

Préparation du bulletin RSEIN N° 4176 articles répertoriés pendant la période de septembre à décembre 2013

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LISTE INDICATIVE DES EXPERTS DU RESEAU POUR CHAQUE THEMATIQUE

NB : Cette liste n'est qu'indicative et ne prétend pas à l'exhaustivité des domaines couverts par chacun.

I- MÉTROLOGIE (PROTOCOLES PRÉLÈVEMENTS / ANALYSES / MODÉLISATION)		N° rubrique
I-1. Gaz inorganiques/ métaux	Barbara LE BOT, Laurence SCHANG, Bernard Collignan (Radon), Philippe PIRARD (Radon), Roselyne AMEON (radon), Hervé PLAISANCE	Rubrique N°1
I-2. COV, COsemi-Volatils	Valérie DESAUZIERS, Caroline MARCHAND, Olivier RAMALHO, Laurence SCHANG, Anne-Lise TIFFONNET (interactions), Corinne MANDIN, Christophe YRIEIX, Hervé PLAISANCE, Tatiana MACE	Rubrique N°2
COSV	Maurice MILLET (COSV), Barbara LE BOT (COSV)	
émission matériaux	François MAUPETIT (émission), Mélanie NICOLAS (émission), Christelle NICOLET (émission), Hervé PLAISANCE, Valérie DESAUZIERS	
modélisation	Marc ABADIE	
pesticides/biocides	Olivier BLANCHARD, Barbara LE BOT, Anita VIGOUROUX-VILLARD, Maurice MILLET	
fumée de tabac environnementale	Frédérique GRIMALDI	
I-3. Particules et fibres / métaux	Olivier BLANCHARD, Laurent MARTINON, Olivier RAMALHO, Mélanie NICOLAS, Maurice MILLET, Corinne MANDIN, Timea BEJAT	
I-4. Biocontaminants	Marina MOLETTA-DENAT, Sophie BARRAL, Valérie BEX	
I-5. Ventilation	Bernard COLLIGNAN, Patrice BLONDEAU, Jacques RIBERON, Alain GINESTET, Olivier RAMALHO	
I-6. Modélisation		
I-7. Études		
II- CONNAISSANCES DES CONCENTRATIONS ET DES EXPOSITIONS		
II-1. Logement	François BELANGER, Denis CHARPIN (allergène), Gaëlle GUILLOSSOU, Corinne SCHADKOWSKI, Caroline MARCHAND, Corinne MANDIN, Olivier RAMALHO, Marie-Aude KERAUTRET, Sabine HOST (moisissure), Hervé PLAISANCE, Anita VIGOUROUX-VILLARD (pesticide), Dorothee GRANGE (moisissures), Philippe GLORENNEC (Plomb, COSV), Edwige RÉVÉLAT	Rubrique N°3
II-2. Transports	Olivier BLANCHARD, Caroline MARCHAND, Bruno COUTY, Hélène DESQUEYROUX, Hervé PLAISANCE	Rubrique N°4
II-3. Bureaux	Caroline MARCHAND, Luc MOSQUERON, Bruno COUTY, Edwige RÉVÉLAT	
II-4. ERP	Caroline MARCHAND, Luc MOSQUERON, Bruno COUTY, Edwige RÉVÉLAT	Rubrique N°5
II-5. Autres lieux de vie	Christelle NICOLET, Corinne MANDIN, Marie-Aude KERAUTRET, Sabien HOST (moisissure), Luc MOSQUERON	Rubrique N°6
II-6. Ventilation	Bernard COLLIGNAN, Patrice BLONDEAU, Jacques RIBERON, Alain GINESTET, O. RAMALHO, Timea BEJAT	
II-7. Modélisation	Marc ABADIE, Patrice BLONDEAU, Timea BEJAT, Bernard COLLIGNAN, Francis ALLARD, Anne-Lise TIFFONNET	Rubrique N°7
II-8. Air extérieur – Air intérieur	Souad BOUALLALA, Hélène DESQUEYROUX, Edwige RÉVÉLAT, Marie-Aude KERAUTRET, Laurent MARTINON (particules), Dorothee GRANGE	Rubrique N°8
III- RISQUE ET IMPACT SUR LA SANTÉ		
III-1. Toxicologie expérimentale	Nathalie BONVALLOT, Vincent NEDELLEC	
III-2. Expologie		Rubrique N°10
III-3. Épidémiologie	Isabella ANNESI-MAESANO, Hélène BAYSSON, François BELANGER, Denis CHARPIN (asthme/allergène), Hélène DESQUEYROUX, Véronique EZRATTY, Philippe GLORENNEC, Frédérique GRIMALDI, Marie-Thérèse GUILLAM, Dorothee GRANGE, Sabine HOST, Isabelle MOMAS, Philippe PIRARD, Claire SEGALA, Gaëlle GUILLOSSOU, Vincent NEDELLEC, Denis CHARPIN (allergène)	Rubrique N°11

III-4. Évaluation des risques	Nathalie BONVALLOT, Véronique EZRATTY, Philippe GLORENNEC, Corinne MANDIN, Luc MOSQUERON, Vincent NEDELLEC, Hélène BAYSSON (radon), Olivier BLANCHARD	Rubrique N°12
IV- GESTION/DIVERS		
IV-1. Système de ventilation	François MAUPETIT, Mélanie NICOLAS, Laurence LE-COQ, Alain GINESTET	Rubrique N°13
IV-2. Analyse cout-benefice	Vincent NEDELLEC	Rubrique N°14
IV-3. Technique	François MAUPETIT, Mélanie NICOLAS, Fabien SQUINAZI, Xavier CAUCHERIE, Laurence LE-COQ, Alain GINESTET	Rubrique N°15
IV-4. Réglementaire		Rubrique N°15

I. MÉTROLOGIE (PROTOCOLES PRELEVEMENTS / ANALYSES / MODELISATION)

1.1 Gaz inorganiques / métaux

Rubrique N°1

a. Radon

2. Measurement of indoor and outdoor radon concentrations during Superstorm Sandy

By: [Kotrappa, P](#) (Kotrappa, Payasada)^[1]; [Paul, P](#) (Paul, Prateek)^[1]; [Stieff, A](#) (Stieff, Alex)^[1]; [Stieff, F](#) (Stieff, Frederick)^[1]

RADIATION PROTECTION DOSIMETRY Volume: 157 Issue: 3 Pages: 455-458

Published: DEC 2013

Superstorm Sandy affected much of the US East Coast extending over 1800 km. It passed over the test location in the State of Maryland on 29 October 2012. Being 350 km away from the regions of highest intensity the storm was of lower intensity at the test location. Continuous radon monitors and passive radon monitors were used for the measurement. The test location was the basement of a single family home representing the indoor concentration. A partially opened garage of the same test home represented the outdoor radon concentration. In 24 h, the atmospheric pressure dropped from 990 to 960 mbar and the indoor radon concentration increased from 70 to 1500 Bq m(3) and returned to the normal of 70 Bq m(3) at the end of the storm. Throughout the storm, the outdoor radon concentration was not significantly affected. Probable reasons for such surprisingly large changes are discussed. However, the outdoor temperature dropped from 13C to 7C during the radon peak.

3. An approach to define potential radon emission level maps using indoor radon concentration measurements and radiogeochemical data positive proportion relationships

By: [Drolet, JP](#) (Drolet, Jean-Philippe)^[1]; [Martel, R](#) (Martel, Richard)^[1]; [Poulin, P](#) (Poulin, Patrick)^[2]; [Dessau, JC](#) (Dessau, Jean-Claude)^[3]; [Lavoie, D](#) (Lavoie, Denis)^[4]; [Parent, M](#) (Parent, Michel)^[4]; [Levesque, B](#) (Levesque, Benoit)^[2]

JOURNAL OF ENVIRONMENTAL RADIOACTIVITY Volume: 124 Pages: 57-67 Published: OCT 2013

The aim of this paper is to present the first step of a new approach to make a map of radon-prone areas showing different potential radon emission levels in the Quebec province. This map is a tool intended to assist the Quebec government in identifying populations with a higher risk of indoor radon gas exposure. This map of radon-prone areas used available radiogeochemical information for the province of Quebec: (1) Equivalent uranium (eU) concentration from airborne surface gamma-ray surveys; (2) uranium concentration measurements in sediments; and (3) bedrock and surficial geology. Positive proportion relationships (PPR) between each individual criterion and the 1417 available basement radon concentrations were demonstrated. It was also shown that those criteria were reliable indicators of radon-prone areas. The three criteria were discretized into 3, 2 and 2 statistically significant different classes respectively. For each class, statistical heterogeneity was validated by Kruskal-Wallis one way analyses of variance on ranks. Maps of radon-prone areas were traced down for each criterion. Based on this statistical study and on the maps of radon-prone areas in Quebec, 18% of the dwellings located in areas with an equivalent uranium (eU) concentration from airborne surface gamma-ray surveys under 0.75 ppm showed indoor radon concentrations above 150 Bq/m³. This percentage increases to 33% when eU concentrations are between 0.75 ppm and 1.25 ppm and exceeds 40% when eU concentrations are above 1.25 ppm. A uranium concentration in sediments above 20 ppm showed an indoor radon concentration geometric mean of 215 Bq/m³ with more than 69% of the dwellings exceeding 150 Bq/m³ or more than 50% of dwellings exceeding the Canadian radon

guideline of 200 Bq/m³. It is also shown that the radon emission potential is higher where a uranium-rich bedrock unit is not covered by a low permeability (silt/clay) surficial deposit. (c) 2013 Elsevier Ltd. All rights reserved.

1.2 COV, COSEmi-Volatils

Rubrique N°2

a. COV/Aldéhydes

4. Benzene and xylene detection by absorbance in the range of 10-100 ppb application: Quality of indoor air

[Hue, J](#) (Hue, J.)^[1]; [Dupoy, M](#) (Dupoy, M.)^[1]; [Bordy, T](#) (Bordy, T.)^[1]; [Rousier, R](#) (Rousier, R.)^[1]; [Vignoud, S](#) (Vignoud, S.)^[1]; [Schaerer, B](#) (Schaerer, B.)^[1]; [Tran-Thi, TH](#) (Tran-Thi, T-H)^[2]; [Rivron, C](#) (Rivron, C.)^[2]; [Mugherli, L](#) (Mugherli, L.)^[3]; [Karpe, P](#) (Karpe, P.)^[4]

SENSORS AND ACTUATORS B-CHEMICAL Volume: 189 Pages: 194-198 Published: DEC 2013

In the framework of a French Joint program COVADIS, an innovative system is developed for the simultaneous detection of benzene, toluene and xylenes in indoor air. The present work is focused on the benzene and xylene detection. The detection is based on absorbance measurements over the 250 nm-300 nm spectral range with a cooled and uncooled spectrophotometer. The prototype includes an exposure chamber, which contains five sensors. The sensors are nanoporous disks, whose pore sizes are tailored to efficiently entrap the targeted pollutants. 20 ppb of benzene and 10 ppb of m-xylene have been successfully detected within 40 min of exposure.

5. Simultaneous quantification of five phenols in settled house dust using ultra-high performance liquid chromatography-tandem mass spectrometry

By: [Lu, XM](#) (Lu, Xiaomei)^[1]; [Chen, MJ](#) (Chen, Minjian)^[2]; [Zhang, XL](#) (Zhang, Xiaoling)^[1]; [Sun, YG](#) (Sun, Yonggang)^[3]; [Zhu, DM](#) (Zhu, Dongmei)^[3]; [Zhang, Q](#) (Zhang, Qi)^[4]; [Wang, BL](#) (Wang, Bingling)^[4]; [Zhang, ZD](#) (Zhang, Zhengdong)^[4]

ANALYTICAL METHODS Volume: 5 Issue: 19 Pages: 5339-5344 Published: 2013

A simple analytical method for the simultaneous determination of five phenols (bisphenol A, triclosan, 4-tert-octylphenol, 4-n-octylphenol, 4-n-nonylphenol) in indoor settled house dust was developed based on ultra-high performance liquid chromatography-tandem mass spectrometry (UPLC-MS/MS). Analytes were extracted from dust samples using acetone under sonication. The extracts were concentrated and dissolved in 0.2 mL acetonitrile, then analyzed using UPLC-MS/MS in multiple reaction monitoring mode. For quantification, calibration curves of phenol standards in blank dust samples were used. Only 0.025 g of each dust sample was needed for the analysis. Method detection limits were 1.4-192 ng g⁻¹, and absolute recoveries were 79-114% with coefficients of variation <20% for all the analytes (except triclosan, which was at 39.7%). This method was applied to measure the concentration of five phenols in 47 settled house dust samples from urban homes in which pre-school aged children lived. A high frequency of detection for most of the target phenols (except 4-n-octylphenol and 4-n-nonylphenol) combined with a wide distribution in concentration, supported the notion that indoor dust may represent an important (but widely variable) pathway of exposure to bisphenol A, triclosan and 4-tert-octylphenol for toddlers.

6. Short Duration Needle Trap Sampling with Gas Chromatography Analysis to Determine Nearly Instantaneous Concentrations of Selected Organic Vapor Contaminants

Authors: Strating, SJ; Juarez, TJ; Stevens, ME; White, DW; Smith, PA

Source: JOURNAL OF OCCUPATIONAL AND ENVIRONMENTAL HYGIENE , 10 (12):674-684; DEC 1 2013

: Needle trap device samplers were used for rapid (60s) quantitative sampling of short-term exposure limit (STEL) and peak exposure standard concentrations using a manually operated pump to collect small volume (10mL) gas phase samples containing methylene chloride, benzene, toluene, and tetrachloroethylene vapors. Solventless introduction of chemical samples for gas chromatography analysis with flame ionization detection yielded linear results ($R^2 > 0.99$) for vapor standard mixtures of the four target analytes ranging from 10% to 200% of their respective nominal STEL or peak exposure standard concentrations. Needle trap samplers showed 86% recovery (as GC-FID peak area responses) following 14-day storage at room temperature compared to the same samplers analyzed immediately, with better recovery values observed with shorter storage (95% at room temperature for seven days, except for methylene chloride) or with storage at 4 degrees C. Calibration for quantitation of concentrations of benzene, toluene, and tetrachloroethylene was shown to be possible with the use of an internal standard to account for injector discrimination between the solventless NTD approach and injections of target analytes in carbon disulfide. Due to the simple sampling method (no field calibration and battery-free pumping) and the avoidance of solvent dilution, a needle trap sampling approach could simplify sample collection and analysis to chromatographically determine nearly instantaneous (1min) exposure concentrations.

7. Application of multi-sorbent tubes filled with modified multi-walled carbon nanotubes for determining volatile organic compounds in a wide range of polarity

Author(s): Hu, XH (Hu, Xiaohan)^[1]; Liu, JM (Liu, Jiemin)^[1]; Wang, L (Wang, Li)^[1]; Zhao, P (Zhao, Peng)^[1,2]

Source: ANALYTICAL METHODS **Volume:** 5 **Issue:** 17 **Pages:** 4436-4441 **DOI:** 10.1039/c3ay40589c
Published: 2013

New adsorbent M101 was obtained by loading multi-walled carbon nanotubes (MWCNTs) on 101 white support, and 3-aminopropyl silica gel-MWCNTs (APSG-MW) were prepared by chemical modification. Based on the early research, 15 kinds of adsorbents were tested to adsorb sulfide and amine compounds. Then 4 combinations of multi-sorbent tubes were prepared including Tenax TA/M101/Carbopack B (TMB), Tenax TA/M101/Carboxen 564 (TM564), Carbopack B/M101/Silica gel (BMS) and Carbopack B/APSG-MW/Silica gel (BAMS). The adsorption and desorption recoveries for alkanes, aromatic hydrocarbons, halogenated hydrocarbons, alcohols, esters, ketones, sulfides and amines were determined. The results showed that the recoveries of multi-layer adsorbents BMS and BAMS were above 90% for most of the target compounds, and 80% for amines. Then the influence of humidity on the sampling, storage stability and sampling precision of BMS and BAMS was tested. The results indicated that BMS and BAMS were more suitable for sampling both polar and non-polar compounds in the air.

a. Semi-volatils**8. A semi-quantitative approach for analysing low-volatile organic compounds in house dust using an SFE method: Significant common features and particular differences of the extracts**

[Papadopoulos, A](#) (Papadopoulos, Athanasios)^[1]; [Vlachogiannis, D](#) (Vlachogiannis, Diamando)^[2]; [Maggos, T](#) (Maggos, Thomas)^[2]; [Sfetsos, A](#) (Sfetsos, Athanasios)^[2]; [Karayiannis, MI](#) (Karayiannis, Miltiades I.)^[3]

JOURNAL OF SUPERCRITICAL FLUIDS Volume: 82 Pages: 268-281 Published: OCT 2013

A number of samples have been collected from various indoor environments located in a semi-rural area in north-western Italy, for extraction with supercritical carbon dioxide (CO₂) and analysis of low volatility organic compounds on house dust. The investigation was based on a survey analysis approach aiming at the identification of the organic content of indoor dust. The quantification of the content of the compounds was obtained with a semi-quantitative method, incorporating three pre-defined concentration ranges. The classes of compounds, mostly detected in the indoor dust samples analyzed, were fatty acids and some of their esters, n-alkanes, phthalates and alcohols. Other less frequently found classes were other esters, phenols, aliphatic aldehydes and ketons. The compounds that were identified in all or in most of the house dust samples appeared predominantly in high concentration ranges while compounds detected scarcely were measured mainly in low concentrations. The experimental study verified that the most important emission sources for the organic compounds detected in the indoor environment were a wide variety of plastic materials and human activities (e.g., cooking). Particular features of some extracts were attributed to specific actions that took place in the house prior or during sampling, and/or to the materials used in the house construction or heating methods. Among the compounds identified as prominent in the house dust samples were the phthalates, of major interest with regard to their impact on human health. (C) 2013 Elsevier B.V. All rights reserved.

9. Optimisation steps of an innovative air sampling method for semi volatile organic compounds

Authors: Lazarov, B; Swinnen, R; Spruyt, M; Goelen, E; Stranger, M; Desmet, G; Wauters, E

Source: **ATMOSPHERIC ENVIRONMENT**, 79 780-786; NOV 2013

This work describes optimisation steps of an innovative method for the measurement several groups of semi-volatile organic compounds (SVOCs) in air, collecting both gaseous and particulate air fractions. It is based on active air sampling on sorption tubes (consisting of polydimethylsiloxane (PDMS) and Tenax TA), followed by thermal desorption and gas chromatography mass spectrometry analysis (TD-GC-MS). The optimised method was validated in the laboratory for the measurement of selected target compounds from the following chemical classes: polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs) and phthalate esters (PEs). It was applied in different Belgian urban outdoor as well as indoor environments. The new method is characterised by limits of detection in the range of 0.003-0.3 ng m⁻³ for PAHs, 0.004-0.2 ng m⁻³ for PCBs, 0.113 -0.201 ng m⁻³ for PBDEs and 0.002-0.2 ng m⁻³ for PEs, a linearity of 0.996 and a repeatability of less than 10% for all studied compounds. (C) 2013 Elsevier Ltd. All rights reserved.

10. Thermal desorption-gas chromatography mass spectrometry method to determine phthalate and organophosphate esters from air samples

Author(s): Aragon, M (Aragon, M.)^{1,1,1}; Borrull, F (Borrull, F.)^{1,1,1}; Marce, RM (Marce, R. M.)^{1,1,1}

Source: JOURNAL OF CHROMATOGRAPHY A **Volume:** 1303 **Pages:** 76-82 **DOI:** 10.1016/j.chroma.2013.06.025 **Published:** AUG 16 2013

Conference: 12th Scientific Meeting of the Spanish-Society-of-Chromatography-and-Related-Techniques

Location: Tarragona, SPAIN **Date:** NOV 14-16, 2012

Sponsor(s): Spanish Soc Chromatog & Related Tech

A method based on thermal desorption-gas chromatography-mass spectrometry (TD-GC-MS) has been developed to determine four organophosphate esters, seven phthalate esters, and bis(2-ethylhexyl) adipate in the gas phase from harbour and urban air samples. The method involves the sampling of 1.5 L of air in a Tenax TA sorbent tube followed by thermal desorption (using a Tenax TA cryogenic trap) coupled to gas chromatography-mass spectrometry. The repeatability of the method expressed as %RSD (n = 3) is less than 15% and the MQLs are between 0.007 $\mu\text{g m}^{-3}$ (DMP, TBP, BBP, TPP and DnOP) and 6.7 $\mu\text{g m}^{-3}$ (DEHP). The method was successfully applied in two areas (urban and harbour) testing two and three points in each one, respectively. Some of these compounds were found in both urban and harbour samples. Di-(2-ethylhexyl)phthalate was the most abundant compound found in both areas at concentration levels between 6.7 $\mu\text{g m}^{-3}$ and 136.4 $\mu\text{g m}^{-3}$. This study demonstrates that thermal desorption is an efficient method for the determination of these semi-volatile compounds in the gas phase fraction of air samples (c) 2013 Elsevier B.V. All rights reserved.

a. Réactions chimiques

11. Effect of Temperature on Aerosol Formation Potential for a Terpene-Rich Air Freshener in the Presence of Ozone

By: Vu, TP (Thai Phuong Vu)^{1,2,1}; Lee, SB (Lee, Seung-Bok)^{1,1}; Bae, GN (Bae, Gwi-Nam)^{1,2,1}

INDOOR AND BUILT ENVIRONMEN Volume: 22 Issue: 5 Pages: 808-821 Published: OCT 2013

The temperature dependence of secondary organic aerosol (SOAs) formation resulting from reactions of ozone with volatile organic compounds (VOCs) emitted from a terpene-rich air freshener was investigated in a temperature-controlled chamber. To assess the contribution of the air freshener to SOAs related to indoor air pollution, a new concept of aerosol formation potential (AFP) is proposed to replace the traditional SOA yield (Y). The AFP is defined as aerosol mass formed per unit ozone reacted. The AFP of the air freshener is simple to use for ozone-initiated SOA formation, because only the amount of reacted ozone is used, instead of the reacted amount of a large number of VOCs. The AFP of the air freshener was higher at lower temperature. The AFP at 10°C was 1.3, 2.3, and 3.4 times higher than those at 20, 31, and 36°C, respectively. The AFP is more dependent on temperature than on injected ozone concentration under the experimental conditions of this study. The AFP approach provides a simple tool that can be applied to examine SOAs formation potential from reactions of ozone with VOCs emitted from household consumer products.

12. Ozone reaction with clothing and its initiated particle generation in an environmental chamber

Authors: Rai, AC; Guo, B; Lin, CH; Zhang, JS; Pei, JJ; Chen, QY

Source: *ATMOSPHERIC ENVIRONMENT*, 77 885-892; OCT 2013

Ozone-initiated chemistry in indoor air can produce sub-micron particles, which are potentially harmful for human health. Occupants in indoor spaces constitute potential sites for particle generation through ozone reactions with human skin and clothing. This investigation conducted chamber experiments to examine particle generation from ozone reactions with clothing (a T-shirt) under different indoor conditions. We studied the effect of various factors such as ozone concentration, relative humidity, soiling levels of T-shirt with human skin oils, and air change rate on particle generation. The results showed that ozone reactions with the T-shirt generated sub-micron particles, which were enhanced by the soiling of the T-shirt with human skin oils. In these reactions, a burst of ultrafine particles was observed about one hour after ozone injection, and then the particles grew to larger sizes. The particle generation from the ozone reactions with the soiled T-shirt was significantly affected by the different factors studied and these reactions were identified as another potential source for indoor ultrafine particles. (C) 2013 Elsevier Ltd. All rights reserved.

a. Émission des matériaux

13. Emission behavior of hexabromocyclododecanes and polybrominated diphenyl ethers from flame-retardant-treated textiles

By: Kajiwara, N (Kajiwara, Natsuko)^[1]; Takigami, H (Takigami, Hidetaka)^[1]

ENVIRONMENTAL SCIENCE-PROCESSES & IMPACTS

Volume: 15 **Issue:** 10 **Pages:** 1957-1963 **Published:** 2013

To evaluate the emission behavior of hexabromocyclododecanes (HBCDs) and polybrominated diphenyl ethers (PBDEs) added to textile products as flame retardants, we used a small stainless steel container (7 cm i.d. x 5.5 cm height, ca. 210 cm³) to conduct emission tests on three upholstery textile samples at temperatures of 20, 40, 60, and 80 degrees C. The textile samples, which were intended for use in curtain manufacture and had been treated with either technical HBCD or technical DecaBDE, emitted HBCDs and PBDEs, including BDE 209, even at room temperature (20 degrees C), and the emission rates increased with increasing test temperature. These results indicate that flame-retardant-treated upholstery textiles have the potential to be major sources of brominated flame retardant contamination in indoor air and dust. The HBCD diastereomer emission profiles at the test temperatures of 20 and 40 degrees C were similar to the profiles of the original textile samples; in contrast, at the higher test temperatures, the proportion of alpha-HBCD was larger (up to 70% of the total HBCD emission) than in the original samples. At the higher test temperatures, the proportions of di- to hexa-BDEs in the emissions were clearly larger than in the original sample, suggesting that the textile products treated with technical DecaBDE could be a source of environmentally relevant PBDE congeners such as BDE 47, 99, and 100. The emission rates of HBCDs from the textiles were two orders of magnitude higher than those of PBDEs, suggesting that HBCDs volatilize more easily from textile products to the indoor environment than PBDEs.

14. Evaluation of three common green building materials for ozone removal, and primary and secondary emissions of aldehydes

Authors: Gall, E; Darling, E; Siegel, JA; Morrison, GC; Corsi, RL

Source: *ATMOSPHERIC ENVIRONMENT*, 77 910-918; OCT 2013

Ozone reactions that occur on material surfaces can lead to elevated concentrations of oxidized products in the occupied space of buildings. However, there is little information on the impact of materials at full scale, especially for green building materials. Experiments were completed in a 68 m³ climate-controlled test chamber with three certified green building materials that can cover large

areas in buildings: (1) recycled carpet, (2) perlite-based ceiling tile and (3) low-VOC paint and primer on recycled drywall. Ozone deposition velocity and primary and secondary emission rates of C-1 to C-10 saturated carbonyls were determined for two chamber mixing conditions and three values of relative humidity. A direct comparison was made between ozone deposition velocities and carbonyl yields observed for the same materials analyzed in small (10 L) chambers. Total primary carbonyl emission rates from carpet, ceiling tile and painted drywall ranged from 27 to 120 $\mu\text{g m}^{-2} \text{h}^{-1}$, 13 to 40 $\mu\text{g m}^{-2} \text{h}^{-1}$, 3.9 to 42 $\mu\text{g m}^{-2} \text{h}^{-1}$, respectively. Ozone deposition velocity to these three materials averaged 6.1 m h^{-1} , 2.3 m h^{-1} and 0.32 m h^{-1} , respectively. Total secondary carbonyl emissions from these materials ranged from 70 to 276 $\mu\text{g m}^{-2} \text{h}^{-1}$, 0 to 12 $\mu\text{g m}^{-2} \text{h}^{-1}$, and 0 to 30 $\mu\text{g m}^{-2} \text{h}^{-1}$, respectively. Carbonyl emissions were determined with a transient approximation, and were found to be in general agreement with those found in the literature. These results suggest that care should be taken when selecting green building materials due to potentially large differences in primary and secondary emissions. (C) 2013 Elsevier Ltd. All rights reserved.

15. VOC sorption and diffusion behavior of building materials

Author(s): Niedermayer, S (Niedermayer, Sabrina)^{1,1}; Furrhapper, C (Furrhapper, Christina)^{1,1}; Nagl, S (Nagl, Stefan)^{2,1}; Polleres, S (Polleres, Sylvia)^{2,1}; Schober, KP (Schober, Klaus Peter)^{2,1}

Source: EUROPEAN JOURNAL OF WOOD AND WOOD PRODUCTS **Volume:** 71 **Issue:** 5 **Pages:** 563-571
DOI: 10.1007/s00107-013-0713-4 **Published:** SEP 2013

In this study 25 different building materials often used in timber constructions (wood based panels, gypsum boards, vapor barriers, adhesive tapes, insulation materials and sealants) were investigated with regard to their adsorption, desorption and diffusion behaviour towards volatile organic compounds (VOC). The materials were exposed to four, respectively five selected VOCs typically found in indoor air: hexanal, butyl acetate, p-xylene, nonane and alpha-pinene. Adsorption and desorption properties were investigated under static conditions, whereas the diffusion behavior was examined in a 0.225 m^3 emission chamber with an air exchange rate of 1 h^{-1} . The results of the experiments indicate that some building products have a high potential to reduce VOCs in indoor air. Apart from the vapor barriers, two insulating materials and one plasterboard, all tested materials represented an adsorption efficiency of about 50 % or higher related to the injected VOC standards. Materials with high adsorption capacity bound substances strongly and desorbed them less, whereas less adsorbing materials acted inversely. The obtained results indicate that material properties and processing play a considerable role in diffusion behavior of building materials.

1.3 Particules et fibres

16. Fifteen years of nuclear techniques application to suspended particulate matter studies

Author(s): Almeida, SM (Almeida, S. M.)^{1,1}; Freitas, MC (Freitas, M. C.)^{1,1}; Reis, M (Reis, M.)^{1,1}; Pinheiro, T (Pinheiro, T.)^{1,1}; Felix, PM (Felix, P. M.)^{1,1}; Pio, CA (Pio, C. A.)^{2,1}

Source: JOURNAL OF RADIOANALYTICAL AND NUCLEAR CHEMISTRY **Volume:** 297 **Issue:** 3 **Pages:** 347-356 **DOI:** 10.1007/s10967-012-2354-1 **Published:** SEP 2013

Cited References: 30 [view related records]  Citation Map

Acute and chronic exposures to Airborne Particulate Matter (APM) have been linked, in epidemiological studies, to increased mortality and to a wide spectrum of respiratory and cardiovascular disorders. One factor that highly influences the toxicity of APM is its chemical composition. Nuclear Analytical Techniques (NATs) can be advantageously used in the determination of the particles element composition due to their multielement capability in association with low detection limits. Therefore, the characterization of APM by these techniques contributes to the identification of emission sources and, consequently, to the assessment of the effectiveness of the current air pollution abatement strategies. The main goal of this paper was to present the achievements obtained within 15 years of activities related with the use of NATs on the analysis of APM sampled in outdoor, indoor and industrial environments. The results presented in this work confirmed the relevance of NATs as efficient analytical techniques not only in the characterization of APM, but also in source apportionment, identification of long range transport and health assessment studies

1.4 Biocontaminants

CONFERENCE

17. CORRELATION OF LASER PARTICLE COUNTS WITH VISUAL SPORE COUNTS IN INDOOR AIR

By: [Humphrey, AL](#) (Humphrey, A. L.); [Barnes, CS](#) (Barnes, C. S.); [Allenbrand, R](#) (Allenbrand, R.); [Muhammed, M](#) (Muhammed, M.)

ANNALS OF ALLERGY ASTHMA & IMMUNOLOGY Volume: 111 Issue: 5 Pages: A7-A7
Supplement: 1 Published: NOV 2013

ELSEVIER SCIENCE INC, 360 PARK AVE SOUTH, NEW YORK, NY 10010-1710 USA

Categories / Classification

Research Areas:Allergy; Immunology

Meeting

1.5 Ventilation

18. Influence of ventilation and filtration on indoor particle concentrations in urban office buildings

Authors: Quang, TN; He, CR; Morawska, L; Knibbs, LD

Source: **ATMOSPHERIC ENVIRONMENT** , 79 41-52; NOV 2013

This study aimed to quantify the efficiency of deep bag and electrostatic filters, and assess the influence of ventilation systems using these filters on indoor fine (<2.5 µm) and ultrafine particle concentrations in commercial office buildings. Measurements and modelling were conducted for different indoor and outdoor particle source scenarios at three office buildings in Brisbane, Australia. Overall, the in-situ efficiency, measured for particles in size ranges 6-3000 nm, of the deep bag filters ranged from 26.3 to 46.9% for the three buildings, while the in-situ efficiency of the electrostatic filter in one building was 60.2%. The highest PN and PM_{2.5} concentrations in one of the office buildings (up to 131% and 31% higher than the other two buildings, respectively) were due to the proximity of the building's HVAC air intakes to a nearby bus-only roadway, as well as its higher outdoor ventilation rate. The lowest PN and PM_{2.5} concentrations (up to 57% and 24% lower than the other two buildings, respectively) were measured in a building that utilised both outdoor and mixing air filters in its HVAC system. Indoor PN concentrations were strongly influenced by outdoor levels and were significantly higher during rush-hours (up to 41%) and nucleation events (up to 57%), compared to working-hours, for all three buildings. This is the first time that the influence of new particle formation on indoor particle concentrations has been identified and quantified. A dynamic model for indoor PN concentration, which performed adequately in this study also revealed that using mixing/outdoor air filters can significantly reduce indoor particle concentration in buildings where indoor air was strongly influenced by outdoor particle levels. This work provides a scientific basis for the selection and location of appropriate filters and outdoor air intakes, during the design of new, or upgrade of existing, building HVAC systems. The results also serve to provide a better understanding of indoor particle dynamics and behaviours under different ventilation and particle source scenarios, and highlight effective methods to reduce exposure to particles in commercial office buildings.

II. CONNAISSANCES DES CONCENTRATIONS ET DES EXPOSITIONS

II.1 Logement

Rubrique N°3

a. COV

19. Occurrence of linear and cyclic volatile methyl siloxanes in indoor air samples (UK and Italy) and their isotopic characterization

By: [Pieri, F.](#) (Pieri, F.)^[11]; [Katsoyiannis, A.](#) (Katsoyiannis, A.)^[12]; [Martellini, T.](#) (Martellini, T.)^[11]; [Hughes, D.](#) (Hughes, D.)^[11]; [Jones, K. C.](#) (Jones, K. C.)^[11]; [Cincinelli, A.](#) (Cincinelli, A.)^[13]

ENVIRONMENT INTERNATIONAL Volume: 59 Pages: 363-371 Published: SEP 2013

Research Domain Environmental Sciences & Ecology

The occurrence of linear- and cyclic-volatile methyl siloxanes (IVMSs and cVMSs, respectively) in various indoor environments, occupational and domestic, in Italy and in the United Kingdom was studied. The results show that the cVMSs are the most abundant, detected in average concentrations that in some cases were as high as 170 $\mu\text{g m}^{-3}$. Our study highlights the differences that can be observed between various indoor environments (e.g. domestic like bathrooms, bedrooms, or occupational) and between two countries. In most cases, the concentrations found in the UK are higher than in the respective indoor environments in Italy. The assessment of exposure to these two countries for adults and children revealed significant differences both not only in the levels of exposure, but also in the patterns. In Italy, the biggest part of the exposure to VMSs takes place domestically, whereas in the UK, it is observed for occupational environments. Additionally, the compound specific isotopic analysis was employed as a source identification technique. The results are promising mainly for D5 that occurs in higher concentrations, but not for the less abundant IVMSs and cVMSs. (C) 2013 Elsevier Ltd. All rights reserved.

20. Volatile aromatic hydrocarbons (VAHs) in residential indoor air in Brisbane, Australia

Author(s): [Hamidin, N.](#) (Hamidin, Nasrul)^[11]; [Yu, J.](#) (Yu, Jimmy)^[11]; [Phung, DT.](#) (Dung Tri Phung)^[21]; [Connell, D.](#) (Connell, Des)^[11]; [Chu, C.](#) (Chu, Cordia)^[21]

Source: CHEMOSPHERE Volume: 92 Issue: 11 Pages: 1430-1435 DOI: 10.1016/j.chemosphere.2013.03.050 Published: SEP 2013

Times Cited: 0 (from Web of Science)

Cited References: 75 [view related records]  Citation Map

Volatile aromatic hydrocarbons (VAHs: benzene, toluene, ethylbenzene, mp-xylene, o-xylene, styrene, naphthalene) in residential indoor air in Brisbane, Australia were measured in 32 houses. The total VAHs (TVAHs) levels ranged between 2 and 137 $\mu\text{g/m}^3$ and were lower than the most of the houses in the literature data. The VAHs were believed to originate from heat insulation systems, building material products as well motor vehicles but naphthalene and styrene originated from other sources. Internal garages had concentrations which are higher than the indoor air by 25-50% due to the presence of motor vehicles and may be a major source of indoor VAHs. However indoor concentrations are higher than that in the outdoor ambient air. The age of the house was found to be negatively related to VAHs concentrations in the houses with the half-life of TVAH at approximately 13 years. The concentration levels of benzene, toluene, ethylbenzene and styrene are well below the guideline values set by agencies from Hong Kong, Japan, Germany and the WHO while the concentration level of naphthalene in one house exceeded the guideline value from Germany. Crown Copyright (C) 2013 Published by Elsevier Ltd. All rights reserved.

a. COSV**21. Polybrominated diphenyl ethers (PBDEs), hexabromocyclododecane (HBCD) and “novel” brominated flame retardants in house dust in Germany**

[H. Fromme](#), [B. Hilger](#), [E. Kopp](#), [M. Miserok](#), [W. Völkel](#)

Brominated flame retardants (BFRs) are used in a wide variety of products such as electronic devices, upholstery and carpets and in insulation boards. The study presented here aimed to quantify the amounts of BFRs in house dust in Germany. For this purpose 20 residences' dust samples were collected from vacuum cleaner bags and analysed with LC–MS/MS and simultaneously with GC/MS.

Using GC/MS, the median (95th percentile) concentrations of PBDEs (sum of tetra- to hepta-congeners), BDE 209, Σ -HBCD (sum of three congeners), and decabromodiphenylethane (DBDPE) were 42 ng/g (230 ng/g), 950 ng/g (3426 ng/g), 335 ng/g (1545 ng/g), and 146 ng/g (1059 ng/g), respectively. Using LC–MS/MS some “novel” flame retardants were found in median concentrations of 343 ng/g (bis(2-ethyl-1-hexyl)tetrabromophthalate, TBPH), and 28 ng/g (tetrabromobisphenol A, TBBPA). Whilst 1,2-bis-(2,4,6-tribromophenoxy)ethane (BTBPE) and 2-ethyl-1-hexyl-2,3,4,5-tetrabromobenzoate (EH-TBB) could not be detected.

Based on these measurements an exposure assessment for the sum of tetra- to heptabrominated congeners, BDE 209, and Σ -HBCD resulted in a “high” daily intake for toddlers (based on 95th percentiles) of 1.2 ng/kg b.w., 0.69 ng/kg b.w., and 8.9 ng/kg b.w., respectively. For TBPH the “high” intake was calculated at 4.1 ng/kg b.w. and for DBDPE at 5.3 ng/kg b.w.

A clear tendency was observed to apply “novel” BFRs in Germany. Moreover, the results suggest that the recent exposure to PBDEs and HBCD via house dust in Germany is well below the levels that are associated with health effects. For the “novel” brominated flame retardants such an assessment is not possible due to limited toxicological information.

22. Analysis of selected phthalates in Canadian indoor dust collected using household vacuum and standardized sampling techniques

By: [Kubwabo, C.](#)^[1]; [Rasmussen, PE](#) (Rasmussen, P. E.)^[1]; [Fan, X](#) (Fan, X.)^[1]; [Kosarac, I](#) (Kosarac, I.)^[1]; [Wu, F](#) (Wu, F.)^[1]; [Zidek, A](#) (Zidek, A.)^[2]; [Kuchta, SL](#) (Kuchta, S. L.)^[2]

INDOOR AIR Volume: 23 Issue: 6 Pages: 506-514 Published: DEC 2013

Phthalates have been used extensively as plasticizers to improve the flexibility of polymers, and they also have found many industrial applications. They are ubiquitous in the environment and have been detected in a variety of environmental and biological matrices. The goal of this study was to develop a method for the determination of 17 phthalate esters in house dust. This method involved sonication extraction, sample cleanup using solid phase extraction, and isotope dilution GC/MS/MS analysis. Method detection limits (MDLs) and recoveries ranged from 0.04 to 2.93g/g and from 84 to 117%, respectively. The method was applied to the analysis of phthalates in 38 paired household vacuum samples (HD) and fresh dust (FD) samples. HD and FD samples compared well for the majority of phthalates detected in house dust. Data obtained from 126 household dust samples confirmed the historical widespread use of bis(2-ethylhexyl) phthalate (DEHP), with a concentration range of 36g/g to 3840g/g. Dibutyl phthalate (DBP), benzyl butyl phthalate (BzBP), diisononyl phthalate (DINP), and diisodecyl phthalate (DIDP) were also found in most samples at relatively high concentrations. Another important phthalate, diisobutyl phthalate (DIBP), was detected at a frequency of 98.4% with concentrations ranging from below its MDL of 0.51g/g to 69g/g.

23. Associations between PBDEs in office air, dust, and surface wipes

By: Watkins, DJ (Watkins, Deborah J.)^[1]; McClellan, MD (McClellan, Michael D.)^[1]; Fraser, AJ (Fraser, Alicia J.)^[1]; Weinberg, J (Weinberg, Janice)^[2]; Stapleton, HM (Stapleton, Heather M.)^[3]; Webster, TF (Webster, Thomas F.)^[1]

ENVIRONMENT INTERNATIONAL Volume: 59 Pages: 124-132 Published: **SEP 2013**

Increased use of flame-retardants in office furniture may increase exposure to PBDEs in the office environment. However, partitioning of PBDEs within the office environment is not well understood. Our objectives were to examine relationships between concurrent measures of PBDEs in office air, floor dust and surface wipes.

We collected air, dust, and surface wipe samples from 31 offices in Boston, MA. Correlation and linear regression were used to evaluate associations between variables. Geometric mean (GM) concentrations of individual BDE congeners in air and congener specific octanol-air partition coefficients (K_{oa}) were used to predict GM concentrations in dust and surface wipes and compared to the measured concentrations.

GM concentrations of PentaBDEs in office air, dust, and surface wipes were 472 pg/m³, 2411 ng/g, and 77 pg/cm², respectively. BDE209 was detected in 100% of dust samples (GM = 4202 ng/g), 93% of surface wipes (GM = 125 pg/cm²), and 39% of air samples. PentaBDEs in dust and air were moderately correlated with each other ($r = 0.60$, $p = 0.0003$), as well as with PentaBDEs in surface wipes ($r = 0.51$, $p = 0.003$ for both dust and air). BDE209 in dust was correlated with BDE209 in surface wipes ($r = 0.69$, $p = 0.007$). Building (three categories) and PentaBDEs in dust were independent predictors of PentaBDEs in both air and surface wipes, together explaining 50% ($p = 0.0009$) and 48% ($p = 0.001$) of the variation respectively. Predicted and measured concentrations of individual BDE congeners were highly correlated in dust ($r = 0.98$, $p < 0.0001$) and surface wipes ($r = 0.94$, $p = 0.002$). BDE209 provided an interesting test of this equilibrium partitioning model as it is a low volatility compound.

Associations between PentaBDEs in multiple sampling media suggest that collecting dust or surface wipes may be a convenient method of characterizing exposure in the indoor environment. The volatility of individual congeners, as well as physical characteristics of the indoor environment, influence relationships between PBDEs in air, dust, and surface wipes. (C) 2013 Elsevier Ltd. All rights reserved.

24. Dioxin-related compounds in house dust from New York State: Occurrence, in vitro toxic evaluation and implications for indoor exposure

By: Tue, NM (Nguyen Minh Tue)^[1]; Suzuki, G (Suzuki, Go)^[2]; Takahashi, S (Takahashi, Shin)^[1]; Kannan, K (Kannan, Kurunthachalam)^[4]; Takigami, H (Takigami, Hidetaka)^[2]; Tanabe, S (Tanabe, Shinsuke)^[1]

ENVIRONMENTAL POLLUTION Volume: 181 Pages: 75-80 Published: **OCT 2013**

This study analysed sulphuric-acid-treated extracts of house dust from New York State with DR-CALUX assay and HRGC-HRMS to elucidate the total dioxin-like (DL) activities, the occurrence of various dioxin-related compounds (DRCs), including PBDD/Fs, and their toxic contribution. The DL activities were 30 -8000, median 210 pg CALUX-TEQ/g. PCDD/Fs, PBDD/Fs and DL-PCBs were detected with a large variation in concentrations (0.12-80, 0.33-150, 0.46-35, medians 1.7, 2.1 and 5.6 ng/g, respectively) and profiles, indicating the existence of multiple contamination sources in homes. PCDD/Fs, PBDD/Fs and DL-PCBs with known potency theoretically contributed <1%-130%, <1%-21% and <1%-6.8%, respectively, of the measured CALUX-TEQs. These results and those from DR-CALUX assays with fractionated dust extracts indicated that a substantial portion of the CALUX-TEQs could be caused by unknown dust contaminants. Considering that the DRC intake from indoor dust ingestion can be significant, identification of unknown DL contaminants in indoor dust is necessary. (C) 2013 Elsevier Ltd. All rights reserved.

25. Polyfluorinated compounds in dust from homes, offices, and vehicles as predictors of concentrations in office workers' serum

Alicia J. Fraser^a, Thomas F. Webster^a, Deborah J. Watkins^{a, b}, Mark J. Strynar^c, Kayoko Kato^d, Antonia M. Calafat^d, Verónica M. Vieira^{a, e}, Michael D. McClean^a

We aimed to characterize levels of polyfluorinated compounds (PFCs) in indoor dust from offices, homes, and vehicles; to investigate factors that may affect PFC levels in dust; and to examine the associations between PFCs in dust and office workers' serum. Dust samples were collected in 2009 from offices, homes, and vehicles of 31 individuals in Boston, MA and analyzed for nineteen PFCs, including perfluorooctanoate (PFOA), perfluorooctane sulfonate (PFOS), fluorotelomer alcohols (FTOHs), and sulfonamidoethanols (FOSEs). Serum was collected from each participant and analyzed for eight PFCs including PFOA and PFOS. Perfluorononanoate, PFOA, perfluoroheptanoate, perfluorohexanoate, PFOS and 8:2 FTOH had detection frequencies > 50% in dust from all three microenvironments. The highest geometric mean concentration in office dust was for 8:2 FTOH (309 ng/g), while PFOS was highest in homes (26.9 ng/g) and vehicles (15.8 ng/g). Overall, offices had the highest PFC concentrations, particularly for longer-chain carboxylic acids and FTOHs. Perfluorobutyrate was prevalent in homes and vehicles, but not offices. PFOA serum concentrations were not associated with PFC dust levels after adjusting for PFC concentrations in office air. Dust concentrations of most PFCs are higher in offices than in homes and vehicles. However, indoor dust may not be a significant source of exposure to PFCs for office workers. This finding suggests that our previously published observation of an association between FTOH concentrations in office air and PFOA concentrations in office workers was not due to confounding by PFCs in dust.

26. Polycyclic Aromatic Hydrocarbons in Residential Dust: Sources of Variability

By: Whitehead, TP (Whitehead, Todd P.)^{1,1}; Metayer, C (Metayer, Catherine)^{1,1}; Petreas, M (Petreas, Myrto)^{1,2}; Does, M (Does, Monique)^{1,1}; Buffler, PA (Buffler, Patricia A.)^{1,1}; Rappaport, SM (Rappaport, Stephen M.)^{1,1}

ENVIRONMENTAL HEALTH PERSPECTIVES Volume: 121 Issue: 5 Pages: 543-550 Published: MAY 2013

BACKGROUND: There is interest in using residential dust to estimate human exposure to environmental contaminants.

OBJECTIVES: We aimed to characterize the sources of variability for polycyclic aromatic hydrocarbons (PAHs) in residential dust and provide guidance for investigators who plan to use residential dust to assess exposure to PAHs

METHODS: We collected repeat dust samples from 293 households in the Northern California Childhood Leukemia Study during two sampling rounds (from 2001 through 2007 and during 2010) using household vacuum cleaners, and measured 12 PAHs using gas chromatography-mass spectrometry. We used a random- and a mixed-effects model for each PAH to apportion observed variance into four components and to identify sources of variability.

RESULTS: Median concentrations for individual PAHs ranged from 10 to 190 ng/g of dust. For each PAH, total variance was apportioned into regional variability (1-9%), intraregional between-household variability (24-48%), within-household variability over time (41-57%), and within-sample analytical variability (2-33%). Regional differences in PAH dust levels were associated with estimated ambient air concentrations of PAH. Intraregional differences between households were associated with the residential construction date and the smoking habits of residents. For some PAHs, a decreasing time trend explained a modest fraction of the within-household variability; however, most of the within-household variability was unaccounted for by our mixed-effects models. Within-household differences between sampling rounds were largest when the interval between dust sample collections was at least 6 years in duration.

CONCLUSIONS: Our findings indicate that it may be feasible to use residential dust for retrospective assessment of PAH exposures in studies of health effects.

27. The distribution of phthalate esters in indoor dust of Palermo (Italy)

By: [Orecchio, S](#) (Orecchio, Santino)^[1]; [Indelicato, R](#) (Indelicato, Roberta)^[1,2]; [Barreca, S](#) (Barreca, Salvatore)^[2]

ENVIRONMENTAL GEOCHEMISTRY AND HEALTH

Volume: 35 **Issue:** 5 **Pages:** 613-624 **Special Issue:** SI **DOI:** 10.1007/s10653-013-9544-9 **Published:** OCT 2013

In this work, phthalic acid esters (PAEs): dimethyl phthalate (DMP), diethyl phthalate (DEP), di-n-butyl phthalate, benzyl butyl phthalate, bis(2-ethylhexyl) phthalate, and di-n-octyl phthalate in indoor dust (used as passive sampler) were investigated. The settled dust samples were collected from thirteen indoor environments from Palermo city. A fast and simple method using Soxhlet and GC-MS analysis has been optimized to identify and quantify the phthalates. Total phthalates concentrations in indoor dusts ranged from 269 to 4,831 mg/kg d.w. (d.w. = dry weight). The data show a linear correlation between total PAEs concentration and a single compound content, with the exclusion of the two most volatile components (DMP and DEP) that are present in appreciable amounts only in two samples. These results suggest that most of the PAEs identified in the samples of settled dust originate from the same type of material. This evidence indicates that, in a specific indoor environment, generally is not present only one compound but a mixture having over time comparable percentages of PAEs. Consequently, for routine analyses of a specific indoor environment, only a smaller number of compounds could be determined to value the contamination of that environment. We also note differences in phthalate concentrations between buildings from different construction periods; the total concentration of PAEs was higher in ancient homes compared to those constructed later. This is due to a trend to reduce or remove certain hazardous compounds from building materials and consumer goods. A linear correlation between total PAEs concentration and age of the building was observed ($R = 0.71$).

28. Thermal effects on polybrominated diphenyl ether mass transfer and emission from computer cases

By: [Waye, SK](#) (Waye, Scot K.)^[1]; [Anderson, A](#) (Anderson, Austin)^[2]; [Corsi, RL](#) (Corsi, Richard L.)^[3]; [Ezekoye, OA](#) (Ezekoye, Ofodike A.)^[2]

INTERNATIONAL JOURNAL OF HEAT AND MASS TRANSFER **Volume:** 64 **Pages:** 343-351 **Published:** SEP 2013

The increase in temperature of some consumer products, especially electronic devices, results in an increase of semivolatile organic compound (SVOC) emissions. Brominated Flame Retardants (BFRs), such as polybrominated diphenyl ethers (PBDEs), are used in many electronic casings and circuit boards to protect consumers from fires. However, the heat from the internal circuitry increases the SVOC vapor pressure and the material-air partition coefficient decreases, driving SVOC transport out of the substrate and into the indoor environment. In the case of a computer tower, the cooling fan also increases the mass transfer coefficient, further increasing emissions. Such enhanced emissions are a concern since recent studies claim adverse health effects of PBDEs on human health. In this study, a simplified heat and mass transfer model is developed to characterize the combined heat and mass transfer problem for a computer tower in an indoor space to determine the levels of PBDE that would be outgassed. As expected, higher temperatures increase the emission rate of the SVOC and explain one of the transport mechanisms for BFRs into the environment. The emission rate of PBDEs was on the order of tens of nanograms per hour. The concentration of PBDEs in the air increases 40-80% for every 5 degrees C increase inside the computer case, depending on the congener. If these emission rates prove to be toxicologically significant, then models such as the one proposed can be used in risk analysis modeling and to develop mitigation strategies. (C) 2013 Elsevier Ltd. All rights reserved.

a. BIOCONTAMINANTS**29. Stenotrophomonas, Mycobacterium, and Streptomyces in home dust and air: associations with moldiness and other home/family characteristics**

By: [Kettleson, E.](#) (Kettleson, E.)^[1]; [Kumar, S.](#) (Kumar, S.)^[1]; [Reponen, T.](#) (Reponen, T.)^[1]; [Vesper, S.](#) (Vesper, S.)^[2]; [Meheust, D.](#) (Meheust, D.)^[3]; [Grinshpun, SA.](#) (Grinshpun, S. A.)^[1]; [Adhikari, A.](#) (Adhikari, A.)^[1]

INDOOR AIR Volume: 23 Issue: 5 Pages: 387-396 Published: OCT 2013

Respiratory illnesses have been linked to children's exposures to water-damaged homes. Therefore, understanding the microbiome in water-damaged homes is critical to preventing these illnesses. Few studies have quantified bacterial contamination, especially specific species, in water-damaged homes. We collected air and dust samples in twenty-one low-mold homes and twenty-one high-mold homes. The concentrations of three bacteria/genera, *Stenotrophomonas maltophilia*, *Streptomyces* sp., and *Mycobacterium* sp., were measured in air and dust samples using quantitative PCR (QPCR). The concentrations of the bacteria measured in the air samples were not associated with any specific home characteristic based on multiple regression models. However, higher concentrations of *S. maltophilia* in the dust samples were associated with water damage, that is, with higher floor surface moisture and higher concentrations of moisture-related mold species. The concentrations of *Streptomyces* and *Mycobacterium* sp. had similar patterns and may be partially determined by human and animal occupants and outdoor sources of these bacteria.

30. Microbial content of household dust associated with exhaled NO in asthmatic children

By: [Johansson, E.](#) (Johansson, Elisabet)^[1]; [Reponen, T.](#) (Reponen, Tuna)^[1]; [Vesper, S.](#) (Vesper, Stephen)^[2]; [Levin, L.](#) (Levin, Linda)^[1]; [Lockey, J.](#) (Lockey, James)^[1]; [Ryan, P.](#) (Ryan, Patrick)^[1]; [Bernstein, DI.](#) (Bernstein, David I.)^[1]; [Villareal, M.](#) (Villareal, Manuel)^[1]; [Hershey, GKK.](#) (Hershey, Gurjit K. Khurana)^[1]; [Schaffer, C.](#) (Schaffer, Chris)^[1] ...More

ENVIRONMENT INTERNATIONAL Volume: 59 Pages: 141-147 Published: SEP 2013

Exhaled nitric oxide (eNO) is increasingly used as a non-invasive measure of airway inflammation. Despite this, little information exists regarding the potential effects of indoor microbial components on eNO. We determined the influence of microbial contaminants in house dust and other indoor environmental characteristics on eNO levels in seven-year-olds with and without a physician-diagnosis of asthma. The study included 158 children recruited from a birth cohort study, and 32 were physician-diagnosed as asthmatic. The relationship between eNO levels and exposures to home dust streptomycetes, endotoxin, and molds was investigated. Streptomycetes and endotoxin were analyzed both as loads and concentrations in separate models. Dog, cat, and dust mite allergens also were evaluated. In the multivariate exposure models, high streptomycetes loads and concentrations were significantly associated with a decrease in eNO levels in asthmatic ($p < 0.001$) but not in healthy children. The presence of dog allergen, however, was associated with increased levels of eNO ($p = 0.001$). Dust endotoxin was not significant. The relationship between eNO and indoor exposure to common outdoor molds was u-shaped. In non-asthmatic children, none of the exposure variables was significantly associated with eNO levels. To our knowledge, this is the first study demonstrating a significant association between microbial components in the indoor environment and eNO levels in asthmatic children. This study demonstrates the importance of simultaneously assessing multiple home exposures of asthmatic children to better understand opposing effects. Common components of the indoor *Streptomyces* community may beneficially influence airway inflammation. (C) 2013 Elsevier Ltd. All rights reserved.

a. PARTICULES

Pas d'article

b. PESTICIDES/BIOCIDES**31. Transfluthrin indoor air concentration and inhalation exposure during application of electric vaporizers**

By: [Vesin, A](#) (Vesin, Aude)^[1]; [Glorennec, P](#) (Glorennec, Philippe)^[2,3]; [Le Bot, B](#) (Le Bot, Barbara)^[2,3]; [Wortham, H](#) (Wortham, Henri)^[1]; [Bonvallot, N](#) (Bonvallot, Nathalie)^[2,3]; [Quivet, E](#) (Quivet, Etienne)^[1]

ENVIRONMENT INTERNATIONAL Volume: 60 Pages: 1-6 Published: OCT 2013

Different household insecticide applications via two electric vaporizers emitting transfluthrin were realized in a full-scale experimental room under controlled air exchange rate conditions. On-line high-time resolved measurements of the gas-phase concentrations of the active substance during and immediately after the spreading periods were performed with a High Sensitivity Proton-Transfer-Reaction Mass Spectrometer (HS-PTR-MS). Experimental and modelled data from the ConsExpo 4.0 software were also compared to evaluate the sources of differences. Different application scenarios were also compared. Averaged inhaled concentrations over 1 h, 1 week, and 5 months were estimated to be 83, 1.8, and 1.8 $\mu\text{g}\cdot\text{m}^{-3}$, respectively. Corresponding margins of exposures range from 1000 to 10,000, claiming for the absence of effect Dermal and dust ingestion pathways, although roughly estimated, seems being non-negligible. This claims for a more in-depth integrated risk assessment. (C) 2013 Elsevier Ltd. All rights reserved.

32. Breaking the take home pesticide exposure pathway for agricultural families: Workplace predictors of residential contamination

By: [Fenske, RA](#) (Fenske, Richard A.)^[1]; [Lu, CS](#) (Lu, Chensheng)^[2]; [Negrete, M](#) (Negrete, Maria)^[1]; [Galvin, K](#) (Galvin, Kit)^[1]

AMERICAN JOURNAL OF INDUSTRIAL MEDICINE

Volume: 56 Issue: 9 Pages: 1063-1071 Published: SEP 2013

Background Pesticides used in agriculture can be taken into worker homes and pose a potential risk for children and other family members. This study focused on identification of potential intervention points at the workplace.

Methods Workers (N=46) recruited from two tree fruit orchards in Washington State were administered a 63-item pesticide safety questionnaire. Dust was collected from commuter vehicles and worker homes and analyzed for four organophosphorus (OP) pesticides (azinphosmethyl, phosmet, chlorpyrifos, malathion).

Results Geometric mean azinphosmethyl concentrations in dust for three worker groups (16 pesticide handlers, 15 green fruit thinners, 15 organic orchard workers) ranged from 0.027-1.5g/g, with levels in vehicle dust higher than in house dust, and levels in house dust from handlers' homes higher than levels from tree fruit thinners' homes. Vehicle and house dust concentrations of azinphosmethyl were highly associated ($R=0.44$, $P<0.001$). Significant differences were found across worker groups for availability of laundry facilities, work boot storage, frequency of hand washing, commuter vehicle use, parking location, and safety training.

Conclusions These findings support a focus on intervention activities to reduce take home pesticide exposure closer to the source of contamination; specifically, the workplace and vehicles used to travel to the workplace. Am. J. Ind. Med. 56:1063-1071, 2013. (c) 2013 Wiley Periodicals, Inc.

II.2 Transports

Rubrique N°4

33. Airborne exposure patterns from a passenger source in aircraft cabins

By: [Bennett, JS](#) (Bennett, James S.)^[1]; [Jones, BW](#) (Jones, Byron W.)^[2]; [Hosni, MH](#) (Hosni, Mohammad H.)^[2]; [Zhang, YH](#) (Zhang, Yuanhui)^[3]; [Topmiller, JL](#) (Topmiller, Jennifer L.)^[1]; [Dietrich, WL](#) (Dietrich, Watts L.)^[1]

HVAC&R RESEARCH Volume: 19 Issue: 8 Pages: 962-973 Published: NOV 17 2013

Airflow is a critical factor that influences air quality, airborne contaminant distribution, and disease transmission in commercial airliner cabins. The general aircraft-cabin air-contaminant transport effect model seeks to build exposure-spatial relationships between contaminant sources and receptors, quantify the uncertainty, and provide a platform for incorporation of data from a variety of studies. Knowledge of infection risk to flight crews and passengers is needed to form a coherent response to an unfolding epidemic, and infection risk may have an airborne pathogen exposure component. The general aircraft-cabin air-contaminant transport effect model was applied to datasets from the University of Illinois and Kansas State University and also to case study information from a flight with probable severe acute respiratory syndrome transmission. Data were fit to regression curves, where the dependent variable was contaminant concentration (normalized for source strength and ventilation rate), and the independent variable was distance between source and measurement locations. The data-driven model showed exposure to viable small droplets and post-evaporation nuclei at a source distance of several rows in a mock-up of a twin-aisle airliner with seven seats per row. Similar behavior was observed in tracer gas, particle experiments, and flight infection data for severe acute respiratory syndrome. The study supports the airborne pathway as part of the matrix of possible disease transmission modes in aircraft cabins.

34. Benzene, toluene and xylenes levels in new and used vehicles of the same model

By: [Faber, J](#) (Faber, Joanna)^[1]; [Brodzik, K](#) (Brodzik, Krzysztof)^[1]; [Golda-Kopek, A](#) (Golda-Kopek, Anna)^[1]; [Lomankiewicz, D](#) (Lomankiewicz, Damian)^[1]

JOURNAL OF ENVIRONMENTAL SCIENCES-CHINA Volume: 25 Issue: 11 Pages: 2324-2330

Published: NOV 1 2013

The aim of this work was to determine the level of benzene, toluene, o-xylene and in, p-xylene (BTX) in air samples collected from the cabins of new and used vehicles of the same model. Ten new vehicles were examined in order to check interior emission from materials used to equip the passenger compartment. In order to compare and define the impact of exhaust gases, air samples were also collected from two used cars, at different mileages (up to 20,000 km). All vehicles tested were of the same type. Samples were collected onto Carbograph 1TD sorbent, thermally desorbed and examined with the use of gas chromatography with flame ionisation and mass spectrometry detectors. All results obtained were referred to Polish and German requirements for indoor air quality (both in public buildings and in workspace environments). Average benzene, toluene, o-xylene and in, p-xylene concentrations in new cars were determined at the level of 11.8 $\mu\text{g}/\text{m}^3$, 82.7 $\mu\text{g}/\text{m}^3$, 21.2 $\mu\text{g}/\text{m}^3$ and 89.5 $\mu\text{g}/\text{m}^3$, respectively. In the used cars, BTX concentration increased with increasing vehicle mileage. The most significant increase of BTX concentration was observed above 11,000 km mileage.

II.3 Bureaux

Pas d'article

II.4 ERP

Rubrique N°5

a. Ecoles / université

35. Monitoring indoor air quality in French schools and day-care centers

[Michelot, N](#) (Michelot, Nicolas)^[1]; [Marchand, C](#) (Marchand, Caroline)^[2]; [Ramalho, O](#) (Ramalho, Olivier)^[1]; [Delmas, V](#) (Delmas, Veronique)^[4]; [Carrega, M](#) (Carrega, Marie)^[1]

HVAC&R RESEARCH Volume: 19 Issue: 8 Pages: 1083-1089 Published: NOV 17 2013

Indoor air quality monitoring in public premises, especially those hosting vulnerable populations such as children, was introduced in the second French national environment and health action plan and then regulated by the first Grenelle Environment law, on August 3, 2009. A national pilot monitoring survey of indoor air quality in 310 French schools and day-care centers was performed in two phases from 2009 to 2011. This article is dedicated to the results of the first phase (2009 to 2010, in 160 schools and day-care centers), and another article is in preparation about the whole survey results. Formaldehyde, benzene, and air stuffiness were the targeted compounds. They were measured for 1-2 weeks during heating and non-heating seasons in each investigated building. The results of the first phase are presented in this article. They show, referring to the management values suggested by the French committee for public health, that air quality is acceptable in most establishments tested. Nonetheless, a few cases required additional investigations or corrective measures. Furthermore, the air stuffiness (based on carbon dioxide measurements) was found to be very high in 16% of the classrooms (up to 25% in elementary schools). In 47% of the elementary schools, at least one classroom had very high air stuffiness. The mayors and school principals were informed and provided with means to identify the main sources of pollution and to implement remediation actions. The outcomes of this research have led to another step toward mandatory indoor air quality monitoring of public premises in France. France is the first country to implement a routine and mandatory assessment of air quality in public buildings accommodating vulnerable people.

36. Comfort Parameters and Particulate Matter (PM10 and PM2.5) in School Classrooms and Outdoor Air

By: [Alves, C](#) (Alves, Celia)^[1]; [Nunes, T](#) (Nunes, Teresa)^[1]; [Silva, J](#) (Silva, Joana)^[1]; [Duarte, M](#) (Duarte, Marcio)^[1]

AEROSOL AND AIR QUALITY RESEARCH Volume: 13 Issue: 5 Pages: 1521-1535

Published: OCT 2013

In January 2012, one kindergarten and eight elementary school classrooms were monitored. The campaign included simultaneous measurements, indoors and outdoors, of comfort parameters, CO, CO₂ and particles. Automatic monitors using a light scattering technique were employed to measure PM₁₀ continuously. During occupied periods, low volume samplers were used to daily collect PM_{2.5} samples, which were subsequently analysed for carbonates, organic carbon (OC), elemental carbon (EC) and water soluble inorganic ions. With regard to comfort, the schools did not meet the recommended levels in many rooms. Indoor-outdoor CO₂ ratios between 3 and 12, and indoor levels much higher than 1000 ppm during the occupied periods, indicate the highly inadequate ventilation in these locations. The results clearly demonstrate that there is a high level of exposure to particulate matter in these schools. The continuous measurements of PM₁₀ suggest that the physical activity of pupils, which is assumed to be more marked in younger children, contributes to a constant process of resuspension of sedimented particles. In addition, peak PM₁₀ concentrations coincident with cleaning

activities suggest the need to change certain practices to improve cleanliness. Around 40% of the PM_{2.5} mass is composed of carbonaceous matter, with 4-5 times higher OC mass fractions than EC. It was observed that both OC and EC were significantly influenced by indoor sources. Water-soluble inorganic ions represented around 10-20% of the PM_{2.5} mass measured in classrooms. Excluding calcium, in general the ionic species were present at indoor-outdoor ratios of less than 1, suggesting the major origin in the outdoor air.

37. Healthy environment - indoor air quality of Brazilian elementary schools nearby petrochemical industry

[Godoi, RHM](#) (Godoi, Ricardo H. M.)^[1]; [Godoi, AFL](#) (Godoi, Ana F. L.)^[1]; [Goncalves, SJ](#) (Goncalves Junior, Sergio J.)^[1]; [Paralovo, SL](#) (Paralovo, Sarah L.)^[1]; [Borillo, GC](#) (Borillo, Guilherme C.)^[1]; [Barbosa, CGG](#) (Gregorio Barbosa, Cybelli Goncalves)^[1]; [Arantes, MG](#) (Arantes, Manoela G.)^[1]; [Charello, RC](#) (Charello, Renata C.)^[1]; [Rosario, NA](#) (Rosario Filho, Nelson A.)^[2]; [Grassi, MT](#) (Grassi, Marco T.)^[3] [...More](#)

SCIENCE OF THE TOTAL ENVIRONMENT Volume: 463 Pages: 639-646 Published: OCT 1 2013

The mitigation of pollution released to the environment originating from the industrial sector has been the aim of all policy-makers and its importance is evident if the adverse health effects on the world population are considered. Although this concern is controversial, petroleum refinery has been linked to some adverse health effects for people living nearby. Apart from home, school is the most important indoor environment for children and there is increasing concern about the school environment and its impact on health, also in developing countries where the prevalence of pollution is higher. As most of the children spend more than 40% of their time in schools, it is critical to evaluate the pollution level in such environment. In the metropolitan region of Curitiba, South Brazil, five schools nearby industries and highways with high density traffic, were selected to characterize the aerosol and gaseous compounds indoor and outdoor of the classrooms, during 2009-2011. Size segregated aerosol samples were collected for analyses of bulk and single particle elemental profiles. They were analyzed by electron probe X-ray micro-analysis (EPXMA), and by energy-dispersive X-ray fluorescence (EDXRF), to investigate the elemental composition of individual particles and bulk samples. The concentrations of benzene, toluene, ethylbenzene, and xylene (BTEX); NO₂; SO₂; acetic acid; and formic acid were assessed indoor and outdoor using passive diffusion tubes. BTEX were analyzed by GC-MS and other collected gasses by ion chromatography. Individual exposition of BTEX was assessed by personal passive diffusion tubes. Results are interpreted separately and as a whole with the specific aim of identifying compounds that could affect the health of the scholars. In view of the chemical composition and size distribution of the aerosol particles, local deposition efficiencies in the children's respiratory systems were calculated, revealing the deposition of particles at extrathoracic, tracheobronchial and pulmonary levels.

38. Identification of trace metal pollution in urban dust from kindergartens using magnetic, geochemical and lead isotopic analyses

Authors: Zhu, ZM; Sun, GY; Bi, XY; Li, ZG; Yu, GH

Source: **ATMOSPHERIC ENVIRONMENT** , 77 9-15; OCT 2013

In the present study, magnetic measurements were combined with geochemical analysis and stable Pb isotopic ratios to reveal the distribution and origination of trace metal pollutants in kindergarten dusts from a typical urban environment of Wuhan, central China. The geoaccumulation index (I-geo) of magnetic properties was more prominent than those of individual metals. The magnetic susceptibility (MS) and trace metals (Zn, Pb, and Cu) in this study together with published results from other

Chinese cities formed a linear relationship, suggesting that metal contaminants in Chinese urban areas had similar MS to metal ratios, which could be used as an indicator for identification of pollution sources between Chinese cities and the other Asian cities. Stable Pb isotopic ratios (1.1125-1.1734 for (206)pb/Pb-207 and 2.4457-2.4679 for Pb-208/Pb-207) in the urban dusts from Wuhan were characterized by higher Pb-208 component in comparison with those from other Chinese cities. This result combined with principal component analysis (PCA) indicated that metal pollutants in the dusts were derived from industrial activities and coal combustion, whereas the traffic emissions were no longer a predominant pollution source in urban environment. Our study demonstrated that environmental magnetic methods could not only reveal the overall situation of trace metal contamination, but also prove evidence in the identification of pollution sources. (C) 2013 Elsevier Ltd. All rights reserved.

39. Phthalates in German daycare centers: Occurrence in air and dust and the excretion of their metabolites by children (LUPE 3)

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Phthalates have been used for decades in large quantities, leading to the ubiquitous exposure of the population.

In an investigation of 63 German daycare centers, indoor air and dust samples were analyzed for the presence of 10 phthalate diesters. Moreover, 10 primary and secondary phthalate metabolites were quantified in urine samples from 663 children attending these facilities. In addition, the urine specimens of 150 children were collected after the weekend and before they went to daycare centers. Di-isobutyl phthalate (DiBP), dibutyl phthalate (DnBP), and di-2-ethylhexyl phthalate (DEHP) were found in the indoor air, with median values of 468, 227, and 194 ng/m³, respectively. In the dust, median values of 888 mg/kg for DEHP and 302 mg/kg for di-isononyl phthalate (DiNP) were observed. DnBP and DiBP were together responsible for 55% of the total phthalate concentration in the indoor air, whereas DEHP and DiNP were responsible for 70% and 24% of the total phthalate concentration in the dust.

Median concentrations in the urine specimens were 44.7 µg/l for the DiBP monoester, 32.4 µg/l for the DnBP monoester, and 16.5 µg/l and 17.9 µg/l for the two secondary DEHP metabolites. For some phthalates, we observed significant correlations between their concentrations in the indoor air and dust and their corresponding metabolites in the urine specimens using bivariate analyses. In multivariate analyses, the concentrations in dust were not associated with urinary metabolite excretion after controlling for the concentrations in the indoor air.

The total daily "high" intake levels based on the 95th percentiles calculated from the biomonitoring data were 14.1 µg/kg b.w. for DiNP and 11.9 µg/kg b.w. for DEHP. Compared with tolerable daily intake (TDI) values, our "high" intake was 62% of the TDI value for DiBP, 49% for DnBP, 24% for DEHP, and 9% for DiNP. For DiBP, the total daily intake exceeded the TDI value for 2.4% of the individuals. Using a cumulative risk-assessment approach for the sum of DEHP, DnBP, and DiBP, 20% of the children had concentrations exceeding the hazard index of one. Therefore, a further reduction of the phthalate exposure of children is needed.

40. Airborne Allergens, Endotoxins, and Particulate Matter in Elementary Schools, Results from Germany (LUPE 2)

By: Fromme, H (Fromme, Hermann)^{1,1}; Bischof, W (Bischof, Wolfgang)^{2,1}; Dietrich, S (Dietrich, Silvio)^{1,1}; Lahrz, T (Lahrz, Thomas)^{1,1}; Schierl, R (Schierl, Rudolf)^{1,1}; Schwegler, U (Schwegler, Ursula)^{1,1}

JOURNAL OF OCCUPATIONAL AND ENVIRONMENTAL HYGIENE Volume: 10 Issue: 10 Pages: 573-582 Published: OCT 1 2013

Allergic disorders are the most common childhood-related chronic diseases in developed countries. It is essential to assess the exposure, especially in schools, where children spend a large portion of their time. We aimed to investigate allergen and endotoxin levels in the air of schools and to observe seasonal variations of these factors. We evaluated airborne concentrations of house dust mites allergens (Der p 1, Der f 1), cat allergen (Fel d 1), and endotoxin in PM10 in 14 classrooms during the

school days in the region of Munich, each over 20 consecutive days and in 1 classroom over the course of a year (at 83 days); we also tested outdoor air close to the schools. Endotoxin levels were quantified using two different analytical methods. In addition, indoor air climate parameters were measured. The median daily indoor CO₂ and PM₁₀ concentrations in the classrooms ranged from 423 to 3,135 ppm (median: 1,211 ppm) and 9 to 390 µg/m³ (median: 127 µg/m³), respectively. Fel d 1 in the PM₁₀ samples was the most frequently detected allergen, with levels from 0.02 to 1.15 ng/m³ in a total of 301 samples (median: 0.19 ng/m³, 95th percentile: 0.57 ng/m³). Der p 1 and Der f 1 were detected in only 51% and 19% of the samples, with 95th percentiles at 0.5 and 0.3 ng/m³. Endotoxin levels in the PM₁₀ and inhalable dust samples ranged from 0.5 to 84.1 EU/m³ (median: 15.3 EU/m³; 95th percentile: 58.2 EU/m³) and from 0.03 to 115 EU/m³ (median: 8.4 EU/m³; 95th percentile: 27.9 EU/m³). Fel d 1 and endotoxin were found in higher levels in the winter months. The results of the two different indoor sampling techniques for endotoxin were statistically significantly correlated. The results of airborne allergens indicate a generally low exposure level in classrooms. With regard to endotoxin, our study showed higher levels in schools compared with residences.

41. Endotoxin levels in homes and classrooms of Dutch school children and respiratory health

By: [Jacobs, JH](#) (Jacobs, Jose H.)^[1]; [Krop, EJM](#) (Krop, Esmeralda J. M.)^[1]; [de Wind, S](#) (de Wind, Siegfried)^[1]; [Spithoven, J](#) (Spithoven, Jack)^[1]; [Heederik, DJJ](#) (Heederik, Dick J. J.)^[1]

EUROPEAN RESPIRATORY JOURNAL Volume: 42 Issue: 2 Pages: 314-322 Published: AUG 2013

Several studies describe indoor pollutant exposure in homes and to a lesser extent in schools. Population studies that include both environments are sparse. This study aims to assess endotoxin levels in primary schools and homes of children. Endotoxin was also studied in relation to asthma and sensitisation.

10 schools with (index) and without (reference) dampness were selected, based on reports and inspections. Cases and controls were selected from 169 homes based on the presence or absence of asthma-like symptoms of children. Classroom and bedroom airborne settled dust was sampled using electrostatic dust fall collectors.

Average endotoxin levels in schools ranged from 2178 to 6914 endotoxin units (EU).m⁻² per week compared with 462-1285 EU.m⁻² per week in homes. After mutual adjustment for home and school endotoxin, school endotoxin was positively associated with nonatopic asthma (OR 1.11, 95% CI 0.97-1.27), while no associations with endotoxin were found at home.

The high endotoxin levels in schools compared with homes indicate that exposure at school can contribute considerably to environmental endotoxin exposure of children and teachers. Our results also suggest that endotoxin in schools may be associated with nonatopic asthmatic symptoms in pupils, although the results require reproduction because of the modest sample size.

42. Unexpectedly high indoor hydroxyl radical concentrations associated with nitrous acid

Author(s): [Alvarez, EG](#) (Alvarez, Elena Gomez)^[1]; [Amedro, D](#) (Amedro, Damien)^[2,3]; [Afif, C](#) (Afif, Charbel)^[4,5]; [Gligorovski, S](#) (Gligorovski, Sasho)^[1]; [Schoemacker, C](#) (Schoemacker, Coralie)^[2]; [Fittschen, C](#) (Fittschen, Christa)^[2]; [Doussin, JF](#) (Doussin, Jean-Francois)^[4]; [Wortham, H](#) (Wortham, Henri)^[1]

Source: PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA Volume: 110 Issue: 33 Pages: 13294-13299 DOI: 10.1073/pnas.1308310110 Published: AUG 13 2013

The hydroxyl (OH) radical is the most important oxidant in the atmosphere since it controls its self-oxidizing capacity. The main sources of OH radicals are the photolysis of ozone and the photolysis of nitrous acid (HONO). Due to the attenuation of solar radiation in the indoor environment, the possibility of OH formation through photolytic pathways indoors has been ignored up to now. In the indoor air, the ozonolysis of alkenes has been suggested as an alternative route of OH formation. Models and indirect measurements performed up to now according to this hypothesis suggest concentrations of OH radicals on the order of 10⁴-10⁵ molecules per cubic centimeter. Here, we present direct measurements of significant amounts of OH radicals of up to 1.8.10⁶ molecules per cubic centimeter during an experimental campaign carried out in a school classroom in Marseille. This concentration is

on the same order of magnitude of outdoor OH levels in the urban scenario. We also show that photolysis of HONO is an important source of OH radicals indoors under certain conditions (i.e., direct solar irradiation inside the room). Additionally, the OH concentrations were found to follow a linear dependence with the product $J(\text{HONO}) \times [\text{HONO}]$. This was also supported by using a simple quasiphotostationary state model on the OH radical budget. These findings force a change in our understanding of indoor air quality because the reactivity linked to OH would involve formation of secondary species through chemical reactions that are potentially more hazardous than the primary pollutants in the indoor

II.5 Autres lieux de vie / loisirs

Rubrique N°6

43. CFD Analysis of the Inhaled-Air Quality for the Inpatients in a Four-Bed Sickroom

Author(s): Yang, JH (Yang, Jeong-Hoon)

Source: JOURNAL OF ASIAN ARCHITECTURE AND BUILDING ENGINEERING **Volume:** 12 **Issue:** 1
Pages: 109-116 **Published:** MAY 2013

This study examined the effects of the position and number of the supply openings (SOs) and exhaust openings (EOs) on the inhaled-air quality of inpatients using Computational Fluid Dynamics (CFD) analysis. The positions and number of SOs and EOs were selected to create mixing ventilation, displacement ventilation for a calm indoor environment, and personal ventilation for each inpatient's ventilation. The effect of the installation of a curtain in the sickroom on the inhaled-air quality for inpatients was also examined. The inhaled-air quality of the inpatients was evaluated using the age of air, residual life of air, contribution ratio of nostril-exhaled air, and contribution ratio of the pollution source from the sickroom floor. CFD analysis showed that displacement ventilation, which uses a large SO with a low airflow velocity, supplied better air to the inpatients than the other ventilation methods, but pollution from the sickroom floor made a significant contribution. Overall, in general sickrooms and intensive care units, low-airflow-velocity displacement ventilation can supply high-quality air to the inpatients but the sickroom floor must be cleaned

II.6 Modélisation

Rubrique N°7

CONFERENCE

44. PARTICLE RESUSPENSION FROM CARPETED FLOORINGS IN INDOOR ENVIRONMENT IN TURBULENT FLOWS

By: Goldasteh, I (Goldasteh, Iman)^[1]; Ahmadi, G (Ahmadi, Goodarz)^[1]; Ferro, A (Ferro, Andrea)

Book Group Author(s): ASME

PROCEEDINGS OF THE ASME INTERNATIONAL MECHANICAL ENGINEERING CONGRESS AND EXPOSITION, 2011, VOL 6, PTS A AND B **Pages:** 565-569 **Published:** 2012 **Conference**

Conference: ASME International Mechanical Engineering Congress and Exposition (IMECE)

Location: Denver, CO **Date:** NOV 11-17, 2011

Particle resuspension is an important source of particulate matter in the indoor environment. [1] In this study, a model for resuspension of spherical particles from carpet fibers was developed using the micro-roughness model for simulating the adhesion of rough spherical particles. The Johnson-Kendall-Roberts (JKR) adhesion model was used for modeling the adhesion force between particles and carpet fibers. Adhesion of pollen particles to the carpet fibers was studied, and the pull-off forces predicted by the model are compared with the available experimental data. The effect of the hydrodynamic force of fluid flow on resuspension of particles under turbulent flow conditions was studied and the effect of turbulence bursts was included in the model. In particular, the range of airflow

velocity for resuspension of pollen particles from carpet was evaluated and the results are presented in graphical form. The role of airflow on resuspension of particles from carpeted floorings is discussed.

45. CFD SIMULATION OF PARTICLE TRANSPORT AND DISPERSION IN INDOOR ENVIRONMENT BY HUMAN WALKING

By: [Goldasteh, I](#) (Goldasteh, Iman)^[1]; [Ahmadi, G](#) (Ahmadi, Goodarz)^[1]; [Ferro, A](#) (Ferro, Andrea)

Book Group Author(s): [ASME](#)

PROCEEDINGS OF THE ASME FLUIDS ENGINEERING DIVISION SUMMER MEETING, 2012, VOL 1, PTS A AND B, SYMPOSIA Pages: 267-272 Published: 2012 Conference

Conference: ASME Fluids Engineering Division Summer Meeting (FEDSM)

Location: Rio Grande, PR Date: JUL 08-12, 2012 Sponsor(s): ASME, Fluids Engrn Div

Particle resuspension is an important source of particulate matter in indoor environments that significantly affects the indoor air quality and could potentially have adverse effect on human health. Earlier efforts to investigate indoor particle resuspension hypothesized that high speed airflow generated at the floor level during the gait cycle is the main cause of particle resuspension. The resuspended particles are then assumed to be dispersed by the airflow in the room, which is impacted by both the ventilation and the occupant movement, leading to increased PM concentration. In this study, a three dimensional model of a room was developed using FLUENT (TM) CFD package. A RANS approach with the RNG k-epsilon turbulence model was used for simulating the airflow field in the room for different ventilation conditions. The trajectories of resuspended particulate matter were computed with a Lagrangian method by solving the equations of particle motion. The effect of turbulent dispersion was included with the use of the eddy lifetime model. The resuspension of particles due to gait cycle was estimated and included in the computational model. The dispersion and transport of particles resuspended from flooring as well as particle re-deposition on flooring and walls were simulated. Particle concentrations in the room generated by the resuspension process were evaluated and the results were compared with experimental chamber study data as well as simplified model predictions, and good agreement was found.

II.7 Air extérieur – Air intérieur

Rubrique N°8

46. Determinants of personal, indoor and outdoor VOC concentrations: An analysis of the RIOPA data

[Su, FC](#) (Su, Feng-Chiao)^[1]; [Mukherjee, B](#) (Mukherjee, Bhramar)^[1]; [Batterman, S](#) (Batterman, Stuart)^[1]

ENVIRONMENTAL RESEARCH Volume: 126 Pages: 192-203 Published: OCT 2013

Community and environmental exposure to volatile organic compounds (VOCs) has been associated with a number of emission sources and activities, e.g., environmental tobacco smoke and pumping gasoline. Such factors have been identified from mostly small studies with relatively limited information regarding influences on VOC levels. This study uses data from the Relationship of Indoor Outdoor and Personal Air (RIOPA) study to investigate environmental, individual and social determinants of VOC concentrations. RIOPA included outdoor, indoor and personal measurements of 18 VOCs from 310 non-smoking households and adults in three cities and two seasons, and collected a wide range of information pertaining to participants, family members, households, and neighborhoods. Exposure determinants were identified using stepwise regressions and linear mixed-effect models. Most VOC exposure (66 to 78% of the total exposure, depending on VOC) occurred indoors, and outdoor VOC sources accounted for 5 (d-limonene) to 81% (carbon tetrachloride) of the total exposure. Personal

exposure and indoor measurements had similar determinants, which depended on the VOC. Gasoline-related VOCs (e.g., benzene, methyl tertiary butyl ether) were associated with city, residences with attached garages, self-pumping of gas, wind speed, and house air exchange rate (AER). Odorant and cleaning-related VOCs (e.g., 1,4-dichlorobenzene and chloroform) also were associated with city and AER, and with house size and family members showering. Dry-cleaning and industry-related VOCs (e.g., tetrachloroethylene and trichloroethylene) were associated with city, residence water supply type, and dry-cleaner visits. These and other relationships were significant, explained from 10 to 40% of the variation, and are consistent with known emission sources and the literature. Outdoor concentrations had only two common determinants: city and wind speed. Overall, personal exposure was dominated by the home setting, although a large fraction of VOC concentrations were due to outdoor sources. City, personal activities, household characteristics and meteorology were significant determinants.

47. Estimating the concentration of indoor particles of outdoor origin: A review

By: [Diapouli, E](#) (Diapouli, E.) ; [Chaloulakou, A](#) (Chaloulakou, A.) ; [Koutrakis, P](#) (Koutrakis, P.)

JOURNAL OF THE AIR & WASTE MANAGEMENT ASSOCIATION Volume: 63 Issue: 10 Pages: 1113-1129 Published: OCT 1 2013

Recent toxicological results highlight the importance of separating exposure to indoor- and outdoor-generated particles, due to their different physicochemical and toxicological properties. In this framework, a number of studies have attempted to estimate the relative contribution of particles of indoor and outdoor origins to indoor concentrations, using either statistical analysis of indoor and outdoor concentration time-series or mass balance equations. The aim of this work is to review and compare the methodologies developed in order to determine the ambient particle infiltration factor (F-INF) (i.e., the fraction of ambient particles that enter indoors and remains suspended). The different approaches are grouped into four categories according to their methodological principles: (1) steady-state assumption using the steady-state form of the mass balance equation; (2) dynamic solution of the mass balance equation using complex statistical techniques; (3) experimental studies using conditions that simplify model calculations (e.g., decreasing the number of unknowns); and (4) infiltration surrogates using a particulate matter (PM) constituent with no indoor sources to act as surrogate of indoor PM of outdoor origin. Examination of the various methodologies and results reveals that estimating infiltration parameters is still challenging. The main difficulty lies in the separate calculation of penetration efficiency (P) and deposition rate (k). The values for these two parameters that are reported in the literature vary significantly. Deposition rate presents the widest range of values, both between studies and size fractions. Penetration efficiency seems to be more accurately calculated through the application of dynamic models. Overall, estimates of the infiltration factor generated using dynamic models and infiltration surrogates show good agreement. This is a strong argument in favor of the latter methodology, which is simple and easy to apply when chemical speciation data are available.

Implications: Taking into account that increased health risks may be related with ambient particles, a reliable estimation of the main parameters governing ambient particle infiltration indoors may assist towards the development of appropriate regulation and control measures, targeted to specific sources/factors contributing to increased exposures. The overall study of the methodological approaches estimating particle infiltration indoors suggests that dynamic models provide a more complete and realistic picture of ambient particle infiltration indoors, whereas the use of specific PM constituents to act as surrogates of indoor particles of outdoor origin seems also a promising new methodology.

48. Indoor and outdoor measurements of particle number concentration in near-highway homes

By: Fuller, CH (Fuller, Christina H.)^[12]; Brugge, D (Brugge, Doug)^[3]; Williams, PL (Williams, Paige L.)^[4]; Mittleman, MA (Mittleman, Murray A.)^[5]; Lane, K (Lane, Kevin)^[7]; Durant, JL (Durant, John L.)^[8]; Spengler, JD (Spengler, John D.)^[2]

JOURNAL OF EXPOSURE SCIENCE AND ENVIRONMENTAL EPIDEMIOLOGY

Volume: 23 Issue: 5 Pages: 506-512 Published: SEP-OCT 2013

Exposure to high levels of traffic-generated particles may pose risks to human health; however, limited measurement has been conducted at homes near highways. The purpose of this study was to characterize differences between indoor and outdoor particle number concentration (PNC) in homes near to and distant from a highway and to identify factors that may affect infiltration. We monitored indoor and outdoor PNC (6-3000 nm) for 1-3 weeks at 18 homes located <1500 m from Interstate-93 (I-93) in Somerville, MA (USA). Median hourly indoor and outdoor PNC pooled over all homes were 5.2×10^3 and 5.9×10^3 particles/cm³, respectively; the median ratio of indoor-to-outdoor PNC was 0.95 (5th/95th percentile: 0.42/1.75). Homes <100 m from I-93 (n = 4) had higher indoor and outdoor PNC compared with homes > 1000 m away (n = 3). In regression models, a 10% increase in outdoor PNC was associated with an approximately equal (10.8%) increase in indoor PNC. Wind speed and direction, temperature, time of day and weekday were also associated with indoor PNC. Average mean indoor PNC was lower for homes with air conditioners compared with homes without air conditioning. These results may have significance for estimating indoor, personal exposures to traffic-related air pollution.

III. RISQUE ET IMPACT SUR LA SANTE

III.1 Toxicologie

49. Effect of acrolein, a hazardous air pollutant in smoke, on human middle ear epithelial cells

By: Song, JJ (Song, Jae-Jun)^[1]; Lee, JD (Lee, Jong Dae)^[2]; Lee, BD (Lee, Byung Don)^[2]; Chae, SW (Chae, Sung Won)^[3]; Park, MK (Park, Moo Kyun)^[2]

INTERNATIONAL JOURNAL OF PEDIATRIC OTORHINOLARYNGOLOGY Volume: 77 Issue: 10
Pages: 1659-1664 Published: OCT 2013

Objective: Acrolein is a hazardous air pollutant. Tobacco smoke and indoor air pollution are the main causes of human exposure. Acrolein has been shown to cause cytotoxicity in the airways and induce inflammation and mucin production in pulmonary cells. We investigated whether acrolein caused cytotoxicity, induced inflammation or increased expression of mucin in immortalized human middle ear epithelial cell lines (HMEECs).

Methods: Cytotoxicity following acrolein treatment was investigated using the MTT assay, flow cytometry, and Hoechst 33342 staining of HMEECs. We measured expression of inflammatory cytokines tumor necrosis factor (TNF)-alpha and cyclo-oxygenase (COX)-2 and the mucin gene MUC5AC using semi-quantitative real-time reverse transcriptase polymerase chain reaction (RT-PCR) and Western blotting.

Results: Exposure to >50 µg/mL acrolein caused a decrease in cell viability. Acrolein induced apoptosis and necrosis at 50 µg/mL. Acrolein at 5-50 µg/mL increased expression of TNF-alpha and COX-2, as shown by RT-PCR and Western blotting. Acrolein exposure at 5-50 µg/mL for 2-24 h increased MUC5AC expression, as determined by RT-PCR.

Conclusion: Acrolein decreased cell viability, induced an inflammatory response, and increased mucin gene expression in HMEECs. These findings support the hypothesis that acrolein, a hazardous air pollutant in tobacco smoke and ambient air, is a risk factor for otitis media. (C) 2013 Elsevier Ireland Ltd. All rights reserved.

50. Individual and combined effects of mycotoxins from typical indoor moulds

By: Mueller, A (Mueller, A.)^[1]; Schlink, U (Schlink, U.)^[1]; Wichmann, G (Wichmann, G.)^[2]; Bauer, M (Bauer, M.)^[1]; Graebisch, C (Graebisch, C.)^[1]; Schuurmann, G (Schueuermann, G.)^[3]; Herbarth, O (Herbarth, O.)^[5]

TOXICOLOGY IN VITRO Volume: 27 Issue: 6 Pages: 1970-1978 Published: SEP 2013

The mycotoxins patulin, gliotoxin and sterigmatocystin can be produced by common indoor moulds and enter the human body via inhalation of mycotoxin containing spores and particulates. There are various studies about the individual effects of these mycotoxins, but a lack of knowledge about their effects in mixtures. The aim of this study was to evaluate combined effects on the single celled organism *Tetrahymena pyriformis*. Using the MIXTOX model (EU project NOMIRACLE) synergistic or antagonistic effects with dose level deviation or dose ratio dependent deviation were analyzed. The most toxic compound gliotoxin (EC50 0.37 µg M) and patulin (EC50 9.3 µg M) as shown by the MIXTOX model acted synergistic, caused by similar mode of actions. Within the combination with sterigmatocystin (maximum inhibition of 45% at 12.5 µg M) antagonistic effects were observed with switch to synergism if the toxicity of the mixture is mainly caused by sterigmatocystin. In the end the MIXTOX model was applicable for the prediction of combined effects of toxic compounds. (C) 2013 Elsevier Ltd. All rights reserved.

51. Evaporation of Volatile Organic Compounds from Human Skin In Vitro

By: [Gajjar, RM](#) (Gajjar, Rachna M.)^{1,11}; [Miller, MA](#) (Miller, Matthew A.)^{1,11}; [Kasting, GB](#) (Kasting, Gerald B.)^{1,11}

ANNALS OF OCCUPATIONAL HYGIENE

Volume: 57 **Issue:** 7 **Pages:** 853-865 **Published:** AUG 2013

The specific evaporation rates of 21 volatile organic compounds (VOCs) from either human skin or a glass substrate mounted in modified Franz diffusion cells were determined gravimetrically. The diffusion cells were positioned either on a laboratory bench top or in a controlled position in a fume hood, simulating indoor and outdoor environments, respectively. A data set of 54 observations (34 skin and 20 glass) was assembled and subjected to a correlation analysis employing 5 evaporative mass transfer relationships drawn from the literature. Models developed by Nielsen et al. (Prediction of isothermal evaporation rates of pure volatile organic compounds in occupational environments: a theoretical approach based on laminar boundary layer theory. *Ann Occup Hyg* 1995;39:497511.) and the U.S. Environmental Protection Agency (Peress, Estimate evaporative losses from spills. *Chem Eng Prog* 2003; April: 3234.) were found to be the most effective at correlating observed and calculated evaporation rates under the various conditions. The U.S. EPA model was selected for further use based on its simplicity. This is a turbulent flow model based only on vapor pressure and molecular weight of the VOC and the effective air flow rate u . Optimum values of u for the two laboratory environments studied were 0.23 m s⁻¹ (bench top) and 0.92 m s⁻¹ (fume hood).

52. Formaldehyde and Epigenetic Alterations: MicroRNA Changes in the Nasal Epithelium of Nonhuman Primates

By: [Rager, JE](#) (Rager, Julia E.)^{1,11}; [Moeller, BC](#) (Moeller, Benjamin C.)^{1,21}; [Doyle-Eisele, M](#) (Doyle-Eisele, Melanie)^{1,31}; [Kracko, D](#) (Kracko, Dean)^{1,31}; [Swenberg, JA](#) (Swenberg, James A.)^{1,12,41}; [Fry, RC](#) (Fry, Rebecca C.)^{1,12,41}

ENVIRONMENTAL HEALTH PERSPECTIVES

Volume: 121 **Issue:** 3 **Pages:** 339-344 **Published:** MAR 2013

BACKGROUND: Formaldehyde is an air pollutant present in both indoor and outdoor atmospheres. Because of its ubiquitous nature, it is imperative to understand the mechanisms underlying formaldehyde-induced toxicity and carcinogenicity. MicroRNAs (miRNAs) can influence disease caused by environmental exposures, yet miRNAs are understudied in relation to formaldehyde. Our previous investigation demonstrated that formaldehyde exposure in human lung cells caused disruptions in miRNA expression profiles in vitro.

OBJECTIVES: Using an in vivo model, we set out to test the hypothesis that formaldehyde inhalation exposure significantly alters miRNA expression profiles within the nasal epithelium of nonhuman primates.

METHODS: Cynomolgus macaques were exposed by inhalation to approximately 0, 2, or 6 ppm formaldehyde for 6 hr/day for 2 consecutive days. Small RNAs were extracted from nasal samples and assessed for genome-wide miRNA expression levels. Transcriptional targets of formaldehyde-altered miRNAs were computationally predicted, analyzed at the systems level, and assessed using real-time reverse transcriptase polymerase chain reaction (RT-PCR).

RESULTS: Expression analysis revealed that 3 and 13 miRNAs were dysregulated in response to 2 and 6 ppm formaldehyde, respectively. Transcriptional targets of the miRNA with the greatest increase (miR-125b) and decrease (miR-142-3p) in expression were predicted and analyzed at the systems level. Enrichment was identified for miR-125b targeting genes involved in apoptosis signaling. The apoptosis-related targets were functionally tested using RT-PCR, where all targets showed decreased expression in formaldehyde-exposed samples.

CONCLUSIONS: Formaldehyde exposure significantly disrupts miRNA expression profiles within the nasal epithelium, and these alterations likely influence apoptosis signaling.

53. Diethylhexyl Phthalates Is Associated with Insulin Resistance via Oxidative Stress in the Elderly: A Panel Study

By: [Kim, JH](#) (Kim, Jin Hee)^{1,2,3}; [Park, HY](#) (Park, Hye Yin)^{1,3}; [Bae, S](#) (Bae, Sanghyuk)^{1,2,3}; [Lim, YH](#) (Lim, Youn-Hee)^{1,4}; [Hong, YC](#) (Hong, Yun-Chul)^{1,2,3}

PLOS ONE Volume: 8 Issue: 8 Article Number: e71392 DOI: 10.1371/journal.pone.0071392 Published: **AUG 19 2013**

Background: Insulin resistance (IR) is believed to be the underlying mechanism of metabolic syndrome and type 2 diabetes mellitus (DM). Recently, a few studies have demonstrated that phthalates could cause oxidative stress which would contribute to the development of IR. Therefore, we evaluated whether exposure to phthalates affects IR, and oxidative stress is involved in the phthalates-IR pathway.

Methods: We recruited 560 elderly participants, and obtained blood and urine samples during repeated medical examinations. For the determination of phthalate exposure, we measured urinary levels of mono-(2-ethyl-5-hydroxyhexyl) phthalate (MEHHP) and mono-(2-ethyl-5-oxohexyl) phthalate (MEOHP) as metabolites of diethylhexyl phthalates (DEHP), and mono-n-butyl phthalate (MnBP) as a metabolite of di-butyl phthalate (DBP). Malondialdehyde (MDA), an oxidative stress biomarker, was also measured in urine samples. We measured serum levels of fasting glucose and insulin, and derived the homeostatic model assessment (HOMA) index to assess IR. A mixed-effect model and penalized regression spline were used to estimate the associations among phthalate metabolites, MDA, and IR.

Results: The molar sum of MEHHP and MEOHP (Sigma DEHP) were significantly associated with HOMA (beta = 0.26, P = 0.040), and the association was apparent among participants with a history of DM (beta = 0.88, P = 0.037) and among females (beta = 0.30, P = 0.022). However, the relation between MnBP and HOMA was not found. When we evaluated whether oxidative stress is involved in increases of HOMA by Sigma DEHP, MDA levels were significantly associated with increases of Sigma DEHP (beta = 0.11, P < 0.001) and HOMA (beta = 0.49, P = 0.049).

Conclusions: Our study results suggest that exposure to DEHP in the elderly population increases IR, which is related with oxidative stress, and that participants with a history of DM and females are more susceptible to DEHP exposure.

III.2 Expologie

Rubrique N°9

54. Exposure assessment and distribution of polychlorinated biphenyls (PCBs) contained in indoor and outdoor dusts and the impacts of particle size and bioaccessibility

By: [Wang, W](#) (Wang, Wei); [Huang, MJ](#) (Huang, Min-Juan); [Zheng, JS](#) (Zheng, Jin-Shu); [Cheung, KC](#) (Cheung, Kwai Chung); [Wong, MH](#) (Wong, Ming Hung)^{1,1}

SCIENCE OF THE TOTAL ENVIRONMENT Volume: 463 Pages: 1201-1209 Published: **OCT 1 2013**

The size fraction, bioaccessibility and associated human daily intake of PCBs via indoor and outdoor dust collected from two most populated urban centers of Pearl River Delta (PRD), China, were studied. The Sigma PCBs levels (ng g(-1)) in indoor (51.9-264) and outdoor (4.02-228) dust in Guangzhou (GZ) were found higher than those in indoor (17.4-137) and outdoor (7.75-114) dust of Hong Kong (HK). Hexa-PCB was the largest contributor in dust samples (29-64%), followed by tri-PCB. The size fraction of PCBs indicated a high accumulation effect of particles less than 63 mu m, while the lowest was found in 280-2000 mu m. Toxic equivalency (TEQ) of dioxin-like PCBs in indoor dust of GZ and HK was 2 to 13 times higher than that in outdoor dust. The bioaccessibility of PCBs was determined as 5-61% depending on individual PCB congeners under study and bioaccessible PCB exposure was significantly lower than the estimate for total PCB. The daily intake of bioaccessible PCBs via dust ranged in 0.02-8.95 and 0.37-17.8 ng day(-1) in GZ while 0.01-4.95 and 0.16-9.83 ng day(-1) in HK for adults and children, respectively. Dust ingestion contributed to 0.49-10.6% of overall non-dietary PCB exposure (dust ingestion and inhalation) for adults while 12.9-35% for children, indicating the dominant contribution from inhalation. (C) 2013 Elsevier B.V. All rights reserved.

55. Concentrations of polybrominated diphenyl ethers in matched samples of indoor dust and breast milk in New Zealand

By: [Coakley, JD](#) (Coakley, Jonathan D.)¹; [Harrad, SJ](#) (Harrad, Stuart J.)²; [Goosey, E](#) (Goosey, Emma)²; [Ali, N](#) (Ali, Nadeem)¹; [Dirtu, AC](#) (Dirtu, Alin-Constantin)¹; [Van den Eede, N](#) (Van den Eede, Nele)¹; [Covaci, A](#) (Covaci, Adrian)¹; [Douwes, J](#) (Douwes, Jeroen)¹; [Mannetje, A](#) ('t Mannetje, Andrea)¹

ENVIRONMENT INTERNATIONAL Volume: 59 Pages: 255-261 Published: SEP 2013

Polybrominated diphenyl ethers (PBDEs) are present in many consumer goods. There is evidence that PBDEs are toxic to humans, particular young children. The purpose of this study was to assess indoor dust as an exposure source for PBDEs. Concentrations of 16 PBDEs were determined in dust samples from 33 households in New Zealand, and in breast milk samples from 33 mothers living in these households. Associations between dust and breast milk PBDE concentrations were assessed, and children's PBDE intake from breast milk and dust estimated. Influences of household and demographic factors on PBDE concentrations in dust were investigated. Indoor dust concentrations ranged from 0.1 ng/g for BDE17 to 2500 ng/g for BDE209. Breast milk concentrations were positively correlated ($p < 0.05$) with mattress dust concentrations for BDE47, BDE153, BDE154, and BDE209 and with floor dust for BDE47, BDE183, BDE206, and BDE209. The correlation for BDE209 between dust and breast milk is a novel finding. PBDE concentrations in floor dust were lower from households with new carpets. The estimated children's daily intake of PBDEs from dust and breast milk was below U.S. EPA Reference Dose values. The study shows that dust is an important human exposure source for common PBDE formulations in New Zealand. (C) 2013 Elsevier Ltd. All rights reserved.

56. Polybrominated Diphenyl Ethers in Human Hair from the College Environment: Comparison with Indoor Dust

By: [Tang, L](#) (Tang, Liang)¹; [Lei, B](#) (Lei, Bo)¹; [Xu, G](#) (Xu, Gang)¹; [Ma, J](#) (Ma, Jing)¹; [Lei, JQ](#) (Lei, Jian-Qiu)²; [Jin, SQ](#) (Jin, Shi-Qi)²; [Hu, GY](#) (Hu, Gu-Yu)²; [Wu, MH](#) (Wu, Ming-Hong)²

BULLETIN OF ENVIRONMENTAL CONTAMINATION AND TOXICOLOGY Volume: 91 Issue: 4 Pages: 377-381

Published: OCT 2013

Eight Polybrominated diphenyl ether (PBDE) congeners (BDE 28, 47, 99, 100, 153, 154, 183 and 209) were determined to examine the hair burden at low concentrations, and the relationship between PBDE concentrations in human hair and indoor dust from a college environment (Shanghai University campus). Chemical analyses showed that the total concentrations of PBDEs in hair ranged from 4.04 to 99 ng/g dw, and were found to be fourfold higher in females than in males ($p < 0.05$). The total PBDEs concentrations in indoor dust samples ranged from 170 to 1,360 ng/g dw. Significantly positive correlations were observed between human hair and indoor dust for BDE 47 ($r = 0.44$, $p = 0.048$) and BDE 99 ($r = 0.68$, $p = 0.025$). However, no significant association was noted between other PBDE congeners in human hair and indoor dust in the present study.

- **Biomarqueurs**

57. Urinary Metabolites of Organophosphate Flame Retardants: Temporal Variability and Correlations with House Dust Concentrations

Authors: Meeker, JD; Cooper, EM; Stapleton, HM; Hauser, R

Source: ENVIRONMENTAL HEALTH PERSPECTIVES , 121 (5):580-585; MAY 2013

BACKGROUND: A reduction in the use of polybrominated diphenyl ethers (PBDEs) because of human health concerns may result in an increased use of and human exposure to organophosphate flame retardants (OPFRs). Human exposure and health studies of OPFRs are lacking. OBJECTIVES: We sought to define the degree of temporal variability in urinary OPFR metabolites in order to inform epidemiologic study design, and to explore a potential primary source of exposure by examining the relationship between OPFRs in house dust and their metabolites in urine. METHODS: Nine repeated

urine samples were collected from 7 men over the course of 3 months and analyzed for bis(1,3-dichloro-2-propyl) phosphate (BDCPP) and diphenyl phosphate (DPP), metabolites of the OPFRs tris(1,3-dichloro-2-propyl) phosphate (TDCPP) and triphenyl phosphate (TPP), respectively. Intraclass correlation coefficients (ICCs) were calculated to characterize temporal reliability. Paired house dust and urine samples were collected from 45 men. RESULTS: BDCPP was detected in 91% of urine samples, and DPP in 96%. Urinary BDCPP showed moderate-to-strong temporal reliability (ICC range, 0.55-0.72). ICCs for DPP were lower, but moderately reliable (range, 0.35-0.51). There was a weak [Spearman r ($r(S)$) = 0.31] but significant (p = 0.03) correlation between urinary BDCPP and TDCPP concentrations in house dust that strengthened when nondetects ($r(S)$ = 0.47) were excluded. There was no correlation between uncorrected DPP and TPP measured in house dust ($r(S)$ < 0.1). CONCLUSIONS: Household dust may be an important source of exposure to TDCPP but not TPP. Urinary concentrations of BDCPP and DPP were moderately to highly reliable within individuals over 3 months.

58. Urinary Biomarkers for Phthalates Associated with Asthma in Norwegian Children

By: Bertelsen, RJ (Bertelsen, Randi J.)^[1,2]; Carlsen, KCL (Carlsen, Karin C. Lodrup)^[3,4]; Calafat, AM (Calafat, Antonia M.)^[5]; Hoppin, JA (Hoppin, Jane A.)^[2]; Haland, G (Haland, Geir)^[3,4]; Mowinckel, P (Mowinckel, Petter)^[3]; Carlsen, KH (Carlsen, Kai-Hakon)^[3,4]; Lovik, M (Lovik, Martinus)^[1]

ENVIRONMENTAL HEALTH PERSPECTIVES Volume: 121 Issue: 2 Pages: 251-256 Published: FEB 2013

BACKGROUND: High-molecular-weight phthalates in indoor dust have been associated with asthma in children, but few studies have evaluated phthalate biomarkers in association with respiratory outcomes.

OBJECTIVES: We explored the association between urinary concentrations of phthalate metabolites and current asthma.

METHODS: In a cross-sectional analysis, 11 metabolites of 8 phthalates [including four metabolites of di(2-ethylhexyl) phthalate] were measured in one first morning void collected from 2001 through 2004 from 623 10-year-old Norwegian children. Logistic regression models controlling for urine specific gravity, sex, parental asthma, and income were used to estimate associations between current asthma and phthalate metabolite concentrations by quartiles or as log(10)-transformed variables.

RESULTS: Current asthma was associated with both mono(carboxyoctyl) phthalate (MCOP) and mono(carboxynonyl) phthalate (MCNP), although the association was limited to those in the highest quartile of these chemicals. The adjusted odds ratio (aOR) for current asthma was 1.9 (95% CI: 1.0, 3.3) for the highest MCOP quartile compared with the lowest quartile, and 1.3 (95% CI: 0.98, 1.7) for an interquartile-range increase. The aOR for current asthma was 2.2 (95% CI: 1.2, 4.0) for the highest MCNP quartile and 1.3 (95% CI: 1.0, 1.7) for an interquartile-range increase. The other phthalate metabolites were not associated with current asthma.

CONCLUSIONS: Current asthma was associated with the highest quartiles of MCOP and MCNP, metabolites of two high molecular weight phthalates, diisononyl phthalate and diisodecyl phthalate, respectively. Given the short biological half-life of the phthalates and the cross-sectional design, our findings should be interpreted cautiously.

III.3 *Épidémiologie*

Rubrique N°10

a) COV et Semi-volatils

59. Higher prevalence of breathlessness in elderly exposed to indoor aldehydes and VOCs in a representative sample of French dwellings

By: [Bentayeb, M](#) (Bentayeb, Malek)^[1,2]; [Billionnet, C](#) (Billionnet, Cecile)^[1,2]; [Baiz, N](#) (Baiz, Nour)^[1,2]; [Derbez, M](#) (Derbez, Mickael)^[3]; [Kirchner, S](#) (Kirchner, Severine)^[3]; [Annesi-Maesano, I](#) (Annesi-Maesano, Isabella)^[1,2]

RESPIRATORY MEDICINE Volume: 107 Issue: 10 Pages: 1598-1607 Published: OCT 2013

The purpose of this study was to explore respiratory health effects of indoor exposures to aldehydes and volatile organic compounds (VOCs) in elderly living in a population-based representative sample of French dwellings and to compare them to the rest of the occupants of the dwellings.

Twenty VOCs were objectively measured in 490 main dwellings. The respiratory conditions were assessed through a standardized questionnaire in 1012 inhabitants aged over 15 years, 144 of whom were aged over 65 years. Generalized estimating equations (GEE) were used to model the relationship between respiratory health outcomes and air pollutants concentrations using the median value of the distribution to define elevated exposure.

Similar levels of indoor air pollutants were found in elderly and others. However, associations between breathlessness and living in dwellings with elevated concentrations of toluene and o-xylene respectively were statistically significant in elderly but not in the rest of the population (adjusted odds ratios (AOR)(95% confidence interval) = 3.36(1.13, 9.98) and 2.85(1.06, 7.68) in elderly vs. 0.91(0.59, 1.39) and 0.79(0.47, 1.34) in the others respectively). A more pronounced effect of n-decane on past year breathlessness was observed in case of poor ventilation in the dwellings.

Our results showed a higher risk of breathlessness in elderly exposed to indoor air pollution than in the rest of the exposed population. Further investigations are needed to confirm whether this is related to frailty in elderly. (C) 2013 Elsevier Ltd. All rights reserved.

60. Phthalate Exposure and Allergy in the US Population: Results from NHANES 2005-2006

By: [Hoppin, JA](#) (Hoppin, Jane A.)^[1]; [Jaramillo, R](#) (Jaramillo, Renee)^[2]; [London, SJ](#) (London, Stephanie J.)^[1]; [Bertelsen, RJ](#) (Bertelsen, Randi J.)^[1,3]; [Salo, PM](#) (Salo, Paeivi M.)^[4]; [Sandler, DP](#) (Sandler, Dale P.)^[1]; [Zeldin, DC](#) (Zeldin, Darryl C.)^[4]

ENVIRONMENTAL HEALTH PERSPECTIVES Volume: 121 Issue: 10 Pages: 1129-1134 Published: OCT 2013

Background: Environmental exposures to phthalates, particularly high-molecular-weight (HMW) phthalates, are suspected to contribute to allergy.

Objective: We assessed whether phthalate metabolites are associated with allergic symptoms and sensitization in a large nationally representative sample.

Methods: We used data on urinary phthalate metabolites and allergic symptoms (hay fever, rhinitis, allergy, wheeze, asthma) and sensitization from participants ≥ 6 years of age in the National Health and Nutrition Examination Survey (NHANES) 2005-2006. Allergen sensitization was defined as a positive response to at least one of 19 specific IgE antigens (≥ 0.35 kU/L). Odds ratios (ORs) per one log(10) unit change in phthalate concentration were estimated using logistic regression adjusting for age, race, body mass index, gender, creatinine, and cotinine. Separate analyses were conducted for children (6-17 years of age) and adults.

Results: The HMW phthalate metabolite mono-benzyl phthalate (MBzP) was the only metabolite positively associated with current allergic symptoms in adults (wheeze, asthma, hay fever, and rhinitis). Mono-(3-carboxypropyl) phthalate and the sum of diethylhexyl phthalate metabolites (both representing HMW phthalate exposures) were positively associated with allergic sensitization in adults. Conversely, in children, HMW phthalate metabolites were inversely associated with asthma and hay fever. Of the low-molecular-weight phthalate metabolites, mono-ethyl phthalate was inversely associated with allergic sensitization in adults (OR = 0.79; 95% CI: 0.70, 0.90).

Conclusion: In this cross-sectional analysis of a nationally representative sample, HMW phthalate metabolites, particularly MBzP, were positively associated with allergic symptoms and sensitization in adults, but there was no strong evidence for associations between phthalates and allergy in children 6-17 years of age.

b) Biocontaminants

61. Early life exposures to home dampness, pet ownership and farm animal contact and neuropsychological development in 4 year old children: A prospective birth cohort study

By: [Casas, L](#) (Casas, Lidia)^[1,2,3]; [Torrent, M](#) (Torrent, Maties)^[4]; [Zock, JP](#) (Zock, Jan-Paul)^[1,2,3]; [Doekes, G](#) (Doekes, Gert)^[5]; [Forns, J](#) (Forns, Joan)^[1,2,3]; [Guxens, M](#) (Guxens, Monica)^[1,2,3]; [Taubel, M](#) (Taubel, Martin)^[6]; [Heinrich, J](#) (Heinrich, Joachim)^[7]; [Sunyer, J](#) (Sunyer, Jordi)^[1,2,3,8]

INTERNATIONAL JOURNAL OF HYGIENE AND ENVIRONMENTAL HEALTH Volume: 216

Issue: 6 Pages: 690-697 Published: NOV 2013

Exposure to biocontaminants is associated with behavioural problems and poorer cognitive function. Our study assesses the associations between early life exposure to home dampness, pets and farm animal contact and cognitive function and social competences in 4-year old children, and the associations between these indoor factors and microbial compounds (bacterial endotoxin and fungal extracellular polysaccharides). A Spanish population-based birth-cohort enrolled 482 children, and 424 of them underwent psychometric testing at 4 years of age, including the McCarthy Scales of Child Abilities (MSCA) and the California Preschool Social Competence Scale (CPSCS). Information on pet ownership, farm animal contact and home dampness was periodically reported by the parents through questionnaires. Microbial compounds were measured in living room sofa dust collected at the age of 3 months. Persistent home dampness during early life significantly decreased the general score of MSCA by 4.9 points (95% CI: -8.9; -0.8), and it decreased the CPSCS by 6.5 points (95% CI: -12.2; -0.9) in the child's bedroom. Cat or dog ownership were not associated with the outcomes, but occasional farm animal contact increased the general cognitive score of MSCA by 5.6 points (95% CI: 1.8; 9.3). Cat and dog ownership were associated with higher levels of endotoxins in home dust. None of the measured microbial compounds were related with the psychometric tests scores. In conclusion, damp housing in early life may have adverse effects on neuropsychological development at 4 years old. More research is needed to explore the possible involvement of mycotoxins in the observed results. (C) 2013 Elsevier GmbH. All rights reserved.

62. Dampness and mould in schools and respiratory symptoms in children: the HITEA study

By: [Borras-Santos, A](#) (Borras-Santos, Alicia)^[1,2,3,4]; [Jacobs, JH](#) (Jacobs, Jose H.)^[5]; [Taubel, M](#) (Taubel, Martin)^[6]; [Haverinen-Shaughnessy, U](#) (Haverinen-Shaughnessy, Ulla)^[6]; [Krop, EJM](#) (Krop, Esmeralda J. M.)^[5]; [Huttunen, K](#) (Huttunen, Kati)^[7]; [Hirvonen, MR](#) (Hirvonen, Maija-Riitta)^[6,7]; [Pekkanen, J](#) (Pekkanen, Juha)^[6]; [Heederik, DJJ](#) (Heederik, Dick J. J.)^[5]; [Zock, JP](#) (Zock, Jan-Paul)^[1,2,3] ...[More](#)

OCCUPATIONAL AND ENVIRONMENTAL MEDICINE Volume: 70 Issue: 10 Pages: 681-687

Published: OCT 2013

Background

The adverse respiratory health effects of dampness and mould in the home have been extensively reported, but few studies have evaluated the health effects of such exposures in schools. Objectives

To assess the associations between dampness and mould in school buildings and respiratory symptoms among 6-12-year-old pupils in three European countries with different climates.

Methods

Based on information from self-reports and observations, we selected 29 primary schools with and 27 without moisture damage in Spain, the Netherlands and Finland. Information on respiratory symptoms and potential determinants was obtained using a parent-administered questionnaire among 6-12-year-old pupils. Country-specific associations between moisture damage and respiratory symptoms were

evaluated using multivariable multilevel mixed effects logistic regression analysis.
Results

Data from 9271 children were obtained. Nocturnal dry cough was consistently associated with moisture damage at school in each of the three countries: OR 1.15; 95% CI 1.00 to 1.30 with p for heterogeneity 0.54. Finnish children attending a moisture damaged school more often had wheeze (OR 1.36; CI 1.04 to 1.78), nasal symptoms (OR 1.34; CI 1.05 to 1.71) and respiratory-related school absence (OR 1.50; CI 1.10 to 2.03). No associations with these symptoms were found in the Netherlands or Spain (p for heterogeneity < 0.05).

Conclusions

Moisture damage in schools may have adverse respiratory health effects in pupils. Finnish school children seem to be at higher risk, possibly due to quantitative and/or qualitative differences in exposure.

c) **SBS**
Pas d'article

III.4 Populations sensibles

CONFERENCE

63. Indoor air quality at day care centers is a risk factor for wheezing

By: [Marques, JG](#) (Marques, J. G.)^[1,2]; [Martins, P](#) (Martins, P.)^[1,2,3]; [Papoila, AL](#) (Papoila, A. L.)^[3,4]; [Alves, M](#) (Alves, M.)^[4]; [Caires, I](#) (Caires, I.)^[2,3]; [Pedro, C](#) (Pedro, C.)^[2,3]; [Martins, JA](#) (Martins, J. A.)^[2,3]; [Manilha, MC](#) (Manilha, M. C.)^[5]; [Cano, MM](#) (Cano, M. M.)^[5]; [Mendes, AS](#) (Mendes, A. S.)^[5] ...[More](#)

ALLERGY Volume: **68** Pages: **453-453** Supplement: **97** Special Issue: **SI** Published: **SEP 2013**

Conference

Conference: World Allergy and Asthma Congress of the European-Academy-of-Allergy-and-Clinical-Immunology and World-Allergy-Organization

64. Indoor Pollutant Exposures Modify the Effect of Airborne Endotoxin on Asthma in Urban Children

By: [Matsui, EC](#) (Matsui, Elizabeth C.)^[1]; [Hansel, NN](#) (Hansel, Nadia N.)^[2]; [Aloe, C](#) (Aloe, Charles)^[1]; [Schiltz, AM](#) (Schiltz, Allison M.)^[3,4]; [Peng, RD](#) (Peng, Roger D.)^[5]; [Rabinovitch, N](#) (Rabinovitch, Nathan)^[3,4]; [Ong, MJ](#) (Ong, Mary Jane)^[1]; [Williams, DL](#) (Williams, D'Ann L.)^[6]; [Breyse, PN](#) (Breyse, Patrick N.)^[6]; [Diette, GB](#) (Diette, Gregory B.)^[2] ...[More](#)

AMERICAN JOURNAL OF RESPIRATORY AND CRITICAL CARE MEDICINE Volume: **188** Issue: **10** Pages: **1210-1215** Published: **NOV 15 2013**

Rationale: The effect of endotoxin on asthma morbidity in urban populations is unclear. Objectives: To determine if indoor pollutant exposure modifies the relationships between indoor airborne endotoxin and asthma health and morbidity.

Methods: One hundred forty-six children and adolescents with persistent asthma underwent repeated clinical assessments at 0, 3, 6, 9, and 12 months. Home visits were conducted at the same time points for assessment of airborne nicotine, endotoxin, and nitrogen dioxide (NO₂) concentrations. The effect of concomitant pollutant exposure on relationships between endotoxin and asthma outcomes were examined in stratified analyses and statistical models with interaction terms. Measurements and Main Results: Both air nicotine and NO₂ concentrations modified the relationships between airborne endotoxin and asthma outcomes. Among children living in homes with no detectable air nicotine, higher endotoxin was inversely associated with acute visits and oral corticosteroid bursts, whereas among those in homes with detectable air nicotine, endotoxin was positively associated with these outcomes (interaction P value = 0.004 and 0.07, respectively). Among children living in homes

with lower NO₂ concentrations (<20 ppb), higher endotoxin was positively associated with acute visits, whereas among those living in homes with higher NO₂ concentrations, endotoxin was negatively associated with acute visit (interaction P value = 0.05). NO₂ also modified the effect of endotoxin on asthma symptom outcomes in a similar manner.

65. Dampness and mould in schools and respiratory symptoms in children: the HITEA study

Authors: Borrás-Santos, A; Jacobs, JH; Taubel, M; Haverinen-Shaughnessy, U; Krop, EJM; Huttunen, K; Hirvonen, MR; Pekkanen, J; Heederik, DJJ; Zock, JP; Hyvarinen, A

Source: OCCUPATIONAL AND ENVIRONMENTAL MEDICINE , 70 (10):681-687; OCT 2013

Background The adverse respiratory health effects of dampness and mould in the home have been extensively reported, but few studies have evaluated the health effects of such exposures in schools. **Objectives** To assess the associations between dampness and mould in school buildings and respiratory symptoms among 6-12-year-old pupils in three European countries with different climates. **Methods** Based on information from self-reports and observations, we selected 29 primary schools with and 27 without moisture damage in Spain, the Netherlands and Finland. Information on respiratory symptoms and potential determinants was obtained using a parent-administered questionnaire among 6-12-year-old pupils. Country-specific associations between moisture damage and respiratory symptoms were evaluated using multivariable multilevel mixed effects logistic regression analysis. **Results** Data from 9271 children were obtained. Nocturnal dry cough was consistently associated with moisture damage at school in each of the three countries: OR 1.15; 95% CI 1.00 to 1.30 with p for heterogeneity 0.54. Finnish children attending a moisture damaged school more often had wheeze (OR 1.36; CI 1.04 to 1.78), nasal symptoms (OR 1.34; CI 1.05 to 1.71) and respiratory-related school absence (OR 1.50; CI 1.10 to 2.03). No associations with these symptoms were found in the Netherlands or Spain (p for heterogeneity < 0.05). **Conclusions** Moisture damage in schools may have adverse respiratory health effects in pupils. Finnish school children seem to be at higher risk, possibly due to quantitative and/or qualitative differences in exposure.

III.5 Évaluation des risques

Rubrique N°11

REVIEW

66. Assessing and controlling risks from the emission of organic chemicals from construction products into indoor environments

By: [Brown, VM](#) (Brown, Veronica M.)^[1]; [Crump, DR](#) (Crump, Derrick R.)^[1]; [Harrison, PTC](#) (Harrison, Paul T. C.)^[1]

ENVIRONMENTAL SCIENCE-PROCESSES & IMPACTS Volume: 15 Issue: 12 Pages: 2164-2177

Published: 2013

Construction products can be a significant source of indoor pollutants, including volatile organic compounds that may be a risk to the health and well-being of building occupants. There are currently a number of schemes for the labelling of products according to their potential to emit organic compounds. Assessment of the complex mixtures of compounds that may be released has mandated the development of test methods that allow the determination of the concentrations of the chemicals released from products in controlled test chamber environments. In response to concerns about the financial burden faced by manufacturers required to test products according to the various different labelling schemes currently in existence, the European Commission has investigated the scope for greater harmonisation. This initiative has sought to harmonise the process for the assessment of emissions data, complementing work led by the European standards organisation focussed on harmonising the test chamber procedures. The current labelling schemes have a range of requirements with respect to the number of chemicals to be quantified. A comparison of 13 schemes worldwide has identified 15 lists of target compounds, with a total of 611 chemicals occurring on at

least one of the target lists. While harmonisation may clarify and perhaps simplify these requirements, at least in Europe, it can be expected that future changes to product formulations, the introduction of new products and our increasing knowledge about the potential risks to health, will require continued development of new and improved measurement techniques. There is, therefore, a particular challenge for analytical chemists to ensure the efficient provision of high quality emissions data and thereby ultimately enable effective control of risks to human health through the prevention or reduction of indoor air pollution.

67. Risk assessment of bioaccessible organochlorine pesticides exposure via indoor and outdoor dust

Authors: Wang, W; Huang, MJ; Wu, FY; Kang, Y; Wang, HS; Cheung, KC; Wong, MH

Source: *ATMOSPHERIC ENVIRONMENT*, 77 525-533; OCT 2013

Dust, enriched by dichlorodiphenyltrichloroethanes (DDTs), was defined as a new route of organochlorine pesticides (OCPs) exposure, especially for children. Chemical analyses showed the medians of Sigma OCPs were 171 (outdoor) and 520 (indoor) $\mu\text{g kg}^{-1}$ in Guangzhou (GZ) while 130 (outdoor) and 115 (indoor) $\mu\text{g kg}^{-1}$ in Hong Kong (HK). Significantly higher accumulative effect of OCPs occurred in the size fractions of <63 and 63-100 μm than 100-280 and 280-2000 μm , therefore 0-100 μm dust particles were used for risk evaluation. Different cytotoxic effects on human hepatocellular live carcinoma cell (HepG2) and human skin keratinocyte cell line (KERTr) were found for extracts of indoor dust and outdoor dust from different functional areas. For total exposure (dust and food), OCPs intake via dust was low for adults (accounting for 0.16-3.78% of total exposure), while for children it was high (8.16-24.4% of total exposure). Non-carcinogenic OCPs exposure via dust was safe for adults; however DDT and Dieldrin exposure for children was higher than Reference Dose (RID). The cancer risk related to indoor dust exposure for GZ and HK was moderate, below 10^{-4} , while 42% of residences in GZ should be of concern (10^{-5}). However, when bioaccessible OCPs used, daily intake and health risk were found to be greatly lower than the estimates without considering bioaccessibility. (C) 2013 Elsevier Ltd. All rights reserved.

IV. GESTION / DIVERS

IV.1 *Systèmes de ventilation*

Rubrique N°12

Pas d'article

IV.2 *Analyse coût-bénéfice*

Rubrique N°13

Pas d'article

IV.3 *Technique*

Rubrique N°14

68. Four principles for achieving good indoor air quality

[Nazaroff, WW](#) (Nazaroff, William W.)

INDOOR AIR Volume: 23 Issue: 5 Pages: 353-356 Published: OCT 2013

69. Ultrafine particle removal by residential heating, ventilating, and air-conditioning filters

By: [Stephens, B](#) (Stephens, B.)^[1]; [Siegel, JA](#) (Siegel, J. A.)^[2,3]

INDOOR AIR Volume: 23 Issue: 6 Pages: 488-497 Published: DEC 2013

This work uses an in situ filter test method to measure the size-resolved removal efficiency of indoor-generated ultrafine particles (approximately 7-100nm) for six new commercially available filters installed in a recirculating heating, ventilating, and air-conditioning (HVAC) system in an unoccupied test house. The fibrous HVAC filters were previously rated by the manufacturers according to ASHRAE Standard 52.2 and ranged from shallow (2.5cm) fiberglass panel filters (MERV 4) to deep-bed (12.7cm) electrostatically charged synthetic media filters (MERV 16). Measured removal efficiency ranged from 0 to 10% for most ultrafine particles (UFP) sizes with the lowest rated filters (MERV 4 and 6) to 60-80% for most UFP sizes with the highest rated filter (MERV 16). The deeper bed filters generally achieved higher removal efficiencies than the panel filters, while maintaining a low pressure drop and higher airflow rate in the operating HVAC system. Assuming constant efficiency, a modeling effort using these measured values for new filters and other inputs from real buildings shows that MERV 13-16 filters could reduce the indoor proportion of outdoor UFPs (in the absence of indoor sources) by as much as a factor of 2-3 in a typical single-family residence relative to the lowest efficiency filters, depending in part on particle size.

70. Performance Evaluation of Plasma Air Cleaning Systems with Ion Impactor Type Electrodes for Removing Yellow Sand Dust

[Park, S](#) (Park, Sangkyung)^[1]; [Hyun, O](#) (Hyun, Okchun)^[1]; [Cho, M](#) (Cho, Minchul)^[1]; [Bae, H](#) (Bae, Heunghee)^[1]; [Lee, S](#) (Lee, Soowon)^[1]; [Hur, H](#) (Hur, Hyun)^[1]; [Choi, B](#) (Choi, Bongjun)^[1]; [Lee, Y](#) (Lee, Yoochul)^[2]; [Ahn, Y](#) (Ahn, Youngchull)^[3]; [Lee, J](#) (Lee, Jaekeun)^[4]

PARTICULATE SCIENCE AND TECHNOLOGY Volume: 31 Issue: 6 Pages: 541-546 Published: NOV 2 2013

Yellow sand dust (Asian dust storm) causes harmful damage to both indoor and outdoor environments during the springtime. Removal of Yellow sand dust has become an issue for suitable indoor conditions, and an air cleaner is required to remove it efficiently; thus, an analysis of its characteristics should be conducted. In this article, two types of plasma air cleaning systems based on the principle of electrostatic precipitation are evaluated using equivalent dust to Yellow sand dust. To study the influence of an electrode shape of precharger on the collection efficiency, we carried out experiments using a plate and an ion impactor type electrode. From the results, the discharge current was found to be higher for the ion impactor electrode than for the plate electrode. Also, the collection efficiency was greater with the ion impactor electrode than with the plate electrode. For the single-pass test, the removal efficiencies of Yellow sand equivalent dust at the face velocity of 1.0m/s are greater than 80% with the plate and ion impactor electrodes. For the multi-pass test in occupied spaces, the operation time required to reduce Yellow sand dust concentration from the initial concentration of 300-150 $\mu\text{g}/\text{m}^3$ (the criteria of indoor air quality), is 5min for the ion impactor electrode and 7min for the plate electrode. Also, the clean air delivery rate (CADR) value is 113 for the ion impactor electrode and 85 for the plate electrode. The plasma air cleaning systems are suitable for the removal of Yellow sand dust for maintaining suitable indoor air quality.

71. Composite electrospun fly ash/polyurethane fibers for absorption of volatile organic compounds from air

By: [Kim, HJ](#) (Kim, Han Joo)^[1]; [Pant, HR](#) (Pant, Hem Raj)^[2,3]; [Choi, NJ](#) (Choi, Nag Jung)^[1]; [Kim, CS](#) (Kim, Cheol Sang)^[1,2]

CHEMICAL ENGINEERING JOURNAL Volume: 230 Pages: 244-250 Published: AUG 15 2013

This study reports an electrospun fly ash/polyurethane composite fibrous membrane intended for removal of volatile organic compounds (VOCs) from air. Smooth and uniform PU nanofibers loaded with a sufficient amount of commercially available fly ash particles (FAPs) (byproduct of thermal plant) were easily fabricated using blend solution of PU and particles. Electron microscopy and spectroscopy showed that a sufficient amount of FAPs were loaded on/into the PU fibers. The mechanical strength of composite mats was improved (up to certain amount of FAPs on PU) compared to that of the pristine PU mat. Five different VOCs (chloroform, benzene, toluene, xylene, and styrene) were used to measure the absorption capacity of different electrospun mats. The absorption capacity of PU fibers improved with increasing amounts of FAPs in the fibers. Experimental data showed that, among the five VOCs, styrene was the most highly absorbed, regardless composition of PU fibers. PU fibers with 30 wt% FA showed the highest VOC absorption capacity, which was 2.52-2.79 times (for five VOCs) greater than that of pristine PU fibers. The unchanged efficiency of VOC absorption during cyclic use demonstrated the completely reversible absorption and desorption behavior of the mat at room conditions. Results demonstrated that the composite mat is an economically and environmentally-friendly nonwoven matrix for outdoor and indoor VOC filtration. (C) 2013 Elsevier B.V. All rights reserved.

72. Can hydroculture be used to enhance the performance of indoor plants for the removal of air pollutants?

By: [Irga, PJ](#) (Irga, P. J.)^[1]; [Torpy, FR](#) (Torpy, F. R.)^[1]; [Burchett, MD](#) (Burchett, M. D.)^[1]

ATMOSPHERIC ENVIRONMENT

Volume: 77 Pages: 267-271 Published: OCT 2013

The indoor plant, *Syngonium podophyllum*, grown in both conventional potting mix and hydroculture, was investigated for its capacity to reduce two components of indoor air pollution; volatile organic compounds (VOCs) and CO₂. It was found that, with a moderate increase in indoor light intensity, this species removed significant amounts of CO₂ from test chambers, removing up to 61% +/- 2.2 of 1000 ppmv over a 40 min period. It was also found that the hydroculture growth medium facilitated increased CO₂ removal over potting mix. The VOC removing potential of hydroculture plants was also demonstrated. Whilst the rate of VOC (benzene) removal was slightly lower for hydroculture-grown plants than those grown in potting mix, both removed 25 ppmv from the test chambers within 7 days. The effect of benzene on the community level physiological profiles of rhizospheric bacteria was also assessed. There was less variability in the carbon substrate utilisation profile of the bacterial community from the rhizosphere of hydroculture plants compared to potting mix, however the species present encompassed at least those involved with VOC removal. Overall, we propose that plants grown in hydroculture can simultaneously deplete CO₂ and VOCs, and thus may have potential for improving indoor air quality. Crown Copyright (C) 2013 Published by Elsevier Ltd. All rights reserved.

73. Nanocomposite materials for rapid-response interior air humidity buffering in closed environments

By: [Casey, SP](#) (Casey, Sean P.)^[1]; [Hall, MR](#) (Hall, Matthew R.)^[1]; [Tsang, SCE](#) (Tsang, S. C. Edman)^[2]; [Khan, MA](#) (Khan, Muhammad A.)^[2]

JOURNAL OF BUILDING PERFORMANCE SIMULATION Volume: 6 Issue: 5 Pages: 354-366 Special Issue: SI

Published: SEP 1 2013

Three different mesoporous silica (MS) samples were selected as template materials for designing novel, high-performance desiccants to give rapid-response temperature and humidity buffering in closed environments. The aim was to investigate how the functional properties of the MS materials can be tuned to suit differing psychrometric conditions in closed environments, and to inform the design process by conducting sensitivity analysis using building performance simulation software. Their humidity buffering performance was compared with other materials using WUFI Pro v5.1 to conduct numerical hygrothermal simulations. The MS materials had more than two orders of magnitude greater humidity buffering than traditional interior building materials (e.g. painted gypsum plaster) due to their high vapour storage capacity and high dynamic vapour sorption (DVS) response rates. Analysis showed that the gradient of the w(50)-w(80) portion of the absorption branch isotherm is the most sensitive parameter when using the hygrothermal numerical model as a design tool for materials tuning.

IV.4 Réglementaire

Rubrique N°15

74. Exposure to ultrafine particles in hospitality venues with partial smoking bans

Authors: Neuberger, M; Moshhammer, H; Schietz, A

Source: **JOURNAL OF EXPOSURE SCIENCE AND ENVIRONMENTAL EPIDEMIOLOGY**, 23 (5):519-524; SEP-OCT 2013

Fine particles in hospitality venues with insufficient smoking bans indicate health risks from passive smoking. In a random sample of Viennese inns (restaurants, cafes, bars, pubs and discotheques) effects of partial smoking bans on indoor air quality were examined by measurement of count, size and chargeable surface of ultrafine particles (UFPs) sized 10-300 nm, simultaneously with mass of particles sized 300-2500 nm (PM_{2.5}). Air samples were taken in 134 rooms unannounced during busy hours and analyzed by a diffusion size classifier and an optical particle counter. Highest number concentrations of particles were found in smoking venues and smoking rooms (median 66,011 pt/cm³). Even non-smoking rooms adjacent to smoking rooms were highly contaminated (median 25,973 pt/cm³), compared with non-smoking venues (median 7408 pt/cm³). The particle number concentration was significantly correlated with the fine particle mass (P<0.001). We conclude that the existing tobacco law in Austria is ineffective to protect customers in non-smoking rooms of hospitality premises. Health protection of non-smoking guests and employees from risky UFP concentration is insufficient, even in rooms labeled "non-smoking". Partial smoking bans with separation of smoking rooms failed.

IV.5 Divers

75. Promoting Healthy School Environments: A Step-by-Step Framework to Improve Indoor Air Quality in Tangipahoa Parish, Louisiana

By: Massawe, E (Massawe, Ephraim)^{1,1}; Vasut, L (Vasut, Laura)

JOURNAL OF ENVIRONMENTAL HEALTH Volume: 76 Issue: 2 Pages: 22-30 Published: **SEP 2013**

Poor indoor air quality (IAQ) is highly correlated with asthma and other respiratory illnesses. As a chronic lung disease, asthma can have significant impacts on the respiratory system and other complications in large populations of the young, the elderly, and the infirm. This disease is associated with various environmental triggers in indoor environments including schools and homes. Reducing these sources of asthma triggers can lead to improved health outcomes in children. Environmental triggers of asthma and other respiratory illnesses can be reduced by systematically identifying and evaluating their sources and then developing a plan of action to prevent, control, and eliminate them. This article presents a step-by-step framework including easy-to-adopt strategies to support the development and implementation of an IAQ improvement and management plan for schools in semiurban environments with a focus on Tangipahoa Parish, Louisiana. The framework presented here encourages outreach, training, and consultations as key parameters for implementation of a sustainable IAQ program.

76. The influence of human physical activity and contaminated clothing type on particle resuspension

A. McDonagh M.A. Byrne A

A study was conducted to experimentally quantify the influence of three variables on the level of resuspension of hazardous aerosol particles from clothing. Variables investigated include physical activity level (two levels, low and high), surface type (four different clothing material types), and time i.e. the rate at which particles resuspend. A mixture of three monodisperse tracer-labelled powders, with median diameters of 3, 5, and 10 microns, was used to "contaminate" the samples, and the resuspended particles were analysed in real-time using an Aerodynamic Particle Sizer (APS), and also by Neutron Activation Analysis (NAA).

The overall finding was that physical activity resulted in up to 67% of the contamination deposited on clothing being resuspended back into the air. A detailed examination of the influence of physical activity level on resuspension, from NAA, revealed that the average resuspended fraction (RF) of particles at low physical activity was $28 \pm 8\%$, and at high physical activity was $30 \pm 7\%$, while the APS data revealed a tenfold increase in the cumulative mass of airborne particles during high physical activity in comparison to that during low physical activity. The results also suggest that it is not the contaminated clothing's fibre type which influences particle resuspension, but the material's weave pattern (and hence the material's surface texture). Investigation of the time variation in resuspended particle concentrations indicated that the data were separable into two distinct regimes: the first (occurring within the first 1.5 min) having a high, positive rate of change of airborne particle concentration relative to the second regime. The second regime revealed a slower rate of change of particle concentration and remained relatively unchanged for the remainder of each resuspension event.

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