Discussion on Existing Problems of Fresh Air System

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Abstract. In the context of China's energy crisis and deteriorating environment, people's demands on the indoor air quality of living and working are constantly improving. At present the use of fresh air system is the most effective method to improve indoor air quality. With the continuous expansion of the market demand for fresh air conditioning systems, there have been some problems restricting the development of fresh air technology. In this paper, the existing problems of the fresh air system are analyzed from the point of view of the design, operation and maintenance of the fresh air system. It provides reference for the development of fresh air system.

1. Introduction
In recent years, with the rapid development of China's economy, energy shortage and environmental pollution are becoming more and more serious. The haze and PM2.5 exceed the standard seriously in winter in the northern area, which brings great troubles to people's life and work. How to provide a healthy and comfortable living and working environment for indoor environment with serious outdoor environmental pollution has become an important issue for many scholars to study and explore. SARS virus in 2003, avian influenza virus in 2004 and influenza A virus in 2009 are rampant. These infectious and fast spreading diseases are mainly transmitted by air. Because the quality of fresh air is not up to standard, the quality of indoor air is poor, and the ventilation can not meet the standard requirement, it provides a prerequisite for the breeding and spreading of virus.

The fresh air system is composed of the equipment with the air supply (exhaust) device, the supply (exhaust) air duct and the valve and so on. The system form can make full use of the natural ventilation in the transition season and provide comfortable and hygienic clean air for the indoor environment [1]. The principle of fresh air system is to carry out summer dehumidification, filtration, sterilization and winter preheating of outdoor air. The organized air flow is formed in the indoor by the air flow mode, and the dirty air is replaced out, which makes the original indoor environment clean. The fresh air system can not only dilute the concentration of indoor CO2 and reduce the concentration of particulate matter in the air, but also replace the harmful pollutants such as formaldehyde and benzene produced by decoration to maintain the indoor air quality. At the same time, the outdoor fresh air system has little effect on sleep and work because of the low noise level[2].

At present, with the rapid development of the fresh air system, the emerging problems need to be solved by researchers. Therefore, the purpose of this study is to analyze the existing problems of the fresh air system the design, operation and maintenance of the fresh air conditioning system, and provide reference for the application and development of the follow-up fresh air conditioning system.
2. Design of Fresh Air System

As a part of air conditioning system, fresh air system is an important factor to ensure indoor temperature, humidity and comfort. The design stage of the fresh air system is accurate, reasonable and standard is the prerequisite to ensure the normal operation of the fresh air system. Therefore, the design stage of the fresh air system is particularly important. At present, the insufficient or excessive fresh air volume in the design stage of the fresh air system affects the operation of the fresh air system, which leads to the problem of indoor air quality not up to standard and people's high dissatisfaction with the indoor environment.

In the design process of air conditioning fresh air system, the determination of fresh air volume generally takes the maximum value according to the following calculation method [3-4]:

- Fresh air volume to meet the health requirements of personnel;
- Satisfying the fresh air volume required to compensate for the partial exhaust air and the micro-barotropic pressure of the building;
- To meet the need of fresh air to eliminate the remaining humidity in the room.

Tao [5] noted that in the design of the fresh air system, the calculation of the fresh air volume is often carried out directly according to article one, which meets the requirements of personnel hygiene, because the calculation process is not rigorous and not standardized. Causes the fresh air system to appear the fresh air quantity too big or insufficient question. Stanley Mumma [6] reported that indoor pollution includes not only human pollution, but also pollution from buildings themselves. Therefore, the amount of fresh air needed to maintain indoor air quality should be composed of the minimum fresh air volume required by personnel and the minimum fresh air volume required by buildings. Liu Chao [7] analysis that the traditional VAV air conditioning system used single pipe air supply, mixed fresh air and return air to each air conditioning area. Although the demand for fresh air in each air conditioning area is different, it is difficult to reflect the difference of demand for fresh air in different air conditioning area because there is no difference in the quality of fresh air after treatment.

Ren Yucheng [8] showed that the traditional design method of fresh air volume of fresh air system based on the method of minimum fresh air volume and minimum number of air exchange per capita is difficult to meet the needs of large shopping malls, hospitals and supermarkets. The traditional design method of fresh air system is overstretched because of its large flow of people and fluctuating personnel density. Song Yang guang [9] reported that many specifications and standards set up from the actual engineering and actual deviation, many concepts are not subdivided, so it is easy for designers to misunderstand. In the process of air conditioning system design, designers often refer to other people's design according to work experience, which leads to the design process is not scientific and rigorous, and there may be some problems such as errors and deviations.

Chaohui [10] analysed because of the unreasonable design of the fresh air system will appear the problem of short circuit, resulting in outdoor fresh air is not sent to the area that needs to be purified is drained or the emergence of indoor discharge of dirty air is re-inhaled by the fresh air system, aggravated pollution. Zhang Junfu [11] noted that most of the office buildings have many indoor air quality problems, especially with CO2 concentration is mostly high, many indoor average CO2 concentration of more than 800ppm, some test rooms are even higher than 1000ppm. It is concluded that scientific and reasonable airflow organization can improve the effect of indoor ventilation, fully dilute the concentration of indoor pollutants, and has an important influence on the improvement of indoor air quality.

3. Operation and Maintenance of Fresh Air System

New large public buildings will consume 200 billion kWh/a. by 2020 In such buildings, 50% of the electricity used for air conditioning refrigeration and heating is used [12], and about 30% of the energy consumption of air conditioning refrigeration is consumed by fresh air [13]. Therefore, scientific and standardized operation control strategy and regular and timely maintenance and management of the fresh air system can not only improve the operating efficiency of the fresh air system, but also reduce the energy consumption of the fresh air system.
Liu\cite{14} analysed that in order to save money, some high-end cafes in Shanghai usually choose not to turn on the fresh air system or part of the time period, and rely on natural ventilation to improve indoor air quality. These problems lead to poor indoor air quality. CC. Federspiel\cite{15} pointed out that in the on-demand control ventilation system, the air supply volume of the system could not meet the indoor air quality requirements simply by measuring the indoor CO2 concentration, but compared with other indoor pollutant concentrations as the control parameters, It is more reasonable to select CO2 as the control parameter of ventilation system. Fisk W. J.\cite{16} proposed that the combination of on-demand control ventilation system and temperature sensor can not only regulate the air volume of the system according to the concentration of indoor pollutants, but also monitor the temperature and humidity of outdoor air in real time. Feedback the data to the fresh air processing unit to reduce the unit energy consumption.

Moncef Krarti\cite{17} reported that using CO2 to control ventilation system can save energy consumption effectively, but it can not control pollutants produced by interior decoration and decoration materials. An effective solution was to maintain the basic ventilation rate at all times and to ensure that building contaminants are kept at acceptable concentrations. Liu Yanmin\cite{18} through an investigation of the air conditioning system, found that the dust accumulation in the air duct and coil unit of the air conditioning system seriously affected the indoor air quality, resulting in an increase in the concentration of indoor respirable particulates and the breeding of bacteria in the condensate pan. The increase in microbial concentrations also exacerbates indoor air pollution.

Fan Zhongfei\cite{19} analysed that the operation and management of air conditioning units are not scientific and standardized, the hygiene consciousness of the management department is thin, and even in order to reduce the operating cost of the air conditioning system, the problem of using or deactivating the fresh air treatment units in the alternate seasons or some periods is also discussed. Li Jing\cite{20} noted that the design and operation management scheme of the air conditioning system is not reasonable enough to meet the indoor environment requirements of indoor personnel. The fresh air treatment unit is closed all the year round and everyone prefers to open windows for ventilation. This practice not only increases the air conditioning load, And fresh air treatment unit is also virtual, resulting in a serious double waste.

Zhang Yanshun\cite{21} showed that the installation position of CO2 concentration sensor directly affects the accuracy of CO2 concentration in the detection room. When the personnel load is low, if the fresh air volume is reduced according to the concentration of CO2, it will result in the insufficient dilution of the pollutants in the building part. Chen Benlin\cite{22} reported that due to the limitation of building decoration, it is not possible to set up fresh air collection ports on each floor, but only to collect fresh air from fresh air shaft. Fresh air shafts are dark and humid, breeding bacteria and other pollutants, through which the fresh air unit collects poor quality and contaminated fresh air.

4. Conclusion

- In the actual project implementation process, there are many design concepts and actual construction disconnect phenomenon, which also exposes the lack of coordination and communication between designers and engineers. With more and more kinds of pollutants and so on, designers should consider all kinds of indoor pollution factors synthetically.
- The designer should design and formulate a scientific operation control scheme to ensure that the fresh air system can achieve the goal of energy saving and efficiency under the established operation scheme. Equipment maintenance managers should strengthen technical knowledge learning, improve and standardize the operation process of equipment, and strengthen health awareness, timely cleaning and replacement of air filtration equipment, from the source of the discharge of pollution sources.

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