Ventilation and Indoor Air Quality

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Ambient (outdoor) air quality in cities in industrialized countries has improved greatly in recent decades. During this same period, indoor air quality has declined because of energy conservation, decreased ventilation and the introduction of many new materials and sources of indoor pollution. These developments and the fact that people in industrialized countries spend 90% of their lives indoors on average makes the quality of indoor air an important environmental issue with far-reaching implications for human health. Allergic and asthmatic diseases have doubled in industrialized countries during the past two decades. They comprise one of the greatest current problems for public health, with enormous costs for medicine, treatment and absenteeism. In many industrialized countries, half the schoolchildren suffer from these allergic diseases, which are the main reason for absenteeism in schools.

Indoor air quality has declined partly because of comprehensive energy conservation campaigns and partly because high energy prices have motivated people to tighten their dwellings and reduce the rate of ventilation, so that the air change rate in many homes is at a historically low level. Other factors contributing to poor indoor air quality are the many new materials, especially polymers, and the numerous electronic devices that have been introduced indoors in recent decades, especially in children's rooms. The increasing societal need for energy efficiency will often result in very tight buildings. This means that the amount of outside air supplied by infiltration is not enough to provide the required ventilation.

Until now we do not have a clear definition of and clear criteria for indoor air quality. Today an acceptable indoor air quality is mainly defined by specifying the required level of ventilation in air changes per hour or outside air supply rate. This would be equivalent to defining the requirements for thermal comfort by specifying the level of heating or cooling in Watts.

Even if we today have standards and guidelines for estimating the required minimum ventilation rate, they are far from being complete. The goal is of course to be able to calculate the required ventilation rate as straightforwardly as in cooling load calculations. We need to know the requirements for acceptable indoor air quality based on health, comfort and performance and we need to know the emission rates from all the sources. Unfortunately, this is not as easy as in cooling load calculations, where room and outside temperature (°C), energy emission (watts), heat storage, solar radiation (watts) are all evaluated with similar units and all affect the same parameter of the human body (heat balance). For indoor air quality, we have thousand of substances that are emitted from people, furnishing, systems, from outside etc., each of which may affect one or more organs of the body.

We have good knowledge about the required ventilation for the "people" component, while the "building" component is not very well documented. There is an urgent need for better certification and labeling of the materials used in buildings and we must also develop ventilation standards that favour the manufacturers of "good" (low polluting) materials.

There is an increased interest in the development of air cleaning equipment. This may be an acceptable way of reducing the amount of outside air, saving energy and still having an acceptable indoor air quality. However, better test methods for air cleaners are required, because at present the test is usually based on chemical measurements and the resulting effect on odour or perceived air quality is not taken into account. It is also very important to specify which kind of "pollutants" should be used when testing. Some air cleaners may work well on VOC's (emission from materials) but have zero or even a negative effect if the source is people (bioeffluents).

One serious problem is how to ventilate if a building is located in an area with poor outside air quality or if there is a time of the day (e.g. rush hour) when the outside air quality is unacceptable. In some cases it might even be better to reduce ventilation under these circumstances, and the use of air cleaning technologies can be a better solution.