IAQ and Air Filters – Criteria for the Design Guide Book

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Abstract

There has been lack of fact based knowledge for design and operation of supply air filter for general ventilation. An Invent multi-component project was started in 1994 to tackle this problem area. The paper describes the basic performances of air filters and requirements to be included in the Design Guide Handbook, managed by Invent, Finland.

Introduction

We should expect our air to have the same quality standards as our food and drink. We spend 90% of our time indoors and nobody should get sick because of the indoor air environment. Every day we breathe about 20-30 kg of air and consume around 1 kg of solid food and 3 kg of liquid food. We should therefore expect our air to have the same quality standards as our food and drink.

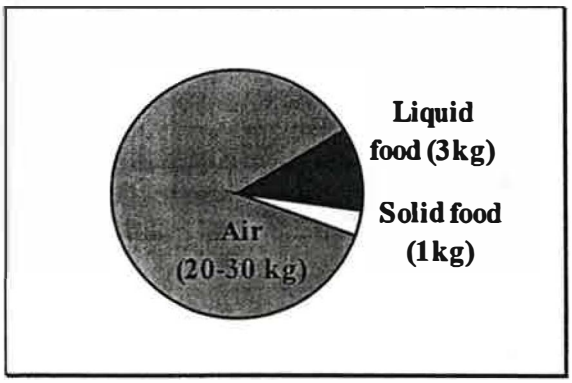

Figure 1. Human consumption of air and food over 24 hours.

IAQ in Focus

ASHRAE has developed strategies for improved environmental health and defined areas to tackle and VDI in Germany has prepared a hygienic standard for the planning, design, operation and maintenance of air conditioning systems (1–7). In the Nordic countries, 1999 was dedicated to IAQ. Eurovent, the association for HVAC manufacturers in Europe is introducing several documents about IAQ (4–6).

Ventilation System

According to current IAQ studies, many problems are still being caused by ventilation systems that are badly designed or operating poorly. Many of these problems can be solved easily. In the US there are two large surveys, NIOSH 1994 and Minnesota 1997, summarising IAQ problems from different studies (3). In most cases, a combination of factors has caused IAQ problems.

Bayer et al (2) made a study for the U.S. Department of Energy about IAQ research that has been conducted in school facilities. They found that most of the IAQ problems could be avoided or resolved by adequate amount of outdoor air, controlled humidity and efficient air filters to prohibit most mold spores and fungi from entering the HVAC system.

An F7 filter can contribute to better IAQ by keeping the system clean and maintaining the designed air flow and if the designed air flow temperature and humidity are kept within specifications, the amount of indoor contaminants generated by humans, building materials and equipment can be reduced. An F7/F8 filter prevents micro-organisms and outdoor contaminants from entering the system.

Hygienic Problems

Particles

Smaller particles play a major role in affecting our respiratory system. There is a direct connection between the death rate and finer particles. Official requirements are under review and are to be based on the concentration of particles smaller than 2.5μm ($PM_{2.5}$). An F7 filter reduces the number of these particles 80%.

Carcinogenic and Allergic Effects of Air

The size and number of particles tell us nothing about how dangerous the particles are, and the filter quality that is required. We know that a large number of studies have been conducted, and that there is a relationship between carcinogenicity, allergens and pollution. The tendency to develop allergies and asthma is probably inherited, but exposure to a number of pollutants can trigger the reaction. Besides allergic reactions to food, allergies can in many cases be related to airborne problems. With efficient filters, the carcinogenic risk from traffic pollution and allergy related to airborne contaminants can be reduced.

Figure 2. Cat hair and pollen. Substances which can case allergic reactions.

Summary

Air filters will play an important role for achieving better IAQ. A filter can do an excellent job to prevent contaminants from entering the system and keep the ventilation system in good condition. A high efficiency air filter (F7) can:

- Keep the ventilation system clean
- Prevent micro-organisms from entering the system
- Remove outdoor contaminants such as particles, allergens, gases and carcinogenic pollutants

An air filter

- Shall have low pressure drop to meet LCC (life cycle costs) and LCA (life cycle assessment) requirements.
- Be replaced frequently to avoid being a source of contamination
- Not lose efficiency during its operation

References

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