxidize into peroxide in the air. The peroxide is unstable, and the heating is easy to explode. It can promote its oxidation when exposed to light, and should be stored away from light. Long-term low concentration of inhaled ether can cause headache, dizziness, fatigue, lethargy, proteinuria, polycythemia. Long-term skin contact can cause dry skin and chapped. Therefore, the ether needs to be absorbed before it can be discharged into the air.

Taking diethyl ether gas as an example, in the experimental operation in this device, ethanol or a large amount of water may be added to the exhaust gas treatment bottle for the absorption of diethyl ether. Considering the secondary recycling of ether, we choose to use a large amount of water to absorb the ether according to the difference in boiling point, and realize the recycling and utilization of the ether by fractional distillation to achieve environmental protection and resource conservation.

3. Equipment application

| harmful gas         | Absorption solution                        |
|---------------------|-------------------------------------------|
| Carbon monoxide     | Silver ammonia solution                   |
| Ammonia             | DILute hydrochloric acid                  |
| Hydrogen chloride   | Sodium hydroxide solution                 |
| Nitrogen dioxide    | Sodium hydroxide solution                 |
| Hydrogen sulfide    | Copper sulfate solution                   |
| formaldehyde        | Acid potassium permanganate solution      |
| Sulfur dioxide      | Sodium hydroxide solution                 |
| Chlorine gas        | Sodium hydroxide solution                 |

4. Conclusion
(1) The device is easy to operate and can ensure that the experimental class completes the teaching progress on time. After the teacher introduces the meaning and usage of the device, the students quickly learn to operate and are willing to help maintain the experimental environment. They could cooperate consciously, maintain a good experimental order, and improve the efficiency of the experiment while protecting the environment.

(2) The device has a significant absorption effect. Since the experimental operation is carried out with its own reusable glove, it is ensured that the sealing property of the entire device is good for the absorption treatment of the exhaust gas.

(3) The device has an energy saving effect. After the exhaust gas is absorbed and purified by the device, the use of the conventional fume hood is reduced as much as possible. After the classification and treatment of the absorption solution, the designated chemical can be recycled and reused, thereby saving resources and energy.

(4) The device solves the problem of low utilization rate of the traditional fume hood in the experimental process of the university, and also solves the problem that the progress of the experiment is affected due to the inability of the harmful gas to be processed.

The detachable portable laboratory hazardous gas purification device currently designed has been fully tested and can meet the requirements of undergraduate teaching and research work.

5. Summary
The design and fabrication of the detachable portable laboratory hazardous gas purification device in the laboratory has been completed, and the gas treatment absorption effect is remarkable and solves the problem that the progress of the experimental teaching is affected due to the inability of the harmful gas to be processed. The device is characterized by convenient operation, remarkable gas absorption treatment effect, resource saving and environmental protection.
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