Analysis and research of several indoor air purification methods

Zhiqiang Wan *, Qingqing Zhang, Liang Xu
Anhui Technical College of Mechanical and Electrical Engineering, Wuhu, Anhui, China

*Corresponding author e-mail: 0120160005@ahcme.edu.cn

Abstract. Air pollutants refer to foreign substances that enter the near ground or the near ground environment in the form of gas. Generally, they are substances that are discharged into the atmospheric environment during human activities or natural processes and have harmful effects on human beings or the environment. Usually there are solid pollutants and gaseous pollutants two categories, solid pollutants in the common dust, suspended particles, etc. (usually called particulate matter); Among the common gaseous pollutants are volatile organic compounds, nitrogen oxides, benzene, sulfur oxides, ammonia, hydrocarbons, formaldehyde and so on caused by pollution caused by decoration materials. Aiming at different air pollutants, this paper introduces the differences and characteristics of several air purification methods, and points out the research significance of air purification technology.

Keywords: Air pollution, air purification, purifiers.

1. Introduction
Air purification technology is a new comprehensive science and technology gradually formed with the continuous development of modern industry. Global air pollution has led many countries to study this topic, and achieved certain results, the formulation of air quality standards, testing standards and analysis standards. Many countries have developed many types of detection, collection and purification equipment, China has also developed a variety of air purification devices. But there are all kinds of problems with the design concept, use and effectiveness of these devices. This situation calls for the continuous development of new easy-to-use, technologically advanced, economical and effective equipment. At present, effective methods to improve indoor air quality include source control, ventilation and air purification [1, 2]. Source control is a way to improve air quality by controlling the source of air pollution. It is an effective way, especially in the control of outdoor air pollution. In our country, there is still a long way to go with the development of economy. Ventilation is to strengthen the flow of indoor and outdoor air, thereby reducing the concentration of indoor pollutants. This way is simple and easy to go, but the reduction degree of all kinds of pollutants is not different, and depends on external conditions and ventilation air conditioning devices. Air purification is similar to ventilation, on the basis of which the polluted air reduces pollutants and purifies granular substances. It has high efficiency and reliability for large solid pollutants. Air purifier is the most direct and convenient equipment for indoor air purification. There are many kinds of ways, mainly divided into dust removal
type and degassing type, dust removal type is divided into scenic spot type and filter type. The effect of these two methods is not very good at present, and most of them are used as auxiliary means. The principle of degassing type is more. Common methods have physical adsorption, chemical adsorption, ozone oxidation, plasma method, ventilation ventilation, ventilation, feeling deodorization and biological methods. Each method has its own advantages and the degree of application development is also different. Sterilization methods include: high temperature drying sterilization, high pressure steam sterilization, gas sterilization, filtration sterilization, radiation sterilization, etc., disinfection methods include: boiling and atmospheric pressure steam disinfection, low temperature disinfection, ultraviolet radiation method and chemical disinfection method, many methods have their own advantages. The functions of the UV air purifier which has been researched as shown in figure 1.

![Fig. 1 The structure chart of the UV air purifier's function](image)

2. The main methods of air purification

(1). physical adsorption is mainly the use of adsorbent compact capillary, with the van der Waals force adsorption of pollutants. The adsorbent used for the adsorption of pollutants is activated carbon, silica gel, alumina, molecular sieve, zeolite and other types. Their adsorption of substances are different, activated carbon on non-polar benzene and other good effect; Formaldehyde will use zeolite to obtain good results. Therefore, prepare to remove what contaminants should be targeted to use the corresponding adsorbents. In view of the diversity of pollutants, a more common approach is to use compound adsorbents.

(2). chemical adsorption is the use of chemical affinity adsorption. It is through the chemical reaction of contaminants and adsorbents to adsorb pollutants out. Neutralization method is one of the typical methods, it is to see the pollutants in the air is acid or alkaline, is acidic with alkaline adsorbent adsorption, and vice versa. Catalytic oxidation uses a catalyst to speed up a reaction and make it go faster. For some reaction speed is very slow, use a catalyst to speed up its reaction. The catalysts we use are precious metals, oxides and sulfides.

(3). ozone oxidation method is very widely used, because it is easy to get, the method is to use ultraviolet lamp or high voltage discharge, it has both sterilization ability, and the ability to remove pollutants. It works for hydrogen sulfide, but it doesn't work for pesticides. Of course, it's also a contaminant and should be removed with a catalyst.
(4). plasma method, the above several methods together. In order to improve the performance of the air purifier, the above principles are combined to make them play their own advantages, improve the purification capacity and expand the purification function.

(5). ventilation ventilator method, used in some places can take the indoor air pollutants away, quick effect, good effect, but its effect depends on the outdoor air quality, and to heat the remote control, heat load is large.

(6). the feeling of deodorization method is to use spices to cover up the smell, but to consider the impact of spices on human health.

In addition, there are absorption methods and biological methods. Absorption must be introduced into water for emergency treatment, not for domestic use. The biological approach is to use microorganisms to decompose pollutants, and provide nutrients, increase in value, degradation. Formaldehyde degradation is the use of formaldehyde dismutase, this method is a very promising method, but in indoor air pollution purification is not used much. The principle of control system is shown in figure 2.

Fig. 2 The principle chart of the air-purifier's control system

At present, the most widely used is a variety of sterilization methods, and mainly formed the following series of purifiers. Such as: mechanical filter adsorption purifier, mechanical filter type purifier, negative ion purifier, electrostatic purifier [3], ultraviolet air purifier and other categories. The brief introduction is as follows:

3. Introduction of several common air purifiers
(1). mechanical filter adsorption purifier: the use of a variety of purification principles to filter out particulate and gaseous pollutants. This kind of purifier is the general air filtration technology and activated carbon adsorption technology integrated use, from the overall performance to improve the purification effect. However, activated carbon has the characteristics of adsorption saturation, which is very troublesome in use, thus restricting its wide application.

(2). Mechanical filter purifier: it is a relatively small filter. After the air is pressurized by the fan, it passes through the filtering material to filter out the particulate pollutants, so as to achieve the purpose of purification. This method is only effective for specific particulate pollutants of a certain size [4]. Generally speaking, its filtering effect is not good.

(3). negative ion purifier: at present, it is a kind of purifier widely used, the use of strong electric field produced by negative ions and particle pollutants together, so as to form a "heavy ion", adsorption
or fall to the surface of the object, can kill bacteria, has a good purification effect. However, such air purifiers are also problematic because they produce secondary pollution with ozone.

(4). Electrostatic purifier: it has a good filtering effect on larger granular pollutants, but it is gradually being eliminated from the market because of secondary pollutants such as ozone.

(5). Ultraviolet air purifier: it is to use ultraviolet light to antivirus, after the irradiation of uv light, ultraviolet light penetrates the microbial cell membrane, to all kinds of germs, bacteria, parasites and other circulating DNA structure damage, destroy their nucleic acid molecule chain [5], the bacteria such as dead immediately or can't reproduce, achieve the purpose of disinfection.

4. Conclusion

According to Japanese statistics, the purifier has become the third household electrical appliances, Japan and South Korea's household penetration rate has reached more than 80 percent. In China, air purifiers have also entered a period of rapid development. In addition to the long-term application in the field of medical and health care, with the indoor ultraviolet air purifier in safety, environmental protection, the effect of a major breakthrough, in the home application has also made great development. Therefore, the study of indoor air purification technology has important promoting significance.

References

[1] SUN Qin. Optimization Design of Power Supply for Indoor Negative Ion Air Purifier with Electrode Heating [D]. Dalian: Dalian University of Technology 2007.

[2] Jiang Anxi. Air Pollution Control [M]. Chemical Industry Press, 2003:255-262.

[3] Loushan Forest. Development of a New Anion Air Purifier [D]. Dalian: Dalian University of Technology, 2006.

[4] Wu Zhongbiao, Zhao Weirong. Indoor air pollution and purification technology [M]. Chemical Industry Press, 2005:2-11.

[5] He Delin. Air Purification Technology Manual [M]. Publishing House of Electronics Industry 1985:244-245.