

Human Exposure to Pollutants via Dermal Absorption and Inhalation

ENVIRONMENTAL POLLUTION

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Preface

Estimates of the air pollution health impact play a crucial role in environmental protection. These estimates require accurate data on the pollutant exposure and dose to the population as well as the dose–response relationships to calculate the health impact. From an air quality manager’s perspective there is concern about the validity and accuracy of these calculations. There is a need for information and possible ways to adjust the assessment.

One important topic for air quality managers is to understand the relative contribution of sources to the total exposure. These sources may be coming from both different outdoor sources from sectors such as transport, industry and energy industries, and from a number of indoor sources, such as heating, ventilation and indoor activities as well as out-gassing from building material and furniture.

Indoor air quality is now drawing the attention of policy makers. The basic right to, and importance of, healthy indoor air was emphasized by the World Health Organization as early as 2000 and several countries have described target concentrations for various pollutants. The WHO Air Quality Guidelines 2005 recommended the development of specific guidelines for indoor air quality and these are expected to be published soon. Indoor air pollutants have not been as extensively monitored as outdoor air pollutants and the evidence base for contributions to health effects needs to be strengthened.

This book reviews information necessary to address the steps in the exposure assessment relevant to air pollution. The aim is to identify available information including data sources and models, and show that an integrated multi-route exposure model can be built, validated and used as part of air quality management process.

Environmental levels of air pollutants are reviewed based on monitoring information from background and urban areas, and compared to the current EU air quality legislation. Further, available information about particle speciation is also assessed. This is one of major gaps of knowledge currently, as most information is based on background measurement sites, and it can not be linked to health effect information due to expected differences in composition.

Many epidemiological studies have focused on inhalation exposure. Whilst this is appropriate for many substances failure to consider the importance of exposure and uptake of material deposited on the skin may lead to an over/under estimation of the risk. Hence dermal exposure is also considered. This involves an assessment

of the quality of drinking water across Europe, providing information about differences between water originating from surface and ground water sources, and providing approximate models for disinfection by-product formation.

Indoor exposures are discussed on the basis of literature information, but more importantly, based on recent measurement campaigns that were targeted towards a description of particulate matter indoors. Other elements of exposure models such as aspects related to human behaviour are also reviewed.

A short review of health aspects connected to ambient levels of air pollution and to drinking water contamination by disinfection by products is also included.

The book also gives significant attention to micro-environmental modelling. This is one of the bases of exposure assessment that has often been identified as an area with significant knowledge gaps. A number of models and other information are identified that addresses the most important elements such as ventilation and infiltration rates, sources and sinks, or general concepts of compartmental modelling.

To further advance all the elements necessary to build and implement a comprehensive exposure model, the review also gives information about ongoing or recently published studies relevant to the topic, that are not yet available in open literature.

The book also includes a review on internal dose modelling both from inhalation and from dermal absorption and show how these can be incorporated into an air quality management system.

Chapter 1 summarizes the environmental levels of air pollutants and quality of drinking water, while Chapters 2 and 3 describe indoor–outdoor relationships of air pollutants and key chemical processes occurring in the indoor environment. In indoor environments, chemistry can significantly alter the composition of the air we breathe and chemical transformations reduce our exposure to reactants and increase our exposure to products. Personal exposure measurements are analyzed in Chapter 4 and this topic is of great importance for accurate exposure evaluation since people move, commute, and frequently change their place they can be exposed every day to various kinds and mixtures of gases and airborne particles. Health effects from air pollutants are studied in Chapter 5 as well as a risk analysis and health impact assessments. Chapter 6 gives an overview of particulate matter deposition in the human respiratory tract including model developments and experimental measurements. Chapter 7 focuses on dermal absorption modelling of chemical pollutants into and across human skin since the skin is a primary route of systemic exposure to a number of environmental pollutants. Micro-environmental modelling is studied in Chapter 8. Indoor air models can be utilized to predict the indoor air quality and are also useful from the engineering point of view to maintain an acceptable indoor air quality in a building. Finally, Chapter 9 studies human exposure to air pollutants using an air quality management computer platform. An Environmental Management System incorporating a human exposure module enables local authorities and scientists to reduce the environmental impacts of air pollution to population and to increase the efficiency with which environmental policies are implemented.

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