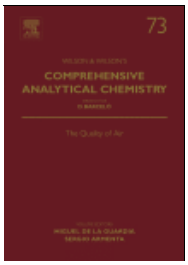

Comprehensive Analytical Chemistry

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The Quality of Air
Edited by Miguel de la Guardia and Sergio Armenta

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Abstract

Physical mass-transfer processes that take place in the troposphere, together with chemical reactions, occurring between chemicals present in ambient air as both gas phase and adsorbed on particulate matter, have been considered in order to evaluate the climate–chemistry interactions. The exchanges between biosphere, geosphere and hydrosphere are described as the frame in which air pollution can affect the earth's sustainability. Photochemical processes have also been considered as the basis for many transformations of pollutants in the air. An additional consideration of pollutant transportation offers a detailed picture of the global problems created by the contamination of air.

Abstract

This chapter introduces the processes related to atmospheric composition considering the atmosphere as a dynamic system which is continuously changing. It focuses on air pollutants, including definitions, classifications, sources, levels and relationships.

Air pollutants can be classified as primary or secondary pollutants depending on whether they would be emitted directly into the air from natural or anthropogenic sources or they would be formed from primary ones. On the other hand, air pollutants can also be classified into three major types: (1) criteria, (2) hazardous and (3) biological pollutants. Criteria air pollutants is a term internationally used to describe air pollutants that have been regulated and are commonly used as indicators of air quality. Special attention is paid to carbon monoxide, lead, nitrogen dioxide, ozone, particles and aerosols and sulphur dioxide.

The different hazardous pollutants that are present in the air, at low concentrations, include volatile organic compounds, polycyclic aromatic hydrocarbons, persistent organic pollutants and other pollutants with characteristics such as toxicity or persistence. Hence as they involve a hazard to humans, their different sources and particular effects are also described in detail.

Additionally, this chapter briefly describes the different biological pollutants that can be present in air including bacteria, moulds, mildew, viruses, animal dander and cat saliva, house dust, mites and pollen, their sources and levels and, also, emerging air pollutants.

Chapter 3 - Indoor Air Pollution Original Research Article

Pages 45-71

V.G. Mihucz, G. Záray

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Abstract

Given that people may spend more than 90% of their time in enclosed spaces, the investigation of indoor air quality is of paramount importance. Indoor air pollutants such as ozone (O_3), nitrogen oxides and volatile organic compounds (VOCs) are linked to outdoor sources. Monoterpenes, such as α-pinene and D-limonene, commonly found indoors have a propensity for oxidation in the air resulting in harmful gaseous products and secondary organic aerosol. Decreased ventilation results in low outdoor air infiltration rates, but the concentration of O_3-reactive VOCs increases simultaneously. Chemical compounds in ambient particulate matter (PM) are capable of generating reactive oxygen species causing cellular damage via oxidative stress. Thus, this chapter focuses on sampling strategies for indoor air pollutants and analytical techniques used for their characterisation. Recent advances in terpene oxidation related to indoors is hereby presented. Assessment of oxidative potential of PM and linkage with its constituents are also reviewed.

Chapter 4 - Outdoor Air Pollution Original Research Article

Pages 73-96

P.B.C. Forbes, R.M. Garland

First page PDF | Purchase PDF - $31.50

Abstract

There are numerous natural and anthropogenic sources of air pollution which contribute to outdoor air quality. Poor outdoor air quality can impact on human health and the environment and can also negatively impact on infrastructure as well as natural resources. The latter is due to the cycling of pollutants in the atmosphere, which can lead to wet or dry deposition thereof into water systems, onto soil or onto the surfaces of plants, for example. In this manner, outdoor air quality may impact on food production and livelihoods. A number of ambient air pollutants are thus governed by standards, such as the criteria pollutants of the US EPA, which include ozone, carbon monoxide, sulphur dioxide, nitrogen oxides, lead and particulates. In addition, there are numerous other outdoor air pollutants, including volatile and semivolatile organic compounds such as benzene, polycyclic aromatic hydrocarbons and pesticides. These are usually present at low levels in comparison to the criteria pollutants, but are hazardous and may therefore still incur human and environmental health risks. This chapter outlines the air pollutants typically monitored in ambient air, their sources, how they are transported and transformed in the atmosphere, and potential impacts.

Chapter 5 - Theoretical Predictive Air Quality Models Original Research Article

Pages 97-115

M. Gavrilescu

First page PDF | Purchase PDF - $31.50

Abstract

This chapter develops an analysis of air quality modelling based on fundamental mathematical description of atmospheric processes, by coupling the effects (air pollution) with the causes that generate them (emissions). The work affords certain contextual matters related to air quality models and discusses a number of issues that are central to air quality model evaluation.

A short overview is made on the relevance and challenges associated with atmospheric monitoring and data acquisition, as well as suitability criteria associated to meteorological characteristics and complexity of the area, level of detail and accuracy required for the analysis, degree of detail and accuracy of the database.

The most part is dedicated to deterministic models in the form of differential equations based on physical laws together with simplifying assumptions, developed based on fundamental mathematical description of atmospheric processes, by coupling the effects induced by air pollution, with the causes that generate them, specifically the emissions.

Ensembles of air quality predictions developed to reduce the uncertainties are succinctly analysed, with some examples of multimodel ensembles.

Chapter 6 - Lichens as Biomonitors of Heavy-Metal Pollution Original Research Article

Pages 117-145

M.E. Conti, M.B. Tudino

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Abstract

The ability of lichens to accumulate different air pollutants beyond their needs in line with the atmospheric levels has conducted to their widely acceptance as biomonitors of inorganic and organic air pollution. Either by determining the concentration of accumulated pollutants or by tracking for damages in their health promoted by pollutants, lichens are used

for environmental assessment worldwide.

In this chapter we review the state of the art on the use of lichens as biomonitors of heavy-metal pollution considering new findings and applications in recent years. To aim on the acquiring of reliable results in inorganic air pollution using lichens, we critically review different alternatives of sample collection and treatment, analytical determination and data analysis for carrying out biomonitoring studies.

In this context the main features of lichens as metal bioaccumulators and the related analytical problems in their use are debated.

Abstract

The main steps of the analytical process for air analysis are discussed in the framework of the quality control of indoor and outdoor air. The principles of green analytical chemistry are taken into consideration in order to enhance, together with the main analytical parameters, the green ones. It is a basic methodological chapter complemented by other chapters of this section of the book in which details are provided about active and passive sampling, sample preservation and transport, and an in-depth discussion of the currently available techniques for quantitative determination of the quality of air and the quantification of many types of contaminants.

Abstract

This chapter reviews the literature information on analytical techniques and laboratory equipment used for active sampling of air (atmospheric and indoor) in regular monitoring research. It describes popular analytical devices used for sample collection using various types of polymeric bags (eg, Tedlar bags, Teflon or Nafion bags) and/or stainless steel vacuum containers. It reviews literature data about the application of various types of sorption media and cryogenic traps for the collection of analytes from air samples in terms of analytical approach and monitoring of organic compounds (eg, volatile organic compounds) present in outdoor and indoor air. This chapter also contains information about in situ monitoring devices like mobile and portable gas chromatographs and hand-held analytical instruments, which can be applied directly in the field measurements. Moreover, it presents the characteristics of measurements conducted with the use of automatic online analysers installed in air quality monitoring stations.

Abstract

The use of different devices for the passive sampling of organic pollutants in air has been reviewed in this chapter. Passive sampling has valuable advantages compared to conventional active one; like that it may provide time-weighted average concentrations and the reduction of campaign costs. Different passive devices have been evaluated for this purpose such as diffusion samplers, semipermeable membrane devices, solid-phase microextraction and polyurethane foam. The analytical procedures for the extraction and determination of retained pollutants in the samplers have been widely discussed. Kinetic models for diffusive and permeation passive samplers have been established for a wide range of volatile and also semivolatile compounds, such as pesticides, polycyclic aromatic hydrocarbons, polychlorinated biphenyls and emerging pollutants. Recommendations for the planning of monitoring campaigns have been also proposed in this study.

Abstract

Today there is a growing interest in improving air quality and thus it has prompted an important increase in atmospheric pollution research. This complex task requires knowledge of all the factors and processes involved, such as the emission of pollutants to the atmosphere by natural and/or anthropogenic sources, including catastrophic accidents, the transport, the chemical nature and physical transformations of the pollutants and, finally, their potential impacts on ecosystem functioning and on public health. In this context, ambient air pollution has been characterised as carcinogenic since December 2013 by the International Agency for Research on Cancer. However, there are many aspects linked to the complexity of the chemical composition and sources of contamination that remains poorly understood. Therefore, air samples' accurate analysis has become a necessity. This chapter reviews the literature data on the status of air sampling strategies, their relevance and application. In addition, sampling artifacts of the different sampler configurations are described. Moreover, useful information about sample preservation strategies to overcome the problem of contamination and matrix effects are described. Finally, current and future projections on air quality analysis are discussed.

Abstract

This chapter discusses the basic categories of chemical sensors together with their utility parameters (including electrochemical, optical, thermal, electric and gravimetric) which are employed for air quality control. The sensors utilising

Volume 14
pp. 2-585 (1982)
Ion Exchangers in Analytical Chemistry. Their Properties and use in Inorganic Chemistry

Volume 10
pp. 1-303 (1980)
Organic Spot Test Analysis the History of Analytical Chemistry

Volume 9
pp. 1-305 (1979)
Ultraviolet Photoelectron and Photoion Spectroscopy Auger Electron Spectroscopy Plasma Excitation in Spectrochemical Analysis

selective detection of particular compound (marker) in investigated gaseous sample as well as the sensor matrix systems comprised of nonselective sensors utilising acquired information for analysis and proper discrimination of chemical image of gaseous sample are presented. Information on commercial availability of the chemical sensors and sensor matrixes is also included.

Chapter 12 - Spectroscopic Measurement of Pollutant Gases Original Research Article
Pages 295-319
D. Venables
First page PDF | Purchase PDF - $31.50

Abstract

This chapter presents an overview of the most common spectroscopic methods for monitoring trace pollutant gases in ambient air. The methods are discussed in the context of monitoring several priority pollutants, namely ozone, nitrogen dioxide and nitric oxide, sulphur dioxide, carbon monoxide, methane, nitrous oxide and ammonia. Spectroscopic methods are widely used for monitoring these gases owing to their sensitivity, selectivity and real-time, online analysis capabilities. Considerations for obtaining sensitive and selective absorption and emission measurements are presented. The absorption techniques considered are UV photometry and nondispersive infrared spectroscopy, differential optical absorption spectroscopy, tunable diode laser absorption spectroscopy, cavity-enhanced absorption spectroscopy, cavity ring-down spectroscopy and cavity-attenuated phase-shift spectroscopy. Fluorescence and chemiluminescence methods are also presented.

Chapter 13 - Volatile and Semivolatile Organic Compounds Determination in Air Original Research Article
Pages 321-342
J.E. Colman Lerner, M.A. Orte, D. Giuliani, N. Matamoros, E.Y. Sanchez, A.A. Porta
First page PDF | Purchase PDF - $31.50

Abstract

The determination of trace levels of contaminants in air, such as volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs), is very important, both indoors and outdoors. An important aspect to achieve sampling methods and coupled instrumental techniques such as gas/liquid chromatographic and spectroscopic methods are discussed. In this chapter, we discuss different options for sampling and analysis of VOCs and SVOCs.

Chapter 14 - Particulate Material Analysis in Air Original Research Article
Pages 343-367
W. Wardencki, M. Bielawska
First page PDF | Purchase PDF - $31.50

Abstract

Particulate matter (PM) is a key indicator of air because it poses more danger to human health than common air pollutants. PM can cause a wide range of diseases that can lead to a significant reduction of human life. It is estimated that more than two million deaths occur globally each year as a direct consequence of air pollution by damage to the lungs and the respiratory system. Because of this negative role of PM and its associated pollutants, it is necessary to monitor the level of air pollution with PM.

At the beginning of the chapter a classification and sources of PM, effects of particle size and particle composition on human diseases associated with PM pollution are presented. The essential part of the chapter focuses on the methods of analysis and different devices typically used in analysis of PM, including sampling of particle by using filters and other systems. Besides the methods recommended by different national standards, other complementing methods, such as electron microscopy techniques, are also described.

Chapter 15 - Ultrafine Particles Pollution and Measurements Original Research Article
Pages 369-390
P. Kumar, A. Wiedensohler, W. Birmili, P. Quincey, M. Hallquist
First page PDF | Purchase PDF - $31.50

Abstract

Suspended particles of different sizes, shapes and composition are an integral part of the air that we breathe. Aerosol particles smaller than 100 nm in diameter are known as ultrafine particles (UFPs). Recent toxicological and epidemiological studies have raised the hypothesis that UFPs have a greater potential to affect public health compared with their larger counterparts. The rationale is that they are so small in size that they can penetrate deep into the lungs and translocate to different part of human body. Because of their small size, however, their contribution to total particle mass concentrations remains hardly detectable. Therefore, UFPs are preferentially measured as particle number concentrations. During the past decade there have been significant advances in the area of identifying sources, measurements and physicochemical characterisation of UFPs. Yet, their progress has not reached a juncture where the ambient air quality standards for UFPs could be set. The overall goal of this chapter is to provide a comprehensive overview of topics related to UFP measurements and their associated pollution issues. While there has been a significant progress in the measurement methods and availability of instruments to reliably monitor, these instruments are still expensive and their standard calibration methods are yet to take place. The process of standardisation and development of measurement infrastructure are needed to bring regulatory guidelines for airborne UFPs in future.

Chapter 16 - Bioaerosol Monitoring of the Atmosphere for Occupational and Environmental Purposes Original Research Article
Pages 391-420
J.R. Sodeau, D.J. O'Connor
First page PDF | Purchase PDF - $31.50

Abstract

The need to measure the occurrence and transformation of airborne bioaerosols in real-time has increased dramatically over recent years. The necessity is based on the undesirable effects that they can have on our health and the role they play in climate change. This review will provide a background to the reasons why online analytical monitoring of Primary Biological Aerosol Particles (PBAP) are performed and will also provide an outline of how the measurements are made. Several applications of flow cytometry to outdoor and indoor air analysis of bioaerosols will be described along with

assessments of the impacts of such studies on environmental and occupational monitoring. The future prospects of this field will likely impact on medical doctors, curators and insurance companies.

Abstract

Pesticides are the most widely used chemicals, many of which are related to agricultural operations. Emission sources of these substances to the atmosphere include spray drift, volatilisation from soils and plants, and wind erosion of soil particles containing sorbed pesticides. Taking into account all of these processes, the fraction emitted to ambient air could be higher than 30% of the applied dose, which could have a serious impact on the air quality of rural areas. Although historically more attention has been paid to persistent and banned pesticides, there is an increasing interest on the occurrence, fate and impact of currently used pesticides. The concentration of these pesticides is very seasonal and correlated to local use pattern, with levels ranging from few pg/m^3 to many ng/m^3. In general, the inhalation risk for the general population is of no significant concern, but more international guidelines on sampling, analysis and risk assessment are required, and more systematic surveillance seems necessary.

Abstract

Biomass burning produces emissions that may have significant impacts on air quality, as well as on atmospheric chemistry processes, weather, visibility, the global radiation budget and climate. This chapter provides an overview of effects on air quality in populated regions downwind from burning vegetation. Global and regional sources of biomass burning, emissions from the various forms of natural or human-initiated burning situations, the different phases of the burning process and temperatures and moisture content of the fuel all have effects on the emitted pollutants. Along with consideration of the variety of emitted species, transformation and chemistry during transport are also important for effects on downstream air quality. Pollutant concentrations and chemical species are also affected by the meteorological conditions near the source fire and along the transport route of the plume. Local meteorological conditions near the receptor region may have a large impact on whether the transported plume can get transported downward to the surface, or remain aloft and never affect ground-level air quality. Detecting and tracking the location and movement of plumes may be an important aspect of an overview of air quality, and some examples of recent remote sensing products are included.

Abstract

Air quality is an important issue for public health, economy and the environment. Urban areas are important emitters of numerous pollutants that affect not only the residing populations but also populations located downwind urban centres where these pollutants are transported and new, secondary ones, are formed. If one takes into account the fact that Europe accommodates 14% of the world's urban population and three megacities (London, Paris and Moscow), the air quality in European cities becomes even more important. Despite all the mitigation efforts and the legislative directives, air pollution remains an important issue, with particulate matter (PM) and ozone (O_3) being considered as the major pollutants. These pollutants affect air quality and visibility, especially in large urban agglomerations where so many people are affected by the prevailing conditions. As far as human health is concerned, $PM_{2.5}$ especially poses a great risk, as it penetrates into sensitive parts of the respiratory system and may deteriorate health and eventually lead to mortality. Finally, with PM being a significant secondary source with a regional character, it can be subject to long-range transport. It has been observed that for several European countries, less than 50% of the measured $PM_{2.5}$ concentrations are derived from the countries' own emissions.

Abstract

Since the mid-1970s, increasing attention has been given to the quality of the ambient air, whereas indoor air quality is a rather recent concern. On this subject, Mrs Marie-Christine Blandin, 'Nord-Pas-de-Calais' French senator, besides, made public a report devoted to the daily chemical risks evoking one *major sanitary stake*. According to the senator, indoor air pollutants form a 'risk cocktail' where health effects are not yet correctly evaluated, because interior media are still regarded as being protected from external pollution, and then considered as safe. This interest for indoor atmosphere is explained not only by the current way of life where individuals spend most of their life inside buildings (85–90%) in particular in their houses but also by measurements of the French Observatory of the Quality of the Interior Air (created in 2001) showing that indoor air is 'more polluted, quantitatively and qualitatively, than outside air'; then, indoor concentrations of pollutants can be more relevant than ambient concentrations for human exposure assessment. In addition, it is known that indoor air concentrations are higher than outdoor because, in particular, for low energy–consumption buildings waterproofing is strong, degradation is limited and many of the sources are indoors. The conclusions of this report recommend reforms in particular by the establishment of *indoor air quality guidelines*.

Among the large categories of compounds which can contaminate indoor air, some are volatile (aldehydes, aromatics and so on), some are semivolatile (pesticides, flame retardants, plasticisers and so on) and some are of biological importance (fungi and bacteria).

Since 2000, some chemicals used in building materials, furnishings and consumer products have been shown to be endocrine-disrupting chemicals (EDCs); that is, they interfere with the action of endogenous hormone. The greatest concern associated with exposure to EDCs is the potential for adverse effects on reproduction and development, because they have been shown to disrupt normal endocrine signalling in vitro and in vivo animal studies.

This chapter details the main processes leading to the contamination of indoor air, and an inventory of the principal indoor contaminants (air and dust) is drawn with respect to their sources, occurrence and potential impact.

Chapter 21 - Air Quality and the Petroleum Industry Original Research Article
Pages 563-587
G.S. Cholakov
First page PDF | Purchase PDF - $31.50

Abstract

Since the primitive human discovered that fire could improve the quality of life, fuels and combustion became a vital part of our civilization. As we realised only recently, they might also damage our environment. This chapter is devoted to the petroleum industry, understood as interrelated anthropogenic activities, realised in several major operations – production and transportation of petroleum; transformation of petroleum into products; transportation and marketing of products. The industry is analysed in the context of sustainable air quality, its impact and its options for monitoring, control and management of air pollution. Its place within combustion-based energy systems and perspectives for improving and replacing them in the future are concisely presented in the concluding remarks.

Chapter 22 - Pharmaceutical Industries Air Quality Original Research Article
Pages 589-621
E. Oddone, S. Negri, F. Morandi, M. Imbriani
First page PDF | Purchase PDF - $31.50

Abstract

Active pharmaceutical ingredients (APIs) could be risk factors for workers exposed in pharmaceutical industries. Indeed, APIs are compounds specifically designed to interact with human organism and to modify its functioning, and some of them could act as carcinogens or sensitisers, for whom a safe threshold cannot be easily determined. Inhalation is the most important route of exposure.

Occupational exposure limits are needed to protect workers' health, both concerning APIs and pharmaceutical intermediates. To date, several approaches have been suggested to set acceptable daily exposure limits in pharmaceutical industries, and they are a key point especially for carcinogens, sensitisers or endocrine disruptors.

Despite literature evidence is sparse, occupational risks in pharmaceutical industries cannot be disregarded; several adverse health effects have been observed.

In recent years, the quality of air in pharmaceutical industries has improved, even though a special attention has to be paid to exposures to carcinogens and sensitisers.

Chapter 23 - Print and Related Industry Air Quality Original Research Article
Pages 623-654
J.S. Kiurski, I.B. Oros, V.S. Kecic
First page PDF | Purchase PDF - $31.50

Abstract

Small printing facilities and photocopying shops present diffuse and permanent polluters. Each printing technique (pad, screen, offset, flexography, digital) is unique in its own way, with certain characteristics of waste flows. As a daily companion to human activity, the printing industry generates wastes classified roughly as solid, liquid and gaseous wastes. The most common emissions produced by the printing process of all techniques are volatile organic compounds (VOCs) from process chemicals and cleaning solutions. In addition, many VOCs, present in higher concentrations in indoor environments, are considered to be toxins. Dry-process photocopiers have been implicated as contributors to indoor air quality problems too. Photocopying process has been found to be a source of ozone, VOCs, nitrogen dioxide, carbon dioxide, carbon monoxide and ammonia. These pollutants can be easily emitted from photocopying equipment and aggravate atmosphere of an industrial environment related to the printing industry.

Chapter 24 - Pesticide Industries Air Quality Original Research Article
Pages 655-682
S. Armenta, M. de la Guardia
First page PDF | Purchase PDF - $31.50

Abstract

This chapter describes in detail the problems associated with the air quality in pesticide industry and its control. The main types of air pollutants including volatile and semivolatile compounds and particulate materials, their effects on human health, the different exposure levels and the way to calculate them are considered. The different analytical methods employed in the pesticide industry to assess air quality are described including aspects regarding sampling, sample treatment and measurement. Finally, some recommendations regarding personal protective equipment and challenges and proposals for greening the pesticide industry are provided.

Chapter 25 - Cement Manufacturing and Air Quality Original Research Article
Pages 683-705
K.H. Karstensen, C.J. Engelsen, S. Ng, P.K. Saha, M.N. Malmedal
First page PDF | Purchase PDF - $31.50

Abstract

Cement manufacturing requires huge amounts of resources and energy and is causing relatively large emissions to air. The main emissions from production of cement are due to physical–chemical reactions involving raw materials and the combustion of fuels in the kiln system. CO_2, particulate matters, oxides of nitrogen and SO_2 constitute the largest portion of the gross air pollutants emitted. If the process is not well engineered or the emissions are not properly abated, the magnitude of these emissions can be significant and can lead to impacts. In this chapter, the formation of the main air pollutants, its normal levels, possible health impacts and abatement techniques are discussed.

Chapter 26 - Ceramic Industry Air Quality. Emissions Into the Atmosphere From Ceramic Tile Processes Original Research Article

Pages 707-729
G. Timellini, R. Resca, M.C. Bignozzi
First page PDF | Purchase PDF - $31.50

Abstract

The subject of this chapter, air quality associated to the ceramic tile industry, represents a very interesting 'real scenario' in the framework of the whole volume. The reasons can be summarised in this way: (1) the ceramic tile technology includes several significant pollutant emissions into the atmosphere and (2) ceramic industry has generated – although many years ago and in rather small industrial areas, characterised by large concentrations of factories – some air quality problems. The Ceramic District of Sassuolo, Italy, can be considered as a significant example of such industrial areas and represents the main reference adopted in this chapter. Another 'ceramic district' is that of Castellón, Spain, which however is quite different as regards significant factors influencing air quality: factors such as territory, orography, climate, meteorological conditions, urban and industrial settlements and density, road system and traffic, etc.

With reference to the Italian ceramic tile industry, this chapter deals with the description and quantification of emissions into the atmosphere from ceramic industries and aims to document the approach adopted, the resources used and the knowledge developed, to drastically reduce the environmental impact of these emissions on air quality.

This objective has been successfully achieved, at the point that, in particular, the Italian ceramic tile sector is still working, in the framework of a continuous improvement approach, on its environmental performances, as well as on the exploitation of the results achieved as competitiveness factors.

Chapter 27 - Air Quality in Metal Industries: Exhaled Breath Condensate, a Tool for Noninvasive Evaluation of Air Pollution Exposure Original Research Article
Pages 731-764
T. Pinheiro, S.M. Almeida, P.M. Félix, C. Franco, S.M. Garcia, C. Lopes, A. Bugalho de Almeida
First page PDF | Purchase PDF - $31.50

Abstract

In occupational settings, exposure to metal dusts and fumes mainly occurs as a result of inhalation. At present, there is no direct biological indicator to assess exposure by inhalation, which is by far the major route for entrance of airborne pollutants into the body. Assessing inhaled hazardous substances noninvasively is the prospect held out by exhaled breath condensate (EBC) as a biomarker of exposure for the respiratory system. To explore the capabilities of EBC as an indicator of professional exposure to metals, workers of the lead (Pb) industry were chosen as a case study. Pb concentrations were measured in EBC at different time points of the working week and correlated with the Pb levels measured in the air particulate matter collected in the industries. Pb concentrations in EBC were dose dependent. The methodology proved reliable and can be extended to other metals. EBC as a noninvasive biomarker for the respiratory system is opening new avenues in risk assessment in occupational health.

Chapter 28 - Air Quality Management in Electronic Industries Original Research Article
Pages 765-784
Z. Shareefdeen, S. Taqvi, A. Elkamel
First page PDF | Purchase PDF - $31.50

Abstract

This chapter focuses on air emission from electronic industries. The chapter starts with an overview of electronic industries, reviews processes that contribute to air emissions and discusses the type-chemical compounds emitted. Health effects resulting from exposure to the chemicals, analytical techniques for measurements of pollutants and environmental regulations related to the chemicals emitted in electronic industry are presented. Furthermore, technologies used to control or eliminate the emissions from electronic industries are outlined.

Chapter 29 - Air Quality of Textile and Related Industries Original Research Article
Pages 785-800
C. Estevan, M.A. Sogorb, E. Vilanova
First page PDF | Purchase PDF - $31.50

Abstract

When assessing the air quality in textile and related industries, one of the most important issues to be considered is the exposure to chemicals substances, as it might represent a health concern in industry and is subject to different airborne chemical occupational limits. This chapter attempts to describe the factors which might have an impact in the air quality in textile and related industries, as well as including a characterisation of the exposure to substances and the analytical methodologies used for monitoring the exposure to chemicals in these occupational environments. The air quality at these types of industries is directly linked to the use, including in some cases manual application, of solvents containing different volatile organic compounds (VOCs). Several studies have observed in the last years a reformulation of the industrial solvents to reduce the exposure intensity to VOCs such as *n*-hexane in response to marketing criteria for less toxic products. Furthermore, the implementation of risk prevention techniques and other exposure control measures such as the use of local exhaust ventilation or other working practices has proven to be efficacious to improve the occupational safety in these industrial settings. Notwithstanding the aforementioned information, as an unsafe use of chemicals has been frequently monitored, further exposure reduction measures are required.

Chapter 30 - Exposure to Softwood Dust in the Wood Industry Original Research Article
Pages 801-823
K. Hagström, V. Schlünssen, K. Eriksson
First page PDF | Purchase PDF - $31.50

Abstract

The wood industry is a historical industry, and wood dust exposure is widespread. Many people are exposed to wood dust, and most are exposed to softwood (eg, pine, spruce and cedar) or a combination of softwood and hardwood. In 2002–03, around 3.6 million workers, c. 2% of the workforce, were exposed to wood dust in the EU making it a very important work exposure. Exposure to softwood dust may cause symptoms and disease in the skin, eyes, nose, and airways, and wood dust is classified as carcinogenic, particularly for cancers of the nasal cavities and paranasal sinuses by International Agency for Research on Cancer. The Scientific Committee for Occupational Exposure Limits of the EU has stated that exposure to wood dust above 0.5 mg/m^3 of inhalable dust induces pulmonary effects and thus should be avoided. Levels

vary in different industries with mean levels in sawmills between 0.20 and 3.6 mg/m^3 for inhalable dust and 0.02–3.0 mg/m^3 for total dust. In the furniture factories and joinery shops, it has been estimated that 87,000 furniture workers in the EU (12%) may be exposed to a level exceeding 5 mg/m^3, the occupation exposure limit (OEL) in the EU. Personal exposure levels vary between 4.5 mg/m^3 of total dust and 0.6 mg/m^3 of inhalable dust. In the wood pellet industry, high levels have been measured with 8–45% of the measurement over the Swedish OEL of 2 mg/m^3. Determinant of exposure that increases the exposure for wood dust is, eg, cleaning with and without compressed air, maintenance work, indoor work, manual wood processing and sanding. Factors that have been shown to decrease the exposure are, eg, work in control rooms and efficient exhaust ventilation. There are some trends showing a decrease in wood dust exposure, but exposure can still be high especially in the beginning of a new production like the example from the wood pellet industry in Sweden. It also shows that it is important to measure the wood dust exposure in different industries since they can vary widely.

Chapter 31 - Improving the Sustainability of Office Partition Manufacturing: A Case Study Original Research Article
Pages 825-857
F.S. Luisser, M.A. Rosen
First page PDF | Purchase PDF - $31.50

Abstract

Through this case study, it is demonstrated that several advantageous options are available to reduce volatile organic compound emissions when manufacturing office furniture partitions, and thereby to enhance that industrial operation. In this study, base volatile organic compound emissions for a typical plant are estimated using a mass balance approach, and pollution prevention measures are assessed using realistic criteria and weightings. The measures deemed most viable for voluntary emission reductions include implementing several best management practices, not painting hidden components, switching gluing processes, recycling solvent and modifying attachments. The results are intended to be balanced so as to improve their acceptability and adoptability by industry.

Chapter 32 - Indoor Air Quality in Chemical Laboratories Original Research Article
Pages 859-878
T. Ugranli, E. Gungormus, A. Sofuoglu, S.C. Sofuoglu
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Abstract

Chemical laboratories are special microenvironments, in which many pollutants may be found because of the large range and number of chemicals that can be used, while concentrations of some specific ones may relatively be elevated due to high source strengths depending on the type and the number of experiments conducted and the number of people working in the laboratory. Laboratories can be considered as public places for the students whereas they are occupational microenvironments for their staff (technicians, specialists and teaching/research assistants). Hence, laboratory indoor air quality (IAQ) is of importance due to chronic, toxic and carcinogenic health risks for the staff in addition to possible acute effects for both staff and students. This chapter presents background information regarding pertinent indoor air pollutants, factors that determine their concentrations, indoor environmental comfort, a review of the literature on indoor environmental quality in chemical laboratories and measures of IAQ management.

Chapter 33 - Damage Costs of Air Pollution and Policy Implications Original Research Article
Pages 881-915
A. Rabl, J.V. Spadaro
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Abstract

In the past two decades there has been much progress in the analysis of environmental damages thanks to the ExternE (External Costs of Energy) projects of the European Commission, as well as analogous work in the United States. This chapter offers a summary of the methodology and key results. Even though the uncertainties are large, the results provide substantial evidence that the classical air pollutants (particles, NO_x and SO_2) from the combustion of fossil fuels impose significant damage costs. The costs of global warming from the emission of greenhouse gases are also large. We present results for the damage costs per kilogram of emitted pollutants for typical conditions in Europe; they are based on the last version of ExternE (published in 2008), but with a major upward adjustment of the monetary values. To illustrate their use, we apply them to obtain the damage costs of the main technologies for electric power. We also present the implications for landfill and incineration of municipal solid waste. The results provide crucial input for the formulation of rational environmental policies, for example, the appropriate level of pollution taxes and the advantages of cleaner technologies.

Chapter 34 - The Challenges of Air Protection and Control Original Research Article
Pages 917-929
M. de la Guardia, S. Armenta
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Abstract

This chapter tries to be a look into the future of generalised systems for accurate, fast and cheap determination of the quality of air, especially taking into consideration the European norm on the registration, evaluation, authorisation and restriction of chemicals and the corresponding evaluation of the contamination exposure scenarios indoor, at home and working sites, and outdoor. Special attention is paid to the challenges in sensitivity and selectivity of the analytical methods together with the consideration of economic reasons and time of analysis in order to take prompt decisions concerning the quality of air.

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