

## Air Pollution

Air pollution – both indoor and outdoor – is a major environment-related health threat, causing a range of respiratory and cardiovascular ailments. Unhealthy air is breathed by an estimated 1.1 billion people and claims 3 million lives a year.

Where and when people are exposed (Jantunen, 2000):

- Primarily indoors – we spend the most of our life indoors.
- Exposure to pollutants from both outdoor and indoor sources, but the population dose/exposure commitment from indoor sources is 100 – 1000 times higher than from outdoor sources.
- In indoor environment exposure to outdoor air O<sub>3</sub>, NO<sub>2</sub> is lower; also sometimes (air conditioning buildings, filtered ventilation systems) fine PM exposure is indoors lower.
- Level of some VOCs are much more higher indoors than outdoors (in that case outdoor contribution to this exposure could be ignored)
- Indoor CO levels are similar or higher than outdoors (lethal CO poisonings occurs only indoors)
- The most important single source of air pollution exposure is tobacco smoke – the dominant source of almost all indoor air pollutants, but is only marginal outdoor air pollution.

Health consequences are of high concern and also have economic significance (tab. 1).

**Table 1: Estimated direct medical costs (in euro) yearly attributable to indoor pollution in Italy (Maroni, 2001).**

Pollutant	Disease	Impact	Direct medical costs
<b>Allergens (acarus, moulds, animal dander)</b>	Bronchial asthma in children/teenagers	> 160 000 prevalent cases/year	<b>&gt; 80 millions</b>
<b>Radon</b>	Lung cancer	1 500 – 6 000 death/year	<b>26 – 105 millions</b>
<b>Environmental Tobacco Smoke (ETS)</b>	Bronchial asthma in children/teenagers	> 30 000 prevalent cases/year	<b>&gt; 15 millions</b>
	Acute airways infections	> 50 000 new cases/year	<b>&gt; 12 millions</b>
	Lung cancer	> 500 death/year	<b>&gt; 9 millions</b>
	Acute heart infarction	> 900 death/year	<b>&gt; 8 millions</b>
<b>Benzene</b>	Leukaemia	36 – 190 cases/years	<b>0,5 – 4 millions</b>
<b>Carbon monoxide</b>	Acute poisoning	> 200 death/year	<b>1 million</b>
<b>Total</b>			<b>&gt; 152 – 234 millions</b>

## **Problems of Indoor Environment**

For more than forty years people try to find the real connection between the quality of outdoor environment and health with results, which are not so convincing. The quality of air inside enclosed spaces has become a matter of growing concern only over the last twenty years.

The first interests were triggered by complains of occupants of various indoor environments about a variety of unspecific symptoms, such as irritation or dryness of mucous membranes, burning eyes, headache or fatigue. It rapidly became clear, however, that acute reactions to specific pollutants were only one of the reasons for becoming concerned about indoor air pollution. The other was more general and related to the fact that estimate of population exposure to air pollutants had been based exclusively on data from outside air monitoring; thus the quality, duration and effects of human exposure to air pollutants indoors were likely to have been overlooked and undervalued.

To correctly characterize the quality of exposure to air pollutants, emissions from a variety of sources, including building materials, appliances of various types and consumer products, must be considered. As to the duration of exposure, the time that the population of industrialized countries spends both outdoors and indoors would have to be taken account.

Up to now, large-scale surveys permitting broader conclusions than case study-type investigations have been scarce and studies directed towards uncovering relationships between indoor air pollution and potential negative health effects are still limited for the majority of pollutants. Indoor air research is a multidisciplinary task which required specialist from different fields including researches from medicine, chemistry, biology, engineering, architecture and building sciences. In some special cases such as buildings with “sick building syndrome” also specialists from very distant specialities such as psychologists or behavioural scientists.

From the perspective of the occupant of a building, the ideal situation is an indoor environment that satisfies all occupants (i.e. they have no complaints) and does not unnecessarily increase the risk or severity of illness or injury. According to the European Directive 89/106/EWG “Construction work must be designed and built in such a way that it will not be a threat to the hygiene or health of the occupants or neighbours”. An unhealthy indoor environment will lead to a decrease in productivity of employees and will lead to an increase in sick leave. The problem we are confronted with now is that the health situation of occupants is far from the ideal situation. One can create a healthier indoor environment by source control (i.e. reducing the emissions of indoor pollution sources), by

ventilation (removing or diluting pollutants i.e. reducing the exposure to pollution sources) and by maintaining comfortable physical conditions (e.g. temperature, humidity and light).

It becomes clear that there may be a potential conflict between strategies to reduce energy use and to create healthy buildings. While there is a strong logic to improving energy performance by attention to healthy indoor environments, more needs to be done to realise the potential. Action needs to be directed at both improving guidance on how to realise the potential, and making a convincing case for the building industry to make changes.

To be able to reach the commitment by the European Commission concerning the savings of energy consumption, passive or even active buildings, it is certainly important to tackle all opportunities of rational use of energy in buildings.

### **Source of pollutants**

Problems of indoor environment have five common causes:

- an inadequate cleaning /maintenance environment
- insufficient ventilation/air exchange
- pollutants emitted from sources/activities inside the building
- contamination from outside sources
- biological contamination due to lack of moisture problems

More over in most “sick” buildings to this is added stress from inadequate humidity, temperature, lighting or noise. Exposure to pollution indoors also adds to stress of occupant density, job dissatisfaction, lack of personal privacy and control over the environment.

Before the 1974 energy crisis most buildings were designed to provide maximum comfort to inhabitants. Since 1974 buildings have been designed to save energy and in the 21.century new buildings should be built at least in passive standard.

The major cause of illness indoors is biological contamination; nevertheless also other pollutants could cause a big health problem even with the worst outcomes (see table1).