

### FRESH AIR IS PROVIDED INTO AIR CONDITIONED ROOM DIRECTLY

Shen, Jinming  
HVAC Department  
Shanghai College of Architectural  
and Municipal Engineering  
Shanghai  
P.R. China 200092



Occupants in air conditioned rooms complained that the indoor air quality (IAQ) was unacceptable as the supplied fresh air was polluted passing through the air conditioning system. Thus, a brand-new filter and a fresh air cleaner were developed, so that fresh air could be directly provided to the air conditioned rooms.

The aim of ventilation is to provide fresh air for human beings. Conventional air conditioning systems do not permit fresh air to be directly provided to air conditioned rooms. The air must first pass through an air conditioning system if the system is to operate to its full design efficiency. Unfortunately, most of these systems do not meet the initial aim of providing fresh air. In Shanghai, a high percentage of occupants in "sick" buildings complained that poor IAQ impaired their work. Several suggested that the fresh air being supplied could have been less than that specified by the air conditioner's design. It was, however, found that these systems did comply with the existing ventilation standards. In fact when the portion of fresh air fed to the air conditioning systems was increased there was no decrease in the complaints(1). Complaints did disappear when occupants left the air conditioned rooms and where exposed to fresh air. This led to the conclusion that the air was being polluted as it passed through the air conditioning systems. There are many possible sources of this kind of pollution including: filters, humidifiers, heating and cooling coils, and sound attenuators. As well, there are pollutants originating from modern materials such as, upholstery, adhesives, etc., which are effective at very low concentrations, so higher ventilation rates are required(2). For these reasons it was decided that fresh air should be provided directly to air conditioned rooms. In order to do this, a fresh air unit with a filter and fan, (ie. a fresh air cleaner), was designed. It is common knowledge that air cleaners can play an important role in improving IAQ. Filters with high efficiencies, of course, improve air quality even more. The filter efficiency deals with the problem of providing adequate IAQ at a reasonable cost.

Firstly, an effective air cleaner should not itself become a pollution source. A sub-high efficiency particulate air filter with a low pressure drop was developed(3). The unique achievement of this filter is the adoption of a filter-medium-tubes structure. The filter medium used was polypropylene-fibre. The filter is shown in figure 1. The brand-new structure has the following characteristics:

---

\* This paper is an unreviewed, reduced-in-length version of the original paper. Questions or discrepancies should be referred directly to the author.

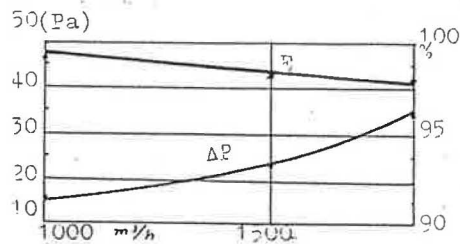
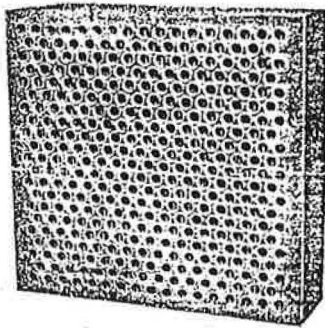


Fig.1 A new type filter

Therefore there are two ways of reforming "sick" buildings:

1. The first is to locate air cleaners in the return plenum or mixing plenum above the suspended ceiling as shown in fig.2. The plenum, of course, should extend far enough to allow for the complete mixing of the fresh air with the supply or return air(4).
2. The fresh air cleaners provide fresh air directly into the top space of the air conditioned room, so that the conditioned supply air mixes completely with the fresh air prior to it reaching the occupied space(5). This is shown in fig.3.

Fresh air flow rate is commonly specified in current standards. However, if the major source of contamination are processes or materials, these factors should be increased or should dominate the setting of standards. The prevention and cure of "sick" buildings requires the systematic removal or reduction of unnecessary pollutants. Providing fresh air directly to rooms is one of these methods. The more fresh air introduced to a room the greater improvement to IAQ. This implies a decrease of required ventilation and energy consumption as well as a diminished risk of draft. Moreover because of the existence of an alternative method of air entry more fresh air can be provided in spring and autumn, with varying mixing portions of recirculated air to maintain indoor air temperature. This will conserve energy.

After installation of the air cleaners, occupants of "sick" buildings found the indoor air fresh and pleasant. They no longer complained. In fact, the IAQ has indeed greatly improved(5). Some of the credit for success must also be given to the psychological factor(6). An important element in the occupants perception of their environment is based on the degree of control they feel. If occupants have found the IAQ unacceptable, in the past, they have had no effective controls for their space. Thus, the only method open to them to change their environment was to express dissatisfaction. The occupants can now control the amount of fresh air to their own desired setting. They regard the new air cleaner as a "window" and it is highly valued by them.

This reform in the clean areas

REF:

1. SH 189.
2. SH Eng.
3. X HVA
4. X Press
5. Li Room
6. SH Tech

cor  
Mix  
play

cor  
a  
re  
pi-

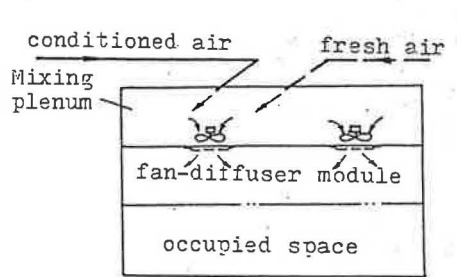
a  
17

7:

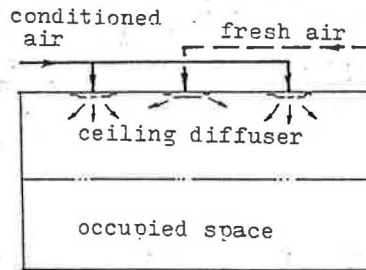
This is the first attempt for us to improve IAQ. These methods have been successful in reforming "sick" buildings in Shanghai. The climate of Shanghai is such that the people are in the habit of opening their windows even during the winter. They like to use this fresh air cleaner. More investigations will be made to verify whether or not it is suitable for other areas.

REFERENCES

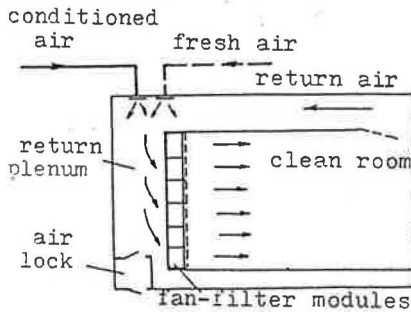
1. Shen J (1988) Challenge to Modern Air Conditioning. J Modern Air Conditioning 1:185-189.
2. Shen J (1988) Biochemistry and Air Conditioning. J Shanghai College of Arch. and Mun. Eng. 4:29-33.
3. Xu Z, Shen J (1988) A Low Resistance and Sub-High Efficiency Particulate Air Filter. J HVAC 1:16-19.
4. Xu Z, Shen J (1988) Usage of Air Cleaning Technology. Chinese Architectural Engineering Press, Beijing, p.65-72.
5. Liu Y, Shen J (1988) Sub-High Efficiency Fresh Air Cleaner Is Used In The Sterilized Room Directly. J Shanghai College Of Arch. and Mun. Eng. 4:27-29.
6. Shen J (1988) Pay Attention to the Problems in Air Clean Room. J Air Cleaning Technology 2:27-31.



(a) in a experimental room

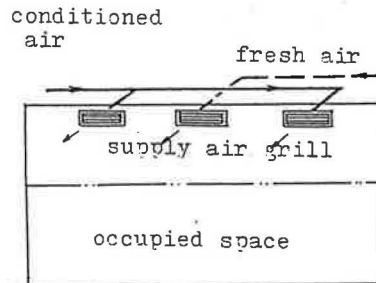


(a) in a computer room



(b) in a clean lab

Fig.2 First reform pattern



(b) in a sterilized room

Fig.3 Second reform pattern