

Préparation du bulletin RSEIN N° 40
85 articles répertoriés pendant la période de mai à août 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, CO Semi-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	Erreur ! Source du renvoi introuvable.
I-4. Biocontaminants	Marina MOLETTA-DENAT, Sophie BARRAL, Valérie BEX	Erreur ! Source du renvoi introuvable.
I-5. Ventilation	Bernard COLLIGNAN, Patrice BLONDEAU, Jacques RIBERON, Alain GINESTET, Olivier RAMALHO	Rubrique N° 3
I-6. Modélisation		Erreur ! Source du renvoi introuvable.
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°4
II-2. Transports	Olivier BLANCHARD, Caroline MARCHAND, Bruno COUTY, Héléne DESQUEYROUX, Hervé PLAISANCE	Rubrique N°5
II-3. Bureaux	Caroline MARCHAND, Luc MOSQUERON, Bruno COUTY, Edwige RÉVÉLAT	Rubrique N°6
II-4. ERP	Caroline MARCHAND, Luc MOSQUERON, Bruno COUTY, Edwige RÉVÉLAT	Rubrique N°7
II-5. Autres lieux de vie	Christelle NICOLET, Corinne MANDIN, Marie-Aude KERAUTRET, Sabine HOST (moisissure), Luc MOSQUERON	Rubrique N°8
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°9
II-8. Air extérieur – Air intérieur	Souad BOUALLALA, Héléne DESQUEYROUX, Edwige RÉVÉLAT, Marie-Aude KERAUTRET, Laurent MARTINON (particules), Dorothee GRANGE	Rubrique N°10
III- RISQUE ET IMPACT SUR LA SANTÉ		
III-1. Toxicologie expérimentale	Nathalie BONVALLOT, Vincent NEDELLEC	Erreur ! Source

		du renvoi introuvable.
III-2. Expologie		Rubrique N°12
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°13
III-4. Évaluation des risques	Nathalie BONVALLOT, Véronique EZRATTY, Philippe GLORENNEC, Corinne MANDIN, Luc MOSQUERON, Vincent NEDELLEC, Hélène BAYSSON (radon), Olivier BLANCHARD	Rubrique N°14
IV- GESTION/DIVERS		
IV-1. Système de ventilation	François MAUPETIT, Mélanie NICOLAS, Laurence LE-COQ, Alain GINESTET	Rubrique N°15
IV-2. Analyse cout-benefice	Vincent NEDELLEC	Rubrique N°16
IV-3. Technique	François MAUPETIT, Mélanie NICOLAS, Fabien SQUINAZI, Xavier CAUCHERIE, Laurence LE-COQ, Alain GINESTET	Rubrique N°17
IV-4. Réglementaire		Rubrique N°17

I. MÉTROLOGIE (PROTOCOLES PRELEVEMENTS / ANALYSES / MODELISATION)

I.1 Gaz inorganiques / métaux

Rubrique N°1

a. Radon

1. THE EUROPEAN INDOOR RADON MAP AND BEYOND

Author(s): Gruber, V (Gruber, Valeria)¹¹; Tollefsen, T (Tollefsen, Tore)¹¹; Bossew, P (Bossew, Peter)¹²¹; De Cort, M (De Cort, Marc)¹¹

Source: CARPATHIAN JOURNAL OF EARTH AND ENVIRONMENTAL SCIENCES **Volume:** 8 **Issue:** 2
Pages: 169-176 **Published:** MAY 2013

Times Cited: 0 (from Web of Science)

Cited References: 12 [[view related records](#)]  [Citation Map](#)

Abstract: Started six years ago, the European map of indoor radon concentrations has evolved to include data from 25 countries, covering a fair part of Europe. As of October 2012, the map is composed of more than 18,000 non-empty grid cells with data, based on more than 800,000 individual measurements. The number of measurements per cell ranges from one up to nearly 24,000. The coverage of territory varies widely between the countries: from less than 20% for some up to more than 100% for others (due to a border effect). While the arithmetic mean for all non-empty cells in Europe (for all participating countries) is 100 Bq/m³, the median is 65 Bq/m³. In parallel, a European map of geogenic radon potential is under development, with a first, trial map having been published. These and other maps will eventually form parts of a planned

2. Radon Exhalation Rate from Building Materials Using CR-39 Nuclear Track Detector

Author(s): Topcu, N (Topcu, N.)¹¹; Bicak, D (Bicak, D.)¹¹; Cam, S (Cam, S.)¹¹; Erees, FS (Erees, F. S.)¹¹

Source: INDOOR AND BUILT ENVIRONMENT **Volume:** 22 **Issue:** 2 **Pages:** 384-387 **DOI:** 10.1177/1420326X11426890 **Published:** APR 2013

Abstract: Humans are exposed to radiological hazards from natural radiation sources that exist mainly in the earth's crust. Radon is a noble gas and is formed by the decay of Ra-226, which is one of the nuclides formed in the disintegration series from U-238. Building materials are considered as one of the major sources of radon in the indoor environment. Radon is one of the indoor sources that cause radiological health risk.

To study radon exhalation rate, samples of sand, gravel, stone, cement, granite, marble, ashlar, ceramic tile and bricks were collected from Manisa and Izmir provinces of Turkey. The radon exhalation rates (in terms of mass and surface area) for these materials were also calculated by using solid-state nuclear track detector (CR-39). The mass and surface exhalation rates are calculated by following the radon activity growth as a function of time. These values were also compared with literature values.

3. A SIMPLE MODEL FOR THE ASSESSMENT OF INDOOR RADIONUCLIDE Pb-210 SURFACE CONTAMINATION DUE TO THE PRESENCE OF RADON

Author(s): Mrdja, DS (Mrdja, Dusan S.)¹¹; Bikit, IS (Bikit, Istvan S.)¹¹; Veskovc, MJ (Veskovc, Miroslav J.)¹¹; Forkapic, SM (Forkapic, Sofija M.)¹¹; Todorovic, NM (Todorovic, Natasa M.)¹¹; Nikolov, JB (Nikolov, Jovana B.)¹¹; Bikit, KI (Bikit, Kristina I.)¹¹

Source: NUCLEAR TECHNOLOGY & RADIATION PROTECTION **Volume:** 28 **Issue:** 1 **Pages:** 68-72 **DOI:** 10.2298/NTRP1301068M **Published:** MAR 2013

Abstract: The presented, very simplified model provides a possibility for estimation of surface Pb-210 activity,

depending on the changes of Rn-222 concentration during the long-term radon presence inside the closed room. This can be useful for retrospective assessment of the average indoor radon concentration for certain historical period, based on the surface contamination by the radionuclide Pb-210 in a closed or poorly ventilated room over a long period of time. However, the surface Pb-210 contamination depends on the pattern of radon concentration changes, and in this model is supposed that the change of indoor radon concentration, which periodically enters the room, is affected only by the radioactive decay and the inserted amount of radon in each entry. So, each radon entry can be comprehended as a "net amount" of radon, or excess which remains inside the room due to radon's periodical in-out flow. It is shown, that under the conditions of the model, the achieved average value of radon concentration of 275 Bq/m(3), implies that the saturated surface contamination by the Pb-210 of 160 Bq/m(2) after approximately 150 years.

I.2 COV, COSEmi-Volatils

Rubrique N°2

a. COV/Aldéhydes

REVIEW

4. Transportable, fast and high sensitive near real-time analyzers: Formaldehyde detection

Author(s): Allouch, A (Allouch, Alaa)^{1,2,1}; Guglielmino, M (Guglielmino, Maud)^{1,1}; Bernhardt, P (Bernhardt, Pierre)^{1,1}; Serra, CA (Serra, Christophe A.)^{1,2}; Le Calve, S (Le Calve, Stephane)^{1,1}

Source: SENSORS AND ACTUATORS B-CHEMICAL **Volume:** 181 **Pages:** 551-558 **DOI:** 10.1016/j.snb.2013.02.043 **Published:** MAY 2013

Abstract: Formaldehyde is a colorless gas emitted into the indoor environment by furniture and many other sources. In 2006, International Agency for Research on Cancer (IARC) classified formaldehyde as carcinogen to humans even at low concentrations. The World Health Organization (WHO) determined a guideline value of 82 ppb (parts per billion). Standard analysis based on sampling and then gas chromatography (GC) or high-performance liquid chromatography (HPLC) methods are off-line methods and are considered to be time-consuming and cumbersome, in addition to their large sizes, weights, high cost in terms of both equipment and consumables. This review reports the developments made over the last decade toward the realization of portable, high sensitive and real-time formaldehyde analyzers. (C) 2013 Elsevier B.V. All rights reserved.

5. Evaluation of a real-time method for monitoring volatile organic compounds in indoor air in a Japanese university

Author(s): Hori, H (Hori, Hajime)^{1,1}; Ishimatsu, S (Ishimatsu, Sumiyo)^{1,1}; Fueta, Y (Fueta, Yukiko)^{1,1}; Ishidao, T (Ishidao, Toru)^{1,1}

Source: ENVIRONMENTAL HEALTH AND PREVENTIVE MEDICINE **Volume:** 18 **Issue:** 4 **Pages:** 285-292 **DOI:** 10.1007/s12199-012-0319-1 **Published:** JUL 2013

Abstract: Objective Real time monitoring of total volatile organic compounds (TVOC) in rooms of Japanese university buildings was carried out to understand the temporal changes in actual indoor air quality.

Methods The TVOC concentrations in seven different rooms, consisting of a lecture room, a seminar room, three laboratories, a computer room and a library, were monitored continuously for 24 h via a personal VOC monitor equipped with a semiconductor gas sensor. An active sampling-thermal desorption method using stainless steel tubes packed with Tenax-TA was also carried out simultaneously to verify the usability of the monitor.

Results The TVOC concentrations measured by the personal VOC monitor were closely correlated with those measured by the active sampling method. The TVOC concentration in all rooms was generally low during the day and increased during the night. This concentration change corresponded to the ventilation cycle in the building. During the day, the TVOC concentration was generally lower than the provisional target criterion (advisable value) of indoor air quality in Japan (400 $\mu\text{g}/\text{m}^3$). During the night, however, it exceeded this criterion in several rooms, especially during the summer season.

Conclusion The real-time monitor using a semiconductor gas sensor can provide useful data on changes in the TVOC concentration in indoor air with high sensitivity.

6. Formaldehyde concentrations in household air of asthma patients determined using colorimetric detector tubes

Author(s): Dannemiller, KC (Dannemiller, K. C.)^[1]; Murphy, JS (Murphy, J. S.)^[2]; Dixon, SL (Dixon, S. L.)^[3]; Pennell, KG (Pennell, K. G.)^[4]; Suuberg, EM (Suuberg, E. M.)^[5]; Jacobs, DE (Jacobs, D. E.)^[3]; Sandel, M (Sandel, M.)^[2]

Source: INDOOR AIR **Volume:** 23 **Issue:** 4 **Pages:** 285-294 **DOI:** 10.1111/ina.12024 **Published:** AUG 2013

Times Cited: 0 (from Web of Science)

Cited References: 53 [[view related records](#)]  [Citation Map](#)

Abstract: Formaldehyde is a colorless, pungent gas commonly found in homes and is a respiratory irritant, sensitizer, carcinogen, and asthma trigger. Typical household sources include plywood and particleboard, cleaners, cosmetics, pesticides, and others. Development of a fast and simple measurement technique could facilitate continued research on this important chemical. The goal of this research is to apply an inexpensive short-term measurement method to find correlations between formaldehyde sources and concentration, and formaldehyde concentration and asthma control. Formaldehyde was measured using 30-min grab samples in length-of-stain detector tubes in homes (n=70) of asthmatics in the Boston, MA area. Clinical status and potential formaldehyde sources were determined. The geometric mean formaldehyde level was 35.1ppb and ranged from 5 to 132ppb. Based on one-way ANOVA, t-tests, and linear regression, predictors of log-transformed formaldehyde concentration included absolute humidity, season, and the presence of decorative laminates, fiberglass, or permanent press fabrics (P<0.05), as well as temperature and household cleaner use (P<0.10). The geometric mean formaldehyde concentration was 57% higher in homes of children with very poorly controlled asthma compared to homes of other asthmatic children (P=0.078). This study provides a simple method for measuring household formaldehyde and suggests that exposure is related to poorly controlled asthma.

7. Determination of gaseous polycyclic aromatic hydrocarbons by a simple direct method using thermal desorption-gas chromatography-mass spectrometry

Author(s): Martins, GV (Martins, Gabriela V.)^[1]; Martins, S (Martins, Susana)^[1]; Martins, AO (Martins, Anabela O.)^[1]; Basto, MCP (Basto, M. Clara P.)^[2]; Silva, GV (Silva, Gabriela Ventura)^[1]

Source: ENVIRONMENTAL MONITORING AND ASSESSMENT **Volume:** 185 **Issue:** 8 **Pages:** 6447-6457 **DOI:** 10.1007/s10661-012-3036-8 **Published:** AUG 2013

Times Cited: 0 (from Web of Science)

Cited References: 49 [[view related records](#)]  [Citation Map](#)

Abstract: In the last decade, the development of novel analytical methodologies enabled the identification of several environmental pollutants responsible for health problems associated with indoor exposure. Polycyclic aromatic hydrocarbons (PAHs) are among the potential hazardous chemicals present in ambient air. Due to their bioaccumulation potential and carcinogenic/mutagenic effects, 16 PAHs are currently listed as priority air pollutants. The main goal of this work was to implement a new and simple method for sampling and determination of PAHs in air by using a thermal desorption (TD) technique followed by gas chromatography coupled with mass spectrometry analysis. A detailed study was carried out to optimise the experimental method in each of its phases, including (active) sampling, TD and chromatographic analysis. The results demonstrate that this approach allowed the detection and quantification of the six more volatile PAHs, namely, naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene. Acceptable precision and good linearity over the explored range were obtained. No carry-over was observed during experimental tests and the method provided a reproducible answer. The applicability of the novel methodology was tested in real environment, namely, on the roof of a building in an urban area, in a domestic kitchen and in a collective car garage. The method enabled the identification of two PAHs in the field samples, specifically, naphthalene (two rings) and phenanthrene (three rings). With regard to PAHs sample composition, the most abundant PAH found, in the three different locations, was naphthalene, accounting for about 84-100 % of the total PAH mass detected.

8. New method to determination of naphthalene in ambient air using cold fiber-solid phase microextraction and gas chromatography-mass spectrometry

Author(s): Menezes, HC (Menezes, Helvecio C.)^{1,11}; Paulo, BP (Paulo, Breno P.)^{1,11}; Costa, NT (Costa, Nathalia T.)^{1,11}; Cardeal, ZL (Cardeal, Zenilda L.)^{1,11}

Source: MICROCHEMICAL JOURNAL **Volume:** 109 **Special Issue:** SI **Pages:** 93-97 **DOI:** 10.1016/j.microc.2012.03.031 **Published:** JUL 2013

Times Cited: 0 (from Web of Science)

Cited References: 40 [[view related records](#)]  [Citation Map](#)

Conference: 16th Brazilian Meeting on Analytical Chemistry (ENQA) **Location:** Campos do Jordao, BRAZIL
Date: OCT 23-26, 2011

Sponsor(s): Univ Sao Paulo, Inst Chem; Brazilian Chemical Soc, Div Analyt Chem; Fundacao Amparo Pesquisa Estado Sao Paulo (FAPESP); Conselho Nacl Desenvolvimento Cientifico & Tecnolico (CNPq)

Abstract: Naphthalene, a highly volatile polycyclic aromatic hydrocarbon (PAH), is classified as possibly carcinogenic to humans and can be found in various environments. This paper describes a cold fiber (CF) solid phase microextraction (SPME-) sampling method coupled with gas chromatography/mass spectrometry (GC/MS) for determining naphthalene in ambient air. The method uses a 100 μm polydimethylsiloxane (PDMS) fiber to generate gaseous standards using a permeation tube. The method shows good results for many validation parameters. The intra-assay precision shows a relative standard deviation (RSD) ranging from 1.04 to 8.11%; the limit of detection (LOD) is 0.33 \pm 0.01 $\mu\text{g}/\text{m}^3$, and the quantification limit (LOQ) is 0.55 \pm 0.01 $\mu\text{g}/\text{m}^3$. The method was applied to the determination of naphthalene from real samples collected from indoor and outdoor air. The results have shown the ability of the method to measure trace levels of naphthalene in the air in different environments. (C) 2012 Elsevier B.V. All rights reserved.

9. Effect of calibration environment on the performance of direct-reading organic vapor monitors

Author(s): LeBouf, RF (LeBouf, Ryan F.)^{1,11}; Slaven, JE (Slaven, James E.)^{1,21}; Coffey, CC (Coffey, Christopher C.)^{1,131}

Source: JOURNAL OF THE AIR & WASTE MANAGEMENT ASSOCIATION **Volume:** 63 **Issue:** 5 **Pages:** 528-533 **DOI:** 10.1080/10962247.2013.772926 **Published:** MAY 1 2013

Abstract: The performance of two direct-reading organic vapor monitors (monitors) when calibrated at different environmental conditions was compared with charcoal tube results. Three MIRAN SapphIRe portable ambient air analyzers (SAP) and three Century portable toxic vapor analyzers (TVAs) were evaluated. Prior to sampling, the monitors were calibrated per the manufacturer's instructions using methane for the TVA flame ionization detector (FID) and isobutylene for the photoionization detector (PID), whereas the SapphIRe instruments were zeroed and the instrument's manufacturer-supplied library was used. For the first series of tests (Part 1 Same condition), the monitors were calibrated under the same environmental conditions as those present during sampling. They were then challenged with four cyclohexane concentrations (30, 150, 300, and 475 ppm) under two extreme environmental conditions: 5 degrees C and 30% relative humidity (RH) (same/cold) and 38 degrees C and 90% RH (same/hot). For the second series of tests (Part 2 Different condition), the monitors were calibrated at approximately normal indoor environmental conditions (21 degrees C and 50% RH) and sampled at extreme environmental conditions (different/cold and different/hot). The monitor readings from the two methods were compared with the actual cyclohexane concentration determined from charcoal tubes using ratios and root mean square errors. A number of monitor failures, both below detection limit values in the presence of a known challenge concentration and erroneously high measurements, occurred in each part: same condition 20.7% (149/720) and different condition 42.4% (305/720), with a majority of the failures (>78%) during the hot and humid conditions. All monitors performed best at the same/cold, followed by the same/hot, in terms of closeness to the reference standard method and low within-monitor variability. The ranked choice of monitors for same/cold is PID > SAP > FID; for different/cold FID > PID > SAP; for same/hot SAP > PID > FID; and for different/hot PID > SAP (FID not included due to 100% failure rate).

Implications: Direct-reading organic vapor monitors are used for assessing the concentrations of

volatile organic compounds in the air at varying environmental conditions. Typical calibration is performed at laboratory temperature and pressure. The monitors may be used in atmospheres that differ from that during calibration. An understanding of the effect of calibration environment on monitor performance may provide valuable information on the reliability and appropriateness of certain monitor types for industrial hygienists, emergency responders, and exposure assessment practitioners. Results of the study indicate monitor calibration should be performed at the same environmental conditions as sampling.

10. Evaluation of VOC emission and sorption characteristics of low-VOC adhesive-bonded building materials

Author(s): Kang, DH (Kang, Dong Hwa)^{1,1}; Choi, DH (Choi, Dong Hee)^{1,1}; Yeo, MS (Yeo, Myoung Souk)^{2,1}; Kim, KW (Kim, Kwang Woo)^{2,1}

Source: JOURNAL OF ADHESION SCIENCE AND TECHNOLOGY **Volume:** 27 **Issue:** 5-6 **Special Issue:** SI **Pages:** 683-698 **DOI:** 10.1080/01694243.2012.690661 **Published:** MAR 1 2013

Abstract: To reduce the risk of indoor air pollution caused by synthetic building materials, low-volatile organic compounds (VOC) building materials, including adhesives, are commonly used in building construction. Although adhesives do not directly contact indoor air, they affect VOC mass transfer at the surface of finishing materials by diffusion. This study investigates VOC emission and sorption behaviors of building materials with low-VOC adhesives. Small chamber emission and sorption experiments were designed in parallel to field measurements to examine the onsite VOC emission and sorption rates of adhesive-bonded building materials. It was found that the onsite emission rates from a wallpaper composite (polyvinyl chloride wallpaper+paper adhesive+gypsum board) were higher than the emission rates detected in the small-scale chamber, which demonstrates the possible sorption effect of the wallpaper composite. The results of the sorption chamber experiment confirm that the wallpaper is a sorptive building material and that the bonding of wallpaper to gypsum board increases the sorption and re-emission rates. These results indicate that even though low-VOC adhesive-bonded materials are used, additional indoor air quality control techniques should be applied to minimize re-emission by sorption processes over long periods of time.

11. Influence of VOC and formaldehyde emission from tile adhesives on their indoor concentrations in buildings

Author(s): Kim, S (Kim, Sunsook)^{1,1}; Cho, B (Cho, Bongho)^{1,1}

Source: JOURNAL OF ADHESION SCIENCE AND TECHNOLOGY **Volume:** 27 **Issue:** 5-6 **Special Issue:** SI **Pages:** 699-709 **DOI:** 10.1080/01694243.2012.693279 **Published:** MAR 1 2013

Abstract: Volatile organic compounds (VOC) and formaldehyde emitted from building materials are considered to be one of the main causes of indoor air pollution in buildings. To reduce indoor pollutant concentrations, new installation methods for wall papers and flooring materials have been widely introduced to the construction field, including a nonadhesive floating method. However, adhesives are still widely used to install wall tiles or floor tiles on areas such as kitchens, bathrooms, and showers. The objective of this study was to investigate the influence of tile adhesive emissions on indoor air quality. The VOC and formaldehyde emission rates from two different types of tile adhesives, a conventional adhesive and a low-VOC emission adhesive, were measured using small emission test chambers. Full scale experiments were also carried out in three identical test rooms in a building. One wall of each room was finished with wallpaper in Test Room 1 and with tiles in Test Rooms 2 and 3. The other walls and ceilings were finished with wall papers in all test rooms. Wall tiles of Test Room 2 were installed with the conventional adhesive, while those of Test Room 3 were installed with the low-VOC emission adhesive. The indoor VOC concentrations in Test Room 2 were significantly higher than those in Test Room 3 due to a significantly higher VOC emission from the conventional tile adhesive. Even though the adhesives were applied under the finishing materials, investigation revealed that the adhesives were the most dominant contributor of indoor VOC concentration.

b. Semi-volatils**12. Benzotriazole, Benzothiazole, and Benzophenone Compounds in Indoor Dust from the United States and East Asian Countries**

Author(s): Wang, L (Wang, Lei)^{1,2,3,1}; Asimakopoulos, AG (Asimakopoulos, Alexandros G.)^{1,2,1}; Moon, HB (Moon, Hyo-Bang)^{1,4,1}; Nakata, H (Nakata, Haruhiko)^{1,5,1}; Kannan, K (Kannan, Kurunthachalam)^{1,1,2,1}

Source: ENVIRONMENTAL SCIENCE & TECHNOLOGY **Volume:** 47 **Issue:** 9 **Pages:** 4752-4759 **DOI:** 10.1021/es305000d **Published:** MAY 7 2013

Abstract: Organic corrosion inhibitors (OCIs), including ultraviolet light filters, are widely used in plastics, rubbers, colorants, and coatings to increase the performance of products. Derivatives of benzotriazole (BTR), benzothiazole (BTH), and benzophenone (BP) are high-production volume OCIs that have been detected in the environment and human tissues. However, knowledge of their occurrence in indoor environments, as well as human exposure to them, is still lacking. In this study, BTR, BTH, BP and their 12 derivatives were determined in indoor dust for the first time. All three groups of OCIs were found in all 158 indoor dust samples from the U.S. and three East Asian countries (China, Japan, and Korea). The geometric mean (GM) concentration of the sum of six BTRs (GM C-Sigma BTRs) ranged from 20 to 90 ng/g among the four countries studied, with a maximum C-Sigma BTRs of similar to 2000 ng/g found in a dust sample from China. Tolyltriazole was the major derivative of BTR measured in dust. GM C-Sigma BTHs in indoor dust from the four countries ranged from 600 to 2000 ng/g. 2-OH-BTH was the predominant BTH in dust from the U.S., Japan, and Korea. GM C-Sigma BPs in dust ranged from 80 to 600 ng/g, with 2-OH-4-MeO-BP and 2,4-2OH-BP, contributing to the majority of Sigma BP concentrations. Based on the concentrations of three types of OCIs in indoor dust, human exposure through dust ingestion was calculated. Daily intake of OCIs through dust ingestion was higher for people in the U.S., Japan, and Korea than in China; the residents in urban China are exposed to higher levels of OCIs via dust ingestion than are those in rural China.

13. Wayne, Anderson et al. - Thermal effects on polybrominated diphenyl ether mass transfer and emission from computer cases.

Journal/International Journal of Heat and Mass Transfer 64 (0):343-351.

Abstract 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's 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 °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. Réactions chimiques (AOS)**14. Indoor Secondary Organic Aerosol Formation Initiated from Reactions between Ozone and Surface-Sorbed D-Limonene**

Author(s): Waring, MS (Waring, Michael S.)^{1,1}; Siegel, JA (Siegel, Jeffrey A.)^{1,2,3}

Source: ENVIRONMENTAL SCIENCE & TECHNOLOGY **Volume:** 47 **Issue:** 12 **Pages:** 6341-6348 **DOI:** 10.1021/es400846d **Published:** JUN 18 2013

Times Cited: 0 (from Web of Science)

Cited References: 54 [[view related records](#)]  [Citation Map](#)

Abstract: Reactions between ozone and terpenoids produce numerous products, some of which may form secondary organic aerosol (SOA). This work investigated the contribution to gas-phase SOA formation of ozone reactions with surface-sorbed D-limonene, which is common indoors. A model framework was developed to predict SOA mass formation because of ozone/terpenoid surface reactions, and it was used with steady state experiments in a 283 L chamber to determine the aerosol mass fraction of SOA resulting from surface reactions, $\xi(s)$ (the ratio of mass of SOA formed and mass of ozone consumed by ozone/terpenoid surface reactions), for ozone/D-limonene reactions on stainless steel. The $\xi(s) = 0.70-0.91$, with lower relative humidity leading to both higher mass and number formation. Also, surface reactions promoted nucleation more than gas phase reactions, and number formation due to surface reactions and gas phase reactions were 126-339 and 51.1-60.2 no./cm³ per $\mu\text{g}/\text{m}^3$ of formed SOA, respectively. We also used the model framework to predict that indoor spaces in which ozone/D-limonene surface reactions would likely lead to meaningful gas phase SOA formation are those with surfaces that have low original reactivity with ozone, such as glass, sealed materials, or smooth metals.

15. The use of a housecleaning product in an indoor environment leading to oxygenated polar compounds and SOA formation: Gas and particulate phase chemical characterization

Author(s): Rossignol, S (Rossignol, S.)^{1,1}; Rio, C (Rio, C.)^{1,1}; Ustache, A (Ustache, A.)^{1,1}; Fable, S (Fable, S.)^{1,1}; Nicolle, J (Nicolle, J.)^{1,2}; Meme, A (Meme, A.)^{1,2}; D'Anna, B (D'Anna, B.)^{1,2}; Nicolas, M (Nicolas, M.)^{1,3}; Leoz, E (Leoz, E.)^{1,1}; Chiappini, L (Chiappini, L.)^{1,1}

Source: ATMOSPHERIC ENVIRONMENT **Volume:** 75 **Pages:** 196-205 **Published:** AUG 2013

Abstract: This work investigates Secondary Organic Aerosol (SOA) formed by limonene ozonolysis using a housecleaning product in indoor environment. This study combines simulation chamber ozonolysis experiments and field studies in an experimental house allowing different scenarios of housecleaning product use in real conditions.

Chemical speciation has been performed using a new method based on simultaneous sampling of both gas and particulate phases on sorbent tubes and filters. This method allowed the identification and quantification of about 35 products in the gas and particulate phases. Among them, products known to be specific from limonene ozonolysis such as limononaldehyde, ketolimonene and ketolimononic acid have been detected. Some other compounds such as 2-methylbutanoic acid had never been detected in previous limonene ozonolysis studies. Some compounds like levulinic acid had already been detected but their formation remained unexplained. Potential reaction pathways are proposed in this study for these compounds. For each experiment, chemical data are coupled together with physical characterization of formed particles: mass and size and number distribution evolution which allowed the observation of new particles formation (about 87,000 particle cm⁻³). The chemical speciation associated to aerosol size distribution results confirmed that limonene emitted by the housecleaning product was responsible for SOA formation. To our knowledge, this work provides the most comprehensive analytical study of detected compounds in a single experiment for limonene ozonolysis in both gaseous and particulate phases in real indoor environment. (C) 2013 Elsevier Ltd. All rights reserved.

16. Ultraviolet-Induced Effects on Chloramine and Cyanogen Chloride Formation from Chlorination of Amino Acids

Author(s): Weng, SC (Weng, ShihChi)^[1]; Blatchley, ER (Blatchley, Ernest R., III)^[1,2]

Source: ENVIRONMENTAL SCIENCE & TECHNOLOGY **Volume:** 47 **Issue:** 9 **Pages:** 4269-4276 **DOI:** 10.1021/es400273w **Published:** MAY 7 2013

Times Cited: 0 (from Web of Science)

Cited References: 36 [[view related records](#)]  [Citation Map](#)

Abstract: Ultraviolet (UV)-based treatment is commonly used to augment chlorination in swimming pools. However, the effects of combined application of UV254/chlorine on disinfection byproduct (DBP) formation are incompletely defined. To examine this issue, experiments were conducted with amino acids (L-arginine, L-histidine, and glycine) that are representative of those introduced to swimming pools via human body fluids. For each precursor, stepwise experiments were conducted with chlorination and UV254 exposure, with/without post chlorination Net formation and decomposition of chloramines and cyanogen chloride (CNCl) were measured for a range of chlorine/precursor (Cl/P) molar ratios and UV254 doses. Substantial production of NH₂Cl from L-arginine and L-histidine was observed at Cl/P = 1.0 and 2.0 when post-chlorination was applied to UV254-irradiated samples. These results suggested a mechanism of rapid N-chlorination, followed by cleavage of NH₃ by UV254 irradiation. CNCl formation was observed from UV254-irradiated samples of L-arginine and L-histidine when Cl/P = 2.0 and 3.0, as well as from glycine for Cl/P ≤ 1. Structurally related precursor compounds were examined for CNCl formation potential in chlorination/UV experiments. CNCl formation was promoted by UV254 exposure of chlorinated imidazole and guanidine compounds, which suggested that these groups contributed to CNCl formation. The results have implications with respect to the application of chlorine and UV for water treatment in swimming pools and other settings, such as water reuse and advanced oxidation processes.

d. Émission des matériaux

17. → A standard method for measuring benzene and formaldehyde emissions from candles in emission test chambers for human health risk assessment purposes

Author(s): Petry, T (Petry, Thomas)^[1]; Cazelle, E (Cazelle, Elodie)^[2]; Lloyd, P (Lloyd, Paul)^[3]; Mascarenhas, R (Mascarenhas, Reuben)^[4]; Stijntjes, G (Stijntjes, Gerard)^[5]

Source: ENVIRONMENTAL SCIENCE-PROCESSES & IMPACTS **Volume:** 15 **Issue:** 7 **Pages:** 1369-1382 **DOI:** 10.1039/c3em00011g **Published:** 2013

Times Cited: 0 (from Web of Science)

Cited References: 31 [[view related records](#)]  [Citation Map](#)

Abstract: Burning candles release a number of volatile or semi-volatile organic compounds (VOC; SVOC) and particulate matters into indoor air. Publicly available candle emission studies vary in protocols and factors known to have a great influence on combustion processes, making it difficult to determine potential implications of candle emissions for human health. The main objective of this investigation was to establish and standardize as far as possible a candle VOC emission testing protocol in small- to mid-scale test chambers on the basis of existing standards as well as to verify its suitability for human health risk assessment purposes. Two pilot studies were conducted to define the boundaries of permissible variations in chamber parameters without significantly impacting the quality of the candle burn. A four-centre ring trial assessed the standardised protocol. The ring trial revealed that when the laboratories were able to control the chamber parameters within the defined boundaries, reproducible formaldehyde and benzene emissions, considered as VOC markers, are determined. It was therefore concluded that the protocol developed in this investigation is suitable for generating candle VOC emission data for human health risk assessment purposes.

18. → Emission characteristics of air pollutants from incense and candle burning in indoor atmospheres

Author(s): Manoukian, A (Manoukian, A.)¹; Quivet, E (Quivet, E.)¹; Temime-Roussel, B (Temime-Roussel, B.)¹; Nicolas, M (Nicolas, M.)²; Maupetit, F (Maupetit, F.)²; Wortham, H (Wortham, H.)¹

Source: ENVIRONMENTAL SCIENCE AND POLLUTION RESEARCH **Volume:** 20 **Issue:** 7 **Pages:** 4659-4670 **DOI:** 10.1007/s11356-012-1394-y **Published:** JUL 2013

Abstract: Volatile organic compounds (VOCs) and particles emitted by incense sticks and candles combustion in an experimental room have been monitored on-line and continuously with a high time resolution using a state-of-the-art high sensitivity-proton transfer reaction-mass spectrometer (HS-PTR-MS) and a condensation particle counter (CPC), respectively. The VOC concentration-time profiles, i.e., an increase up to a maximum concentration immediately after the burning period followed by a decrease which returns to the initial concentration levels, were strongly influenced by the ventilation and surface interactions. The obtained kinetic data set allows establishing a qualitative correlation between the elimination rate constants of VOCs and their physicochemical properties such as vapor pressure and molecular weight. The emission of particles increased dramatically during the combustion, up to $9.1(\pm 0.2) \times 10^4$ and $22.0(\pm 0.2) \times 10^4$ part cm^{-3} for incenses and candles, respectively. The performed kinetic measurements highlight the temporal evolution of the exposure level and reveal the importance of ventilation and deposition to remove the particles in a few hours in indoor environments.

19. Test Procedure to Determine Material Specific VOC Emission Rates and Prediction Model of VOC-levels in Controlled Production Environments

Author(s): Keller, M (Keller, Markus)¹; Gommel, U (Gommel, Udo)¹; Verl, A (Verl, Alexander)¹

Editor(s): DelRosso, R; Pierucci, S; Klemes, JJ

Source: NOSE 2012: 3RD INTERNATIONAL CONFERENCE ON ENVIRONMENTAL ODOUR MONITORING AND CONTROL **Book Series:** Chemical Engineering Transactions **Volume:** 30 **Pages:** 301-306 **DOI:** 10.3303/CET1230051 **Published:** 2012

Conference: 3rd Biannual International Conference on Environmental Odour Monitoring and Control (NOSE)

Location: Palermo, ITALY **Date:** SEP 23-26, 2012

Sponsor(s): Italian Assoc Chemical Engrn (AIDIC)

Abstract: Volatile organic compounds (VOC) are an increasing concern in contamination-sensitive manufacturing sites. For the assessment and classification of VOC emissions from building products, a standardized fast screening procedure for classifying materials regarding VOC outgassing is developed to permit specific reduction of indoor airborne molecular contamination. It describes sample preparation and storage prior sampling followed by micro-chamber sampling and analysis via thermodesorption coupled with gas chromatography and mass spectrometry (TD-GC/MS). Knowing the active surface area, sampling time and emitted VOC mass measured, the material specific surface emission rate SERa and classification number can be determined. The standardized method allows a faster material screening compared to existing large chamber measurement methods. Material screening results are entered into the database www.ipa-csm.com to allow the tested products to be directly compared with one another. Therefore, a material selection already in the planning phase of a controlled environment becomes possible. Based on SERa values, an experimental proven simulation model enables the calculation of the expected ISO-AMC-class of the controlled environment to be constructed according to ISO 14644-8.

20. Formaldehyde Emissions from Ventilation Filters Under Different Relative Humidity Conditions

Author(s): Sidheswaran, M (Sidheswaran, Meera)^[1,1]; Chen, WH (Chen, Wenhao)^[2,1]; Chang, A (Chang, Agatha)^[2,3,1]; Miller, R (Miller, Robert)^[2,1]; Cohn, S (Cohn, Sebastian)^[1,1]; Sullivan, D (Sullivan, Douglas)^[1,1]; Fisk, WJ (Fisk, William J.)^[1,1]; Kumagai, K (Kumagai, Kazukiyo)^[1,2,1]; Destailats, H (Destailats, Hugo)^[1,1]

Source: ENVIRONMENTAL SCIENCE & TECHNOLOGY **Volume:** 47 **Issue:** 10 **Pages:** 5336-5343 **DOI:** 10.1021/es400290p **Published:** MAY 21 2013

Times Cited: 0 (from Web of Science)

Cited References: 28 [[view related records](#)]  [Citation Map](#)

Abstract: Formaldehyde emissions from fiberglass and polyester filters used in building heating, ventilation, and air conditioning (HVAC) systems were measured in bench-scale tests using 10 and 17 cm(2) coupons over 24 to 720 h periods. Experiments were performed at room temperature and four different relative humidity settings (20, 50, 65, and 80% RH). Two different air flow velocities across the filters were explored: 0.013 and 0.5 m/s. Fiberglass filters emitted between 20 and 1000 times more formaldehyde than polyester filters under similar RH and airflow conditions. Emissions increased markedly with increasing humidity, up to 10 mg/h-m(2) at 80% RH. Formaldehyde emissions from fiberglass filters coated with tackifiers (impaction oils) were lower than those from uncoated fiberglass media, suggesting that hydrolysis of other polymeric constituents of the filter matrix, such as adhesives or binders was likely the main formaldehyde source. These laboratory results were further validated by performing a small field study in an unoccupied office. At 80% RH, indoor formaldehyde concentrations increased by 48-64%, from 9-12 $\mu\text{g}/\text{m}^3$ to 12-20 $\mu\text{g}/\text{m}^3$, when synthetic filters were replaced with fiberglass filtration media in the HVAC units. Better understanding of the reaction mechanisms and assessing their overall contributions to indoor formaldehyde levels will allow for efficient control of this pollution source.

1.3 Particules et fibres

21. Real-time particle monitor calibration factors and PM2.5 emission factors for multiple indoor sources

Author(s): Dacunto, PJ (Dacunto, Philip J.)^[1,1]; Cheng, KC (Cheng, Kai-Chung)^[1,2,1]; Acevedo-Bolton, V (Acevedo-Bolton, Viviana)^[1,1]; Jiang, RT (Jiang, Ruo-Ting)^[1,1]; Klepeis, NE (Klepeis, Neil E.)^[1,3,1]; Repace, JL (Repace, James L.)^[1,4,1]; Ott, WR (Ott, Wayne R.)^[1,1]; Hildemann, LM (Hildemann, Lynn M.)^[1,1]

Source: ENVIRONMENTAL SCIENCE-PROCESSES & IMPACTS **Volume:** 15 **Issue:** 8 **Pages:** 1511-1519 **DOI:** 10.1039/c3em00209h **Published:** 2013

Abstract: Indoor sources can greatly contribute to personal exposure to particulate matter less than 2.5 μm in diameter (PM2.5). To accurately assess PM2.5 mass emission factors and concentrations, real-time particle monitors must be calibrated for individual sources. Sixty-six experiments were conducted with a common, real-time laser photometer (TSI SidePak (TM) Model AM510 Personal Aerosol Monitor) and a filter-based PM2.5 gravimetric sampler to quantify the monitor calibration factors (CFs), and to estimate emission factors for common indoor sources including cigarettes, incense, cooking, candles, and fireplaces. Calibration factors for these indoor sources were all significantly less than the factory-set CF of 1.0, ranging from 0.32 (cigarette smoke) to 0.70 (hamburger). Stick incense had a CF of 0.35, while fireplace emissions ranged from 0.44-0.47. Cooking source CFs ranged from 0.41 (fried bacon) to 0.65-0.70 (fried pork chops, salmon, and hamburger). The CFs of combined sources (e. g., cooking and cigarette emissions mixed) were linear combinations of the CFs of the component sources. The highest PM2.5 emission factors per time period were from burned foods and fireplaces (15-16 mg min^{-1}), and the lowest from cooking foods such as pizza and ground beef (0.1-0.2 mg min^{-1}).

22. Size Dependence of the Ratio of Aerosol Coagulation to Deposition Rates for Indoor Aerosols

Author(s): Yu, MZ (Yu, Mingzhou)^[1,2]; Koivisto, AJ (Koivisto, Antti Joonas)^[3]; Hameri, K (Hameri, Kaarle)^[4]; Seipenbusch, M (Seipenbusch, Martin)^[1]

Source: AEROSOL SCIENCE AND TECHNOLOGY **Volume:** 47 **Issue:** 4 **Pages:** 427-434 **DOI:** 10.1080/02786826.2012.759640 **Published:** APR 1 2013

Abstract: A thorough understanding of the importance of aerosol coagulation and deposition relative to each other as modifiers of the particle size distribution plays an important role in the proper selection of conditions to estimate the deposition rate coefficient. In this work, a theoretical analysis was conducted for investigating the size-resolved ratio of coagulation to deposition for different types of size distributions using the Simpson integral method. The theoretical model was subsequently qualitatively validated by experiments in a completely mixed and ventilated aerosol chamber. Both experimental and theoretical studies show that the ratio of the rates of coagulation to deposition is strongly dependent on the total particle number concentration and the geometric mean diameter of the aerosol. A variation of the ratio of coagulation to deposition by several orders of magnitude for aerosols with differing size distributions was found. Thus the previously employed criterion for the negligence of coagulation based solely on the total particle number concentration was shown to be insufficient to accurately judge whether an aerosol is suited for the estimation of the deposition rate coefficient. Aerosols with wide size distributions are not recommended for use in the estimation of the deposition rate coefficient. The study provides a method to understand the role of coagulation and deposition for indoor aerosols. Copyright 2013 American Association for Aerosol Research

23. → Realistic indoor nano-aerosols for a human exposure facility

Author(s): Isaxon, C (Isaxon, C.)^[1]; Dierschke, K (Dierschke, K.)^[2]; Pagels, JH (Pagels, J. H.)^[1]; Wierzbicka, A (Wierzbicka, A.)^[1]; Gudmundsson, A (Gudmundsson, A.)^[1]; Londahl, J (Londahl, J.)^[1]; Hagerman, I (Hagerman, I.)^[3]; Berglund, M (Berglund, M.)^[3]; Assarsson, E (Assarsson, E.)^[2]; Andersson, UB (Andersson, U. B.)^[2]; Jonsson, BAG (Jonsson, B. A. G.)^[2]; Nojgaard, JK (Nojgaard, J. K.)^[4]; Eriksson, A (Eriksson, A.)^[1]; Nielsen, J (Nielsen, J.)^[2]; Bohgard, M (Bohgard, M.)^[1]

Source: JOURNAL OF AEROSOL SCIENCE **Volume:** 60 **Pages:** 55-66 **DOI:** 10.1016/j.jaerosci.2013.02.003 **Published:** JUN 2013

Abstract: The aim of this study was to achieve realistic levels of two different types of aerosols commonly abundant in indoor environments in an experimental chamber intended for human exposure studies and aerosol characterization. The aerosols chosen were particles from candle lights (in particle number dominated by inorganic water soluble particles) and from ozone-terpene reactions (organic particles). The aerosol generation and characterization system consisted of a controlled air tight stainless steel 22 m³ chamber, to which the generation set-ups were connected. No air could enter or leave the chamber except through a conditioning system by which temperature, relative humidity and air exchange rate could be controlled. Candle smoke aerosol was generated from ten candles burning in a 1.33 m³ glass and stainless steel chamber. The aerosol was diluted by clean air from the conditioning system before entering the chamber. Terpene vapor was generated by passing pure nitrogen through a glass bottle containing limonene oil. Ozone was generated by a spark discharge using pure O₂, and was added to the ventilation air flow downstream the inlet for terpene vapors and upstream the inlet to the chamber. Both aerosols were characterized with respect to number and mass concentrations, size distribution and chemical composition. Particle number concentration in the size range 10-650 nm could be varied from <10 cm⁻³ to more than 900,000 cm⁻³ (for candle smoke) or to more than 30,000 cm⁻³ (for particles formed in a 160 ppb terpene/40 ppb ozone mixture). Furthermore, the set-ups were evaluated by, for each source, repeating the generation at six three-hour long events. For both aerosols repeatable generations at pre-determined concentration levels, that were stable over time, could be achieved. The results show that realistic concentrations of aerosols from real-world environments could be reproduced in a well-controlled manner and that this set-up could be used both for aerosol characterization and for human exposures. (C) 2013 Elsevier Ltd. All rights reserved.

1.4 Biocontaminants

24. Indoor allergen assessment quantified by a thin-layer electrochemical cell and magnetic beads

Author(s): Kurita, R (Kurita, Ryoji)^{1,1}; Yanagisawa, H (Yanagisawa, Hiroyuki)^{1,1}; Niwa, O (Niwa, Osamu)^{1,1}

Source: BIOSENSORS & BIOELECTRONICS **Volume:** 48 **Pages:** 43-48 **DOI:** 10.1016/j.bios.2013.04.010
Published: OCT 15 2013

Abstract: We report the electrochemical determination of mite allergen in real house dust by using a thin layer electrochemical flow cell and magnetic beads. Der p1, which is an allergen from *Dermatophagoides pteronyssinus*, was immunochemically sandwiched between two dispersed monoclonal antibodies; one was modified on the surface of magnetic beads and the other was modified with alkaline phosphatase. After washing the beads, a small volume of p-aminophenol phosphate (p-APP) was added to produce p-aminophenol (p-AP). And then the p-AP concentration was measured electrochemically with a home-made electrochemical cell. The Der p1 assay was completed within 30 min and a low detection limit of 0.3 ng/mL was achieved. This is because the diffusion distance of Der p1 and the detection antibody was reduced to 22.3 μm by using dispersed magnetic beads. Only 10 min was required to complete the entire immunoreaction, and 54% of the Der p1 was confirmed to have immunoreacted in only 1 min of mixing. Furthermore, the p-APP volume could be reduced using the thin-layer electrochemical flow cell. This is advantageous in terms of concentrating p-AP, and provides a high signal-to-noise ratio measurement in a short time. We achieved a high correlation ($r=0.967$, $p < 0.001$) between our assay and a conventional enzyme-linked immunosorbent assay (ELISA) for real house dust measurements. (C) 2013 Elsevier B.V. All rights reserved.

25. Air sampling of mold spores by slit impactors: Yield comparison

Author(s): Pityn, PJ (Pityn, Peter J.)^{1,1}; Anderson, J (Anderson, James)^{1,2}

Source: JOURNAL OF ENVIRONMENTAL SCIENCE AND HEALTH PART A-TOXIC/HAZARDOUS SUBSTANCES & ENVIRONMENTAL ENGINEERING **Volume:** 48 **Issue:** 12 **Pages:** 1485-1490 **DOI:** 10.1080/10934529.2013.796817 **Published:** OCT 15 2013

Abstract: The performance of simple slit impactors for air sampling of mold contamination was compared under field conditions. Samples were collected side-by-side, outdoors in quadruplicates with Burkhard (ambient sampler) and Allergenco MK3 spore traps and with two identical Allergenco slit cassettes operated at diverse flow rates of 5 and 15 L/min, respectively. The number and types of mold spores in each sample were quantified by microscopy. Results showed all four single-stage slit impactors produced similar spore yields. Moreover, paired slit cassettes produced similar outcomes despite a three-fold difference in their sampling rate. No measurable difference in the amount or mix of mold spores per m^3 of air was detected. The implications for assessment of human exposures and interpretation of indoor/outdoor fungal burden are discussed. These findings demonstrate that slit cassettes capture most small spores, effectively and without bias, when operated at a range of flow rates including the lower flow rates used for personal sampling. Our findings indicate sampling data for mold spores correlate for different single stage impactor collection methodologies and that data quality is not deteriorated by operating conditions deviating from manufacturers' norms allowing such sampling results to be used for scientific, legal, investigative, or property insurance purposes. The same conclusion may not be applied to other particle sampling instruments and multi-stage impactors used for ambient particulate sampling, which represent an entirely different scenario. This knowledge may help facilitate comparison between scientific studies where methodological differences exist

26. Evolution of microbial aerosol behaviour in heating, ventilating and air-conditioning systems - quantification of *Staphylococcus epidermidis* and *Penicillium oxalicum* viability

Author(s): Forthomme, A (Forthomme, A.)^[1]; Andres, Y (Andres, Y.)^[1]; Joubert, A (Joubert, A.)^[1]; Simon, X (Simon, X.)^[2]; Duquenne, P (Duquenne, P.)^[2]; Bemer, D (Bemer, D.)^[2]; Le Coq, L (Le Coq, L.)^[1]

Source: ENVIRONMENTAL TECHNOLOGY **Volume:** 34 **Issue:** 8 **Pages:** 993-997 **DOI:** 10.1080/09593330.2012.728731 **Published:** APR 1 2013

Abstract: The aim of this study was to develop an experimental set-up and a methodology to uniformly contaminate several filter samples with high concentrations of cultivable bacteria and fungi. An experimental set-up allows contaminating simultaneously up to four filters for range of velocities representative of heating, ventilating and air-conditioning systems. The test aerosol was composed of a microbial consortium of one bacterium (*Staphylococcus epidermidis*) and one fungus (*Penicillium oxalicum*) and aerosol generation was performed in wet conditions. Firstly, the experimental set-up was validated in regards to homogeneity of the air flows. The bioaerosol was also characterized in terms of number and particle size distribution using two particle counters: optical particle counter Grimm (R) 1.109 (optical diameters) and TSI APS 3321 (aerodynamic diameters). Moreover, stabilities of the number of particles generated were measured. Finally, concentrations of cultivable microorganisms were measured with BioSamplers (SKC) downstream of the four filters.

27. Cat and House Dust Mite Allergen Content Is Stable in Frozen Dust over Time

Author(s): Merritt, AS (Merritt, Anne-Sophie)^[1,2]; Andersson, N (Andersson, Niklas)^[1,2]; Almqvist, C (Almqvist, Catarina)^[3,4]

Source: ENVIRONMENTAL SCIENCE & TECHNOLOGY **Volume:** 47 **Issue:** 8 **Pages:** 3796-3799 **DOI:** 10.1021/es3052153 **Published:** APR 16 2013

Abstract: Background: Dust from indoor environments consists of animal allergens, pollen, endotoxins, and other substances which may exacerbate symptoms in sensitive individuals. In prospective cohort studies, dust is often collected from indoor environments in order to assess allergen exposure and possible relationships to health outcomes. Typically, large numbers of samples are collected and kept frozen until further analysis, sometimes several years later. To date, there is insufficient knowledge about what happens to the dust and its contents during storage. Objectives: In the present study, our aim was to analyze allergen content over a 30 month period frozen dust collected from beds in homes in order to simulate a study design of exposure assessment commonly used in epidemiological studies. Methods: Thirty-seven dust samples from mattresses in homes were collected using a Duststream dust collector. Each dust sample was subdivided into six aliquots. One tube (baseline) was extracted and analyzed for cat and house dust mite (HDM) allergen content using ELISA, all other tubes were stored at -80 degrees C until further handling. Approximately every six months (6, 12, 18, and 30 months), dust from one tube was thawed, extracted and analyzed the same way. Data was log-transformed and analyzed using linear regression. Results: No trend for decreasing or increasing cat ($p = 0.606$) or HDM ($p = 0.928$) allergen levels could be observed over time. Levels of cat allergen were considerably higher in mattresses from homes with cats compared to homes without cats ($p < 0.001$). Conclusion: It is important to assess the allergen stability in dust before designing costly and labor-intensive studies of allergen exposure and health outcomes, commonly used in environmental epidemiology. Although the present study showed that cat and HDM allergens remained stable in dust stored at -80 degrees C during a 2.5 year period, analyses of other allergens or substances in frozen dust and evaluating the effect of longer storage times is desirable.

28. Feasibility of Generating Peaks of Bioaerosols for Laboratory Experiments

Author(s): Simon, X (Simon, Xavier)^{1,1}; Duquenne, P (Duquenne, Philippe)^{1,1}

Source: AEROSOL AND AIR QUALITY RESEARCH **Volume:** 13 **Issue:** 3 **Pages:** 877-886 **DOI:** 10.4209/aaqr.2012.12.0340 **Published:** JUN 2013

Abstract: Bioaerosol concentration peaks are frequently encountered in real-life atmospheres (indoor, outdoor, workplace, etc.), where they can be caused by several factors. However, evolution over time and variability of microbiological pollutant concentrations remain under-documented. The contribution of such peaks in the onset or the worsening of respiratory symptoms - in particular immuno-allergic reactions - has yet to be extensively studied. Although experimental bioaerosol generators are increasingly used, the intentional and controlled production of concentration peaks of biological agents has not yet been utilized in laboratory experiments. The main objective of this study was to show that it is possible to produce experimental bioaerosol concentration peaks with defined characteristics. Experiments were performed with a 'Liquid Sparging Aerosoliser'-type generator. With this system, peaks can be created by increasing the bubbling airflow through a film of bacterial (*Escherichia coli*) or fungal (*Penicillium brevicompactum*) liquid culture. The higher the set point value of the bubbling airflow, the greater the maximum bioaerosol concentration during the generated peak. Similarly, longer-lived peaks can be created by maintaining the increased airflow for a longer period of time. For both studied species, the relative size distribution was constant over time, regardless of modifications to the bubbling flow rate. The operator can monitor and control peak formation with this system thanks to real-time measurement of the number concentrations, targeting the appropriate particle size classes corresponding to diameters of the aerosolised microorganisms. This generator, characterized by gentle aerosolisation and a capacity to produce bioaerosol peaks, may contribute to enrich laboratory experiments for numerous applications.

29. In Situ Rapid Evaluation of Indoor Bioaerosols Using an ATP Bioluminescence Assay

Author(s): Lin, CJ (Lin, Chien-Jung)^{1,1}; Wang, YT (Wang, Yi-Tun)^{1,1}; Hsien, KJ (Hsien, Kuo-Jung)^{1,2}; Tsai, YI (Tsai, Ying I.)^{1,1}; Kung, PY (Kung, Pei-Yi)^{1,1}; Chyan, JM (Chyan, Jih-Ming)^{1,1}

Source: AEROSOL AND AIR QUALITY RESEARCH **Volume:** 13 **Issue:** 3 **Pages:** 922-931 **DOI:** 10.4209/aaqr.2013.01.0009 **Published:** JUN 2013

Abstract: An adenosine-5'-triphosphate (ATP) bioluminescence method was developed for detecting microbial activity in indoor air. This method was compared with the traditional method of collecting, culturing and counting CFUs. A comparison of the results showed that ATP bioluminescence, expressed as RLUs, was moderately correlated with the entire set of CFU counts ($r = 0.607$), and that the correlation improved to $r = 0.963$ (p value < 0.001) when CFU outliers were removed from the calculations. The ATP bioluminescence method was applied at four different sites; a hospital Chinese medicine diagnostic room, a library, a government office, and a railway station lobby. The results showed that microbial activity was far higher in the railway station lobby than at the other three sites, and this is believed to be due to the higher volume and density of people in this space. At all four sites, higher microbial activity was linked to indoor plants, garbage cans, shoe racks, and furnished waiting areas. PCA of the data showed that microbial activity in the Chinese medicine diagnostic room was closely related to room temperature and humidity, and hence lowering the latter can reduce the potential for microbial activity at this site. At all four sites, no correlation was found between microbial activity and airborne pollutants. The ATP bioluminescence method was applied for the rapid evaluation of room disinfection using chloride dioxide, and results showed that twenty minutes after spraying with 100 ppm ClO₂, microbial activity was reduced to 38.7% of its original level. ATP bioluminescence is simpler, easier to operate, and more cost-effective than the conventional microbial culture method of evaluating microbial load. The results obtained in this research confirm that the proposed ATP bioluminescence technique is capable of instantaneously detecting microbial activity in an indoor environment. Moreover, this approach can be used for on-line evaluation of room disinfection efficiency.

1.5 Ventilation

Rubrique N°3

30. Monitoring Indoor Carbon Dioxide Concentration and Effectiveness of Natural Trickle Ventilation in a Middle School in Rome

Author(s): Cornaro, C (Cornaro, Cristina)^{1,1}; Paravicini, A (Paravicini, Alessandro)^{1,2,1}; Cimini, A (Cimini, Annamaria)^{1,3,1}

Source: INDOOR AND BUILT ENVIRONMENT **Volume:** 22 **Issue:** 2 **Pages:** 445-455 **DOI:** 10.1177/1420326X11430099 **Published:** APR 2013

Abstract: An extensive CO₂ concentration monitoring activity was carried out in a middle school located in Rome. Objective of the study was to evaluate the indoor air quality in eight classrooms during class occupation and to evaluate the ventilation rates of a natural trickle ventilation system, through an interactive approach involving the pupils. The analysis was conducted in two phases: a long-term analysis that consisted of evaluating the CO₂ concentration and indoor air temperature in each classroom during the 2009/2010 scholastic year to obtain a snapshot of the indoor environment and a short-term testing carried out in 4 days in February 2010, involving the pupils in the monitoring activity. The campaign was performed during the teaching hours and students registered the air exchange events (opening and closing of windows and door) during the class hours. The correlation of the air exchange events recorded by the students with the CO₂ concentration level recorded every minute and the opening and closing control of the trickle ventilation system allowed the evaluation of the ventilation rate of the system. The interactive evaluation approach gave the conclusion that the system alone could not completely fulfil its performance requirement.

II. CONNAISSANCES DES CONCENTRATIONS ET DES EXPOSITIONS

II.1 Logement

Rubrique N°4

a. COV

31. Long-Term Trend of Indoor Volatile Organic Compounds - a 15-Year Follow-Up Considering Real Living Conditions

Author(s): Herbarth, O (Herbarth, Olf)^{1,1}; Matysik, S (Matysik, Silke)^{1,2,1}

Source: INDOOR AND BUILT ENVIRONMENT **Volume:** 22 **Issue:** 4 **Pages:** 669-677 **DOI:** 10.1177/1420326X12458298 **Published:** AUG 2013

Abstract: Indoor volatile organic compounds (VOCs) may be associated with adverse health effects. The aim of this study was to investigate whether the indoor VOCs exposure burden has undergone changes during a past 15-year period, exemplarily in a German city. The study was limited to homes with families. To avoid possible regional-specific confounder effects, this assessment was conducted for this urban centre with a sufficiently long and continuous time series (1994-2008). VOCs were determined using passive sampling over 4 weeks followed by liquid extraction and analysis with gas chromatography-mass spectrometry. All measurement periods were equally distributed over the seasons and years. A substantial reduction in the total sum of VOCs and aromatics could be demonstrated as well as a trend of decrease concentrations for alkanes. No such changes could be observed for cycloalkanes, chlorinated hydrocarbons and terpenes group. Possible reasons for the reduction of indoor VOCs exposure are most likely due to the applied regulations/guidelines for the VOCs reduction in indoor-relevant products. Problems are, however, regarding the slight increase in terpene exposure. These chemicals have been found to be associated with quite specific health effects. Therefore, future emphasis should be directed not only towards the general reduction of anthropogenically generated VOC exposures in the outdoor environment but also on the reduction of health-relevant VOCs, especially indoors.

32. Impact of building materials on indoor formaldehyde levels: Effect of ceiling tiles, mineral fiber insulation and gypsum board

Author(s): Gunschera, J (Gunschera, Jan)^{1,1}; Mentese, S (Mentese, Sibel)^{2,1}; Salthammer, T (Salthammer, Tunga)^{1,1}; Andersen, JR (Andersen, Jan Rud)^{1,3,1}

Source: BUILDING AND ENVIRONMENT **Volume:** 64 **Pages:** 138-145 **DOI:** 10.1016/j.buildenv.2013.03.001 **Published:** JUN 2013

Abstract: Materials like building products or furnishing present in climatically controlled or uncontrolled indoor environments influence the indoor air quality (IAQ) significantly. In this study, the contribution of formaldehyde emissions from building materials and influences of adsorption/desorption behavior to indoor air pollution is investigated in a custom-made test house environment, located in a climate-controlled 48 m³ stainless steel chamber. The complete test house study comprised three experimental cycles applying different types of ceiling tiles as target building materials. In each cycle one type of ceiling tile was used, while the housing construction and fittings were left unchanged. One cycle was divided into three steps to differentiate the contribution of each material to the overall IAQ: after the background monitoring of the empty housing frame (Step I), ceiling tiles were installed in the house and the air quality was monitored for one week (Step II). Finally, furniture and carpet were introduced into the house and the air was again monitored for one week (Step III). Additionally, gypsum boards and ceiling tiles were characterized by determination of their emission, diffusion and adsorption/desorption rates with regard to formaldehyde. It is the most important finding of this study that the resulting formaldehyde concentration does not simply result from additive emissions from the materials involved. In fact, it can only be explained accurately when taking into account multiple parameters. (C) 2013 Elsevier Ltd. All rights reserved.

33. Predictors of indoor BTEX concentrations in Canadian residences

Author(s): Wheeler, AJ (Wheeler, Amanda J.)^{1,1}; Wong, SL (Wong, Suzy L.)^{2,1}; Khoury, C (Khoury, Cheryl)^{1,1}; Zhu, JP (Zhu, Jiping)^{3,1}

Source: HEALTH REPORTS **Volume:** 24 **Issue:** 5 **Pages:** 11-17 **Published:** MAY 2013

Abstract:

Background

Benzene, toluene, ethylbenzene and m-, p-xylenes and o-xylene (BTEX) are a group of volatile organic compounds that originate from similar sources. Given the potentially negative health implications of BTEX exposure and their prevalence in residential indoor air, it is important to understand typical residential concentrations and identify predictors.

Data and methods

The 2009 to 2011 Canadian Health Measures Survey included an indoor air component. Questionnaires were administered, and respondents were asked to deploy an air sampler in their home for 7 consecutive days. This analysis is based on BTEX data from 5,191 respondents. Mean BTEX concentrations were examined overall, and by dwelling type and garage configuration. Stepwise regression models were used to examine potential sources of BTEX components.

Results

Means were 1.95 µg/m³ (benzene), 19.17 µg/m³ (toluene), 4.09 µg/m³ (ethylbenzene), 14.42 µg/m³ (m-, p-xylenes), and 4.16 µg/m³ (o-xylene). Significant predictors of the presence of BTEX included a garage on the property, regular smoking in the home, renovations in the past month, number of occupants, use of paint remover, and use of fragrance.

34. Impacts of contaminant storage on indoor air quality: Model development

Author(s): Sherman, MH (Sherman, Max H.)^{1,1}; Hult, EL (Hult, Erin L.)^{1,1}

Source: ATMOSPHERIC ENVIRONMENT **Volume:** 72 **Pages:** 41-49 **Published:** JUN 2013

Abstract: A first-order, lumped capacitance model is used to describe the buffering of airborne chemical species by building materials and furnishings in the indoor environment. The model is applied to describe the interaction between formaldehyde in building materials and the concentration of the species in the indoor air. Storage buffering can decrease the effect of ventilation on the indoor concentration, compared to the inverse dependence of indoor concentration on the air exchange rate that is consistent with a constant emission rate source. If the exposure time of an occupant is long relative to the timescale of depletion of the compound from the storage medium, however, the total exposure will depend inversely on the air exchange rate. This lumped capacitance model is also applied to moisture buffering in the indoor environment, which occurs over much shorter depletion timescales of the order of days. This model provides a framework to interpret the impact of storage buffering on time-varying concentrations of chemical species and resulting occupant exposure. Pseudo-steady-state behavior is validated using field measurements. Model behavior over longer times is consistent with formaldehyde and moisture concentration measurements in previous

35. Whitehead, Brown et al. - Polybrominated diphenyl ethers in residential dust: Sources of variability.

Journal/Environment International 57(58 0):11-24.

Abstract We characterized the sources of variability for polybrominated diphenyl ethers (PBDEs) in residential dust and provided guidance for investigators who plan to use residential dust to assess exposure to PBDEs. We collected repeat dust samples from 292 households in the Northern California Childhood Leukemia Study during two sampling rounds (from 2001 to 2007 and during 2010) using household vacuum cleaners and measured 22 PBDEs using high resolution gas chromatography–high resolution mass spectrometry. Median concentrations for individual PBDEs ranged from $0.1\text{--}2500\text{ ng per g of dust}$. For each of eight representative PBDEs, we used a random-effects model to apportion total variance into regional variability (0–11%), intra-regional

between-household variability (17%–50%), within-household variability over time (38%–74%), and within-sample variability (0%–23%) and we used a mixed-effects model to identify determinants of PBDE levels. Regional differences in PBDE dust levels were associated with residential characteristics that differed by region, including the presence of furniture with exposed or crumbling foam and the recent installation of carpets in the residence. Intra-regional differences between households were associated with neighborhood urban density, racial and ethnic characteristics, and to a lesser extent, income. For some PBDEs, 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. Our findings indicate that it may be feasible to use residential dust for retrospective assessment of PBDE exposures in studies of children's health (e.g., the Northern California Childhood Leukemia Study).

b. COSV

36. Trace metals, anions and polybromodiphenyl ethers in settled indoor dust and their association

Author(s): Kefeni, KK (Kefeni, Kebede K.)^{1,1}; Okonkwo, JO (Okonkwo, Jonathan O.)^{1,1}

Source: ENVIRONMENTAL SCIENCE AND POLLUTION RESEARCH **Volume:** 20 **Issue:** 7 **Pages:** 4895-4905 **DOI:** 10.1007/s11356-013-1469-4 **Published:** JUL 2013

Abstract: Contaminants in settled indoor dust are potentially health hazardous to human. Thus, identification and quantification of toxic chemicals in settled indoor dust is of great concern. In this study, the levels of major anions (Cl^-), trace metals (Cr, Mn, Fe, Co, Ni, Cu, Zn, Cd, As and Pb) and polybromodiphenyl ethers (PBDEs) in settled office and home dust were determined and correlations between the contaminants investigated. Depending on the available materials in both microenvironments, the most possible sources were identified. The results showed that the settled office dusts ($n = 6$ pooled samples from 85 offices) were more contaminated than home dusts ($n = 8$ homes). For anions, Cl^- accounted for 87 and 97 % of the total office and home dust contaminants, respectively. For trace metals, Fe, Cu, Zn and Mn, accounted for 98 % of the contaminants in both office and home dust samples. Fe exhibited the highest percentage of 76.7 and 87.3 % in office and home dust samples, respectively. For PBDEs, the mean concentrations detected in office and home dust ranged between 5.8-86.3 and 1.5-20.6 ng g⁻¹, respectively. The log-transformed correlation between the total concentrations of trace metals and major anions detected in offices and homes was positive for offices and negative for homes with a statistically significant values ($r = 0.73$, $p < 0.01$; $r = -0.22$, $p < 0.01$, respectively). The daily exposure rates determined for the most hazardous such as As, Cd, Pb and PBDEs congeners, relative to the individual concentrations reported in the literature in settled indoor dust, were found very lower. Therefore, maybe it is possible to expect less potential health risk. Investigation of formation of coordination compounds between trace metals and PBDEs congeners is possible; however, this requires further study.

37. Investigating a Novel Flame Retardant Known as V6: Measurements in Baby Products, House Dust, and Car Dust

Author(s): Fang, ML (Fang, Mingliang)^{1,1}; Webster, TF (Webster, Thomas F.)^{2,1}; Gooden, D (Gooden, David)^{3,1}; Cooper, EM (Cooper, Ellen M.)^{1,1}; McClean, MD (McClean, Michael D.)^{2,1}; Carignan, C (Carignan, Courtney)^{1,2}; Makey, C (Makey, Colleen)^{1,2}; Stapleton, HM (Stapleton, Heather M.)^{1,1}

Source: ENVIRONMENTAL SCIENCE & TECHNOLOGY **Volume:** 47 **Issue:** 9 **Pages:** 4449-4454 **DOI:** 10.1021/es400032v **Published:** MAY 7 2013

Abstract: With the phase-out of polybrominated diphenyl ether (PBDE) flame retardants, the use of new and alternate flame retardants has been increasing. 2,2-bis(chloromethyl)-propane-1,3-diyltetrakis(2-chloroethyl) bisphosphate, known as V6, is a flame retardant applied to polyurethane foam commonly found in furniture and automobile foam. However, to the authors' knowledge, no research has been conducted on V6 levels in the environment. The intention of this study was to measure the concentration of V6 in foam collected from baby products where it was recently detected and measure levels in dust samples collected from homes and automobiles in the Boston, MA area. To accomplish this, a pure V6 commercial standard was purchased from a Chinese manufacturer and

purified (>98%). An analytical method to measure V6 in dust samples using liquid chromatography tandem mass spectrometry (LC/MS-MS) was developed. Extraction was conducted using accelerated solvent extraction (ASE) and extracts were purified using an ENVI-Florisil SPE column (500 mg, 3 mL). V6 was measured in foam samples collected from baby products with a concentration ranging from 24 500 000 to 59 500 000 ng/g of foam (n = 12, average +/- sd: 46 500 000 +/- 12 000 000 ng/g; i.e., on average, 4.6% of the foam mass was V6). V6 was also detected in 19 of 20 car dust samples and 14 of 20 house dust samples analyzed. The concentration of V6 in the house dust ranged from <5 ng/g to 1110 ng/g with a median of 12.5 ng/g, and <5 ng/g to 6160 ng/g in the car dust with a median of 103.0 ng/g. Concentrations in car dust were significantly higher than in the house dust potentially indicating higher use of V6 in automobiles compared to products found in the home. Furthermore, tris (2-chloroethyl) phosphate (TCEP), a known carcinogen, was found in the V6 commercial mixture (14% by weight) as an impurity and was consistently detected with V6 in the foam samples analyzed. A significant correlation was also observed between V6 and TCEP in the dust samples suggesting that the use of V6 is a significant source of TCEP in the indoor environment.

c. BIOCONTAMINANTS

REVIEW

38. HEALTH EFFECTS OF EXPOSURE TO INDOOR FUNGI CASE STUDY - THE RESTORERS OF MURAL PAINTINGS

Author(s): Maxim, D (Maxim, Daniela)

Source: EUROPEAN JOURNAL OF SCIENCE AND THEOLOGY **Volume:** 9 **Issue:** 3 **Pages:** 149-157
Published: JUN 2013

Abstract: The majority of environmental problems in buildings are associated with the lack of maintenance, chronic neglect and building defects leading to water ingress, condensation and dampness in the building fabric. Deterioration of historical building materials such as in churches, monuments and buildings of historic and architectural interest are attributed to changes in the built environment. Fungi inhabit nearly all terrestrial environments. In this regard, the interiors of human dwellings and workspaces are no exception. They are among the most common microbiota in the interiors of buildings, including monuments. The principal agents of indoor fungal contamination in monuments are anamorphic (asexual) fungi mostly belonging to the phyla Ascomycota and Zygomycota, commonly known as 'moulds'. Management of biodeterioration and health problems in buildings is a complex issue and require a multi-disciplinary approach, which combines the skills of scientists, health specialists, restorers, etc.

This paper reviews the literature on health problems and the aim is to make the restorers conscious about the risks of the exposure to indoor fungi in monuments

39. Family and home characteristics correlate with mold in homes

Author(s): Reponen, T (Reponen, Tiina)^{1,1}; Levin, L (Levin, Linda)^{1,1}; Zheng, S (Zheng, Shu)^{1,1}; Vesper, S (Vesper, Stephen)^{2,1}; Ryan, P (Ryan, Patrick)^{1,3,1}; Grinshpun, SA (Grinshpun, Sergey A.)^{1,1}; LeMasters, G (LeMasters, Grace)^{1,1}

Source: ENVIRONMENTAL RESEARCH **Volume:** 124 **Pages:** 67-70 **DOI:** 10.1016/j.envres.2013.04.003
Published: JUL 2013

Times Cited: 0 (from Web of Science)

Cited References: 22 [[view related records](#)]  [Citation Map](#)

Abstract: Previously, we demonstrated that infants residing in homes with higher Environmental Relative Moldiness Index were at greater risk for developing asthma by age seven. The purpose of this analysis was to identify the family and home characteristics associated with higher moldiness index values in infants' homes at age one. Univariate linear regression of each characteristic determined that family factors associated with moldiness index were race and income. Home characteristics associated with the moldiness index values were: air conditioning, carpet, age of the

home, season of home assessment, and house dust mite allergen. Parental history of asthma, use of dehumidifier, visible mold, dog and cat allergen levels were not associated with moldiness index. Results of multiple linear regression showed that older homes had 2.9 units higher moldiness index (95% confidence interval [CI]=0.4, 5.4), whereas homes with central air conditioning had 2.5 units lower moldiness index (95% CI=-4.7, -0.4). In addition, higher dust mite allergen levels and carpeting were positively and negatively associated with higher moldiness index, respectively. Because older homes and lack of air conditioning were also correlated with race and lower income, whereas carpeting was associated with newer homes, the multivariate analyses suggests that lower overall socioeconomic position is associated with higher moldiness index values. This may lead to increased asthma risk in homes inhabited by susceptible, vulnerable population subgroups. Further, age of the home was a surrogate of income, race and carpeting in our population; thus the use of these factors should carefully be evaluated in future studies. (c) 2013 Elsevier Inc. All rights reserved.

→ Reponen, article n°1 analysé dans bulletin précédent

40. Are cats and dogs the major source of endotoxin in homes?

Author(s): Ownby, DR (Ownby, D. R.)¹; Peterson, EL (Peterson, E. L.)²; Wegienka, G (Wegienka, G.)²; Woodcroft, KJ (Woodcroft, K. J.)²; Nicholas, C (Nicholas, C.)²; Zoratti, E (Zoratti, E.)³; Johnson, CC (Johnson, C. C.)²

Source: INDOOR AIR **Volume:** 23 **Issue:** 3 **Pages:** 219-226 **DOI:** 10.1111/ina.12016 **Published:** JUN 2013

Abstract: Previous studies have suggested that exposure to cats and dogs during early childhood reduces the risk of allergic disease, possibly by increasing home endotoxin exposure. This study asked the question of whether cats and dogs are the dominant influence on dust endotoxin concentrations in homes after considering other variables reportedly associated with endotoxin. The presence of cats or dogs in homes, household and home characteristics, and dust endotoxin concentrations from 5 locations were assessed in 966 urban and suburban homes. Whether considered together as pets or as cats and dogs separately, the presence of cats and dogs significantly contributed to living room and bedroom floor endotoxin concentrations, but not to bed endotoxin concentrations. However, the two variables consistently related to endotoxin in all home sites were the home occupant density (occupants/room) and cleanliness of the home. Our data suggest that reducing occupant density and improving home cleanliness would reduce home endotoxin concentrations more than removing pet cats or dogs from the home.

d. PARTICULES

REVIEW

41. Emissions and indoor concentrations of particulate matter and its specific chemical components from cooking: A review

Author(s): Abdullahi, KL (Abdullahi, Karimatu L.)¹; Delgado-Saborit, JM (Delgado-Saborit, Juana Maria)¹; Harrison, RM (Harrison, Roy M.)^{1,2}

Source: ATMOSPHERIC ENVIRONMENT **Volume:** 71 **Pages:** 260-294 **Published:** JUN 2013

Abstract: It has long been known that cooking can create high concentrations of aerosol indoors. Increasingly, it is now being reported that cooking aerosol is also a significant component of outdoor particulate matter. As yet, the health consequences are unquantified, but the presence of well known chemical carcinogens is a clear indication that cooking aerosol cannot be benign. This review is concerned with current knowledge of the mass concentrations, size distribution and chemical composition of aerosol generated from typical styles of cooking as reported in the literature. It is found that cooking can generate both appreciable masses of aerosol at least within the area where the cooking takes place, that particle sizes are largely within the respirable size range and that major groups of chemical compounds which have been used to characterise cooking aerosol include alkanes, fatty acids, dicarboxylic acids, lactones, polycyclic aromatic hydrocarbons, alkanones and sterols. Measured data, cooking emission profiles and source apportionment methods are briefly reviewed. (C) 2013 Elsevier Ltd. All rights reserved.

42. Experimental Investigation of Indoor Air Pollutants in Residential Buildings

Author(s): Tan, CCL (Tan, Caren C. L.)^[11]; Finney, KN (Finney, Karen N.)^[11]; Chen, Q (Chen, Qun)^[11]; Russell, NV (Russell, Nigel V.)^[11]; Sharifi, VN (Sharifi, Vida N.)^[11]; Swithenbank, J (Swithenbank, Jim)^[11]

Source: INDOOR AND BUILT ENVIRONMENT **Volume:** 22 **Issue:** 3 **Pages:** 471-489 **DOI:** 10.1177/1420326X12441806 **Published:** JUN 2013

Abstract: Indoor air quality is affected by many factors, including energy provision/use. The main objective of this research was to investigate indoor air pollutant emissions due to energy use in residential buildings, with a specific focus on particulate matter (PM). Three environments were compared: (a) a rural house with an electric cooker; (b) a city-centre flat with a gas cooker; and (c) an urban flat on a main road, also with gas appliances. Concentrations of PM, CO, NO₂ and VOCs were measured in the kitchens and emission rates were calculated for cooking periods. Although there has been a great deal of research examining the effects of gaseous pollutants in the indoor environment, this is one of the first studies to specifically focus on PM. Most particles were small ($\leq 2.5 \mu\text{m}$) and thus respirable. The elemental analysis of the PM revealed high metal concentrations (Fe/Na/Zn), whilst their morphologies indicated these were present as salt, skin and particles of biological origin. Gaseous emissions, particularly NO₂ and CO, were more prevalent in homes with gas appliances, since these are a significant source of both pollutants.

e. Pesticides/biocides

43. Exposure to herbicides in house dust and risk of childhood acute lymphoblastic leukemia

Author(s): Metayer, C (Metayer, Catherine)^[11]; Colt, JS (Colt, Joanne S.)^[21]; Buffler, PA (Buffler, Patricia A.)^[11]; Reed, HD (Reed, Helen D.)^[31]; Selvin, S (Selvin, Steve)^[11]; Crouse, V (Crouse, Vonda)^[41]; Ward, MH (Ward, Mary H.)^[21]

Source: JOURNAL OF EXPOSURE SCIENCE AND ENVIRONMENTAL EPIDEMIOLOGY **Volume:** 23 **Issue:** 4 **Pages:** 363-370 **DOI:** 10.1038/jes.2012.115 **Published:** JUL-AUG 2013

Abstract: We examine the association between exposure to herbicides and childhood acute lymphoblastic leukemia (ALL). Dust samples were collected from homes of 269 ALL cases and 333 healthy controls (<8 years of age at diagnosis/reference date and residing in same home since diagnosis/reference date) in California, using a high-volume surface sampler or household vacuum bags. Amounts of agricultural or professional herbicides (alachlor, metolachlor, bromoxynil, bromoxynil octanoate, pebulate, butylate, prometryn, simazine, ethalfluralin, and pendimethalin) and residential herbicides (cyanazine, trifluralin, 2-methyl-4-chlorophenoxyacetic acid (MCPA), mecoprop, 2,4-dichlorophenoxyacetic acid (2,4-D), chlorthal, and dicamba) were measured. Odds ratios (OR) and 95% confidence intervals (CI) were estimated by logistic regression. Models included the herbicide of interest, age, sex, race/ethnicity, household income, year and season of dust sampling, neighborhood type, and residence type. The risk of childhood ALL was associated with dust levels of chlorthal; compared to homes with no detections, ORs for the first, second, and third tertiles were 1.49 (95% CI: 0.82-2.72), 1.49 (95% CI: 0.83-2.67), and 1.57 (95% CI: 0.90-2.73), respectively (P-value for linear trend = 0.05). The magnitude of this association appeared to be higher in the presence of alachlor. No other herbicides were identified as risk factors of childhood ALL. The data suggest that home dust levels of chlorthal, and possibly alachlor, are associated with increased risks of childhood ALL.

II.2 Transports

Rubrique N°5

44. Air concentrations of PBDEs on in-flight airplanes and assessment of flight crew inhalation exposure

Author(s): Allen, JG (Allen, Joseph G.)^{1,1}; Sumner, AL (Sumner, Ann Louise)^{1,2,1}; Nishioka, MG (Nishioka, Marcia G.)^{1,2,1}; Vallarino, J (Vallarino, Jose)^{1,1}; Turner, DJ (Turner, Douglas J.)^{1,2,1}; Saltman, HK (Saltman, Hannah K.)^{1,3,1}; Spengler, JD (Spengler, John D.)^{1,1}

Source: JOURNAL OF EXPOSURE SCIENCE AND ENVIRONMENTAL EPIDEMIOLOGY **Volume:** 23 **Issue:** 4 **Pages:** 337-342 **DOI:** 10.1038/jes.2012.62 **Published:** JUL-AUG 2013

Times Cited: 1 (from Web of Science)

Cited References: 45 [[view related records](#)]  [Citation Map](#)

Abstract: To address the knowledge gaps regarding inhalation exposure of flight crew to polybrominated diphenyl ethers (PBDEs) on airplanes, we measured PBDE concentrations in air samples collected in the cabin air at cruising altitudes and used Bayesian Decision Analysis (BDA) to evaluate the likelihood of inhalation exposure to result in the average daily dose (ADD) of a member of the flight crew to exceed EPA Reference Doses (RfDs), accounting for all other aircraft and non-aircraft exposures. A total of 59 air samples were collected from different aircraft and analyzed for four PBDE congeners-BDE 47, 99, 100 and 209 (a subset were also analyzed for BDE 183). For congeners with a published RfD, high estimates of ADD were calculated for all non-aircraft exposure pathways and non-inhalation exposure onboard aircraft; inhalation exposure limits were then derived based on the difference between the RfD and ADDs for all other exposure pathways. The 95th percentile measured concentrations of PBDEs in aircraft air were <1% of the derived inhalation exposure limits. Likelihood probabilities of 95th percentile exposure concentrations >1% of the defined exposure limit were zero for all congeners with published RfDs.

45. Furry pet allergens, fungal DNA and microbial volatile organic compounds (MVOCs) in the commercial aircraft cabin environment

Author(s): Fu, X (Fu, Xi)^{1,2,1}; Lindgren, T (Lindgren, Torsten)^{1,2,1}; Guo, MR (Guo, Moran)^{1,2,1}; Cai, GH (Cai, Gui-Hong)^{1,2,1}; Lundgren, H (Lundgren, Hakan)^{1,3,1}; Norback, D (Norback, Dan)^{1,2,1}

Source: ENVIRONMENTAL SCIENCE-PROCESSES & IMPACTS **Volume:** 15 **Issue:** 6 **Pages:** 1228-1234 **DOI:** 10.1039/c3em30928b **Published:** 2013

Times Cited: 0 (from Web of Science)

Cited References: 42 [[view related records](#)]  [Citation Map](#)

Abstract: There has been concern about the cabin environment in commercial aircraft. We measured cat, dog and horse allergens and fungal DNA in cabin dust and microbial volatile organic compounds (MVOCs) in cabin air. Samples were collected from two European airline companies, one with cabins having textile seats (TSC) and the other with cabins having leather seats (LSC), 9 airplanes from each company. Dust was vacuumed from seats and floors in the flight deck and different parts of the cabin. Cat (Fel d1), dog (Can f1) and horse allergens (Equ cx) were analyzed by ELISA. Five sequences of fungal DNA were analyzed by quantitative PCR. MVOCs were sampled on charcoal tubes in 42 TSC flights, and 17 compounds were analyzed by gas chromatography mass spectrometry (GC-MS) with selective ion monitoring (SIM). MVOC levels were compared with levels in homes from Nordic countries. The weight of dust was 1.8 times larger in TSC cabins as compared to LSC cabins ($p < 0.001$). In cabins with textile seats, the geometric mean (GM) concentrations of Fel d1, Can f1 and Equ cx were 5359 ng g⁻¹, 6067 ng g⁻¹, and 13 703 ng g⁻¹ (GM) respectively. Levels of Fel d1, Can f1 and Equ cx were 50 times, 27 times and 75 times higher respectively, in TSC cabins as compared to LSC cabins ($p < 0.001$). GM levels of *Aspergillus/Penicillium* DNA, *Aspergillus versicolor* DNA, *Stachybotrys chartarum* DNA and *Streptomyces* DNA were all higher in TSC as compared to LSC ($p < 0.05$). The sum of MVOCs in cabin air (excluding butanols) was 3192 ng m⁻³ (GM), 3.7 times higher than in homes ($p < 0.001$) and 2-methyl-1-butanol and 3-methyl-1-butanol concentrations were 15-17 times higher as compared to homes ($p < 0.001$). Concentrations of isobutanol, 1-butanol,

dimethyldisulfide, 2-hexanone, 2-heptanone, 3-octanone, isobutyl acetate and ethyl-2-methylbutyrate were lower in cabin air as compared to homes ($p < 0.05$). In conclusion, textile seats are much more contaminated by pet allergens and fungal DNA than leather seats. The use of seats with smooth surfaces should be encouraged. The MVOC levels differed between cabin air and homes.

II.3 Bureaux

Rubrique N°6

46. Watkins, McClean et al. - Associations between PBDEs in office air, dust, and surface wipes. *Journal/Environment International* 59(0):124-132.

Abstract 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.

47. Mechanisms influencing the BFR distribution patterns in office dust and implications for estimating human exposure

Author(s): Cao, ZG (Cao, Zhiguo)^[1]; Yu, G (Yu, Gang)^[1]; Chen, YS (Chen, Yongshan)^[1]; Liu, C (Liu, Cong)^[2]; Liu, K (Liu, Kai)^[1]; Zhang, TT (Zhang, Tingting)^[1]; Wang, B (Wang, Bin)^[1]; Deng, SB (Deng, Shubo)^[1]; Huang, J (Huang, Jun)^[1]

Source: JOURNAL OF HAZARDOUS MATERIALS **Volume:** 252 **Pages:** 11-18 **DOI:** 10.1016/j.jhazmat.2013.02.043 **Published:** MAY 15 2013

Abstract: The availability of indoor dust for human exposure by hand adhesion depends on size of dust particle. This paper investigates the distribution patterns of brominated flame retardants (BFRs) with particle size in indoor dust. A mixed sample of office dust was obtained from twenty eight high-level offices at Haidian District, Beijing, China. The composite dust (<2 mm) was classified into thirteen size fractions (F1-F13: 2000-900-500-400-300-200-100-75-50 μm , 39.58 +/- 33.56 μm , 27.93 +/- 23.79 μm , 20.15 +/- 17.92 μm , 11.38 +/- 15.01 μm and 5.64 +/- 6.78 μm), by which 18BFRs contents were analyzed. Dust adhered to floc (FD) was also sampled for a separate analysis and was found to contain extremely high level of BFR concentration. The BFR level determined from all fractions of the sampled office dust ranged from ND (not detected) (F1, BDE28, 66) to 5455.4 (FD, BDE209)ng g(-1), in which BDE 209 and BTBPE (1,2-bis (2,4,6-tribromphenoxy) ethane) were found to be the most abundant BFR residue. The influencing factors of BFR distribution patterns in office dust were deduced to be specific surface area, organic content of particles, and origin process (fragmentation and absorption) of BFRs. Selection of dust fraction was demonstrated to be influential on both BFR analytical results and human exposure estimation. (c) 2013 Elsevier B.V. All rights reserved.

48. Indoor aldehydes concentration and emission rate of formaldehyde in libraries and private reading rooms

Author(s): Kim, J (Kim, Jeonghoon)[1,2] ; Kim, S (Kim, Seojin)[1,2] ; Lee, K (Lee, Kiyong)[1,2] ; Yoon, D (Yoon, Dongwon)[3] ; Lee, J (Lee, Jiryang)[4] ; Ju, D (Ju, DaeYoung)[5]

Source: ATMOSPHERIC ENVIRONMENT Volume: 71 Pages: 1-6 Published: JUN 2013

Abstract: Aldehydes are of particularly interest due to their potential adverse impact on human health. Formaldehyde is one of the most abundant indoor pollutants. To improve indoor air quality, identifying and removing the major emission sources of formaldehyde would be desirable. The purposes of this study were to determine aldehyde concentrations in libraries and reading rooms and to identify emission sources of formaldehyde in private reading rooms. Indoor aldehyde concentrations were quantified at 66 facilities, including public libraries, children's libraries, public reading rooms, and private reading rooms, in the Seoul metropolitan area. Emission fluxes of formaldehyde from the surfaces of desks, chairs, floors, walls, and ceilings in 19 private reading rooms were measured using a passive emission colorimetric sensor. Indoor aldehyde (formaldehyde, acetaldehyde, propionaldehyde, benzaldehyde, and hexaldehyde) levels were significantly higher than outdoor levels. Indoor formaldehyde geometric mean concentrations in private reading rooms (1193 $\mu\text{g m}^{-3}$) were significantly higher than in public libraries (29.2 $\mu\text{g m}^{-3}$), children's libraries (29.3 $\mu\text{g m}^{-3}$), and public reading rooms (40.8 $\mu\text{g m}^{-3}$). Indoor formaldehyde levels were associated with relative humidity. In private reading rooms, the emission rates from desks (255.5 +/- 214.8 $\mu\text{g h}^{-1}$) and walls (231.7 +/- 192.3 $\mu\text{g h}^{-1}$) were significantly higher than that from chairs (79.6 +/- 88.5 $\mu\text{g h}^{-1}$). Desks (31%) and walls (29%) were the major emission sources of formaldehyde in 14 facilities in which measurements exceeded the indoor standard of 100 $\mu\text{g m}^{-3}$. The age of interior materials was a significant factor for indoor formaldehyde emission flux. Controlling the emission rates of desks and walls is recommended to improve formaldehyde concentrations in private reading rooms.

49. INDOOR AIR PARTICLES IN OFFICE BUILDINGS WITH SUSPECTED INDOOR AIR PROBLEMS IN THE HELSINKI AREA

Author(s): Lappalainen, S (Lappalainen, Sanna)^{1,1} ; Salonen, H (Salonen, Heidi)^{1,1} ; Salmi, K (Salmi, Kari)^{1,1} ; Reijula, K (Reijula, Kari)^{1,1}

Source: INTERNATIONAL JOURNAL OF OCCUPATIONAL MEDICINE AND ENVIRONMENTAL HEALTH Volume: 26 Issue: 1 Pages: 155-164 DOI: 10.2478/s13382-013-0091-5 Published: 2013

Abstract: Airborne particle concentrations can be used as quality indicators of indoor environments. The previous lack of reference data has limited the use of particle measurements in office environments. The aim of this study was to describe the concentrations of airborne particles (a parts per thousand yen 0.5 μm and a parts per thousand yen 5.0 μm) in 122 Finnish office buildings with suspected indoor air problems

The database consisted of indoor air and supply air particle samples collected in 2001-2006 from the Helsinki area. The particle concentrations (a parts per thousand yen 0.5 μm and a parts per thousand yen 5.0 μm) were measured in the indoor air (528 samples from 122 office rooms) and in the supply air (384 samples from 105 office rooms) with an optical particle counter. Airborne particle concentrations a parts per thousand yen 0.5 μm were categorized according to the efficiency of supply air filtration and health survey data.

The mean concentrations in the indoor air equaled 1900 particles/l and in the supply air 1300 particles/l. The efficiency of supply air filtration decreased the fine particles counts in both the indoor and supply air. The counts of large particles, a parts per thousand yen 5.0 μm , were low in the indoor air. Airborne counts of a parts per thousand yen 0.5 μm particles (geometric mean) were statistically higher in the offices whose occupants had work-related symptoms (eye and/or upper respiratory symptoms or upper respiratory infections) than in the offices whose occupants had no such symptoms. However, the symptoms may also be linked to other indoor air problems or particle characteristics not studied in this work.

This study indicates typical airborne particle levels (a parts per thousand yen 0.5 μm and a parts per thousand yen 5.0 μm) in Finnish office buildings with suspected indoor air problems. The results can be used to evaluate the quality of indoor environment, possible indoor air problems, and the need for additional investigations.

50. Impact of Human Presence on Secondary Organic Aerosols Derived from Ozone-Initiated Chemistry in a Simulated Office Environment

Author(s): Fadeyi, MO (Fadeyi, Moshood O.)^{1,2,1}; Weschler, CJ (Weschler, Charles J.)^{1,3,4,5,1}; Tham, KW (Tham, Kwok W.)^{1,2,1}; Wu, WY (Wu, Wei Y.)^{1,2,1}; Sultan, ZM (Sultan, Zuraimi M.)^{1,6,1}

Source: ENVIRONMENTAL SCIENCE & TECHNOLOGY **Volume:** 47 **Issue:** 8 **Pages:** 3933-3941 **DOI:** 10.1021/es3050828 **Published:** APR 16 2013

Abstract: Several studies have documented reductions in indoor ozone levels that occur as a consequence of its reactions with the exposed skin, hair and clothing of human occupants. One would anticipate that consumption of ozone via such reactions would impact co-occurring products derived from ozone's reactions with various indoor pollutants. The present study examines this possibility for secondary organic aerosols (SOA) derived from ozone-initiated chemistry with limonene, a commonly occurring indoor terpene. The experiments were conducted at realistic ozone and limonene concentrations in a 240 m³ chamber configured to simulate a typical open office environment. During an experiment the chamber was either unoccupied or occupied with 18-20 workers. Ozone and particle levels were continuously monitored using a UV photometric ozone analyzer and a fast mobility particle sizer (FMPS), respectively. Under otherwise identical conditions, when workers were present in the simulated office the ozone concentrations were approximately two-thirds and the SOA mass concentrations were approximately one-half of those measured when the office was unoccupied. This was observed whether new or used filters were present in the air handling system. These results illustrate the importance of accounting for occupancy when estimating human exposure to pollutants in various indoor settings.

II.4 ERP

Rubrique N°7

a. Ecoles / université

CONFERENCES / COLLOQUES

51. A Study of Indoor Air Quality of Public Toilet in University's Building

Author(s): Asmi, A (Asmi, Ade)^{1,1}; Putra, JCP (Putra, Jouvan Chandra Pratama); Rahman, IB (Rahman, Ismail Bin Abdul)

Source: 2012 IEEE COLLOQUIUM ON HUMANITIES, SCIENCE & ENGINEERING RESEARCH (CHUSER 2012) **Published:** 2012

Conference: IEEE Colloquium on Humanities, Science and Engineering Research (CHUSER) **Location:** Kota Kinabalu, MALAYSIA **Date:** DEC 03-04, 2012

Sponsor(s): IEEE; IEEE Malaysia; IEEE Malaysia Power Elect (PEL); Ind Elect (IE); Ind Applicat (IA) Joint Chapter; IEEE Malaysia Power & Energy Chapter

Abstract: This paper presents a study of IAQ in toilets located in the Faculty of Civil and Environmental Engineering building, Universiti Tun Hussein Onn Malaysia (UTHM). This study was conducted to determine the level of gas pollutants exist in the male and female toilets. The important IAQ parameters considered in this study are SO₂, NO, and CO₂. The measurements were conducted during break hour and taken using air quality monitoring. The result indicated that SO₂ exceeded the threshold value and this could have adverse effect on inhalation such as asthmatic. Finally, the existing SO₂ was affected by mechanical ventilation mode, while the existing CO₂ was more generated in female toilet.

52. Indoor Air Quality in Primary Schools and in Homes and its Impact on Children's Health - Study Design

Author(s): [Madureira, J](#) (Madureira, Joana)^[1]; [Paciencia, I](#) (Paciencia, Ines)^[1]; [Ramos, E](#) (Ramos, Elisabete); [Barros, H](#) (Barros, Henrique); [Fernandes, ED](#) (de Oliveira Fernandes, Eduardo)^[1]

Editor(s): [Arezes, P](#); [Baptista, JS](#); [Barroso, MP](#); [Carneiro, P](#); [Cordeiro, P](#); [Costa, N](#); [Melo, R](#); [Miguel, AS](#); [Perestrelo, GP](#)

Source: SHO 2012: INTERNATIONAL SYMPOSIUM ON OCCUPATIONAL SAFETY AND HYGIENE **Pages:** 344-349 **Published:** 2012

Conference: 8th International Symposium on Occupational Safety and Hygiene (SHO) **Location:** Univ Minho, Sch Engr, Guimaraes, PORTUGAL **Date:** FEB 09-10, 2012

Abstract: Children spend most of their time indoors, basically at home and at the school. Beyond the fact that children are particularly vulnerable to indoor air pollution scientific evidence shows that exposure to poor indoor air quality can cause or contribute towards short and long-term health problems including asthma, allergic reactions and respiratory tract infections. The main objective of this study is to make a contribution towards the understanding of the effect on children's health of the exposure to indoor air in schools taking into account also the contribution of the home environment. It aims at to respond to the question: what is the health effect on children of ages 8 -10 of the indoor air quality in schools considering also the effect of the "historic" exposure to indoor air at home. To achieve that objective, a large survey on indoor air quality in schools and homes and on the health related outcomes is set up in Porto, Portugal, from November 2011 to March 2013. The target population involves 20 public primary schools, 420 houses and 1600 children's. The study includes: a) measurements on priority indoor air quality parameters: specific volatile organic compounds, formaldehyde, carbon dioxide, carbon monoxide, nitrogen dioxide, ozone, particulate matter, radon, temperature, relative humidity, ventilation rate and biological agents; b) a checklist for the physical characterization of buildings and indoor spaces and description of occupants' time daily activities; c) three health questionnaires and d) several clinical tests and biomarkers. The data gathered will allow for the undertaking of the risk assessment and risk management related to the exposure to indoor air pollution and will contribute to support public health policies and prevention strategies, good practices regarding building design, construction and management as well as maintenance and day-by-day use. This paper describes the study design involved in this survey.

53. Correlations of air humidity and carbon dioxide concentration in the kindergarten

Author(s): [Gladyszewska-Fiedoruk, K](#) (Gladyszewska-Fiedoruk, Katarzyna)

Source: ENERGY AND BUILDINGS **Volume:** 62 **Pages:** 45-50 **DOI:** 10.1016/j.enbuild.2013.02.052
Published: JUL 2013

Abstract: The education process often begins in kindergarten. Because children spend there between 5 and 10 h a day, the quality of air inside the building is of crucial importance.

Kindergartens most often use stack ventilation, which is frequently aided by airing. Exterior wall thermal insulation influences the quality of the natural ventilation system. Insulation reduces air infiltration, and thus disrupts the effectiveness of the natural ventilation system.

The research presented in this study was conducted in three kindergartens which varied in terms of their exterior wall insulation. The three considered objects were localized in eastern Europe, in the temperate zone.

Relying on the obtained measurement results, analysis of correlation between humidity and CO2 concentration could be conducted. Nearly complete correlation was observed in 61% of the measurements. This fact may constitute a solid basis for the control of natural ventilation. (c) 2013 Elsevier B.V. All rights reserved.

II.5 Autres lieux de vie / loisirs

Rubrique N°8

54. Characterization of decay and emission rates of ultrafine particles in indoor ice rink

Author(s): Kim, J (Kim, J.); Lee, K (Lee, K.)

Source: INDOOR AIR **Volume:** 23 **Issue:** 4 **Pages:** 318-324 **DOI:** 10.1111/ina.12018 **Published:** AUG 2013

Abstract: The purposes of this study were to determine indoor ultrafine particle (UFP, diameter <100 nm) levels in ice rinks and to characterize UFP decay and emission rates. All 15 public ice rinks in Seoul were investigated for UFP and carbon monoxide (CO) concentrations. Three ice rinks did not show peaks in UFP concentrations, and one ice rink used two resurfacers simultaneously. High peaks of UFP and CO concentrations were observed when the resurfacer was operated. The average air change rate in the 11 ice rinks was 0.21 +/- 0.13/h. The average decay rates of UFP number concentrations measured by the P-Trak and DiSCmini were 0.54 +/- 0.21/h and 0.85 +/- 0.34/h, respectively. The average decay rate of UFP surface area concentration was 0.33 +/- 0.15/h. The average emission rates of UFP number concentrations measured by P-Trak and DiSCmini were 1.2×10^{14} +/- 6.5×10^{13} particles/min and 3.3×10^{14} +/- 2.4×10^{14} particles/min, respectively. The average emission rate of UFP surface area concentration was 3.1×10^{11} +/- 2.0×10^{11} $\mu\text{m}^2/\text{min}$. UFP emission rate was associated with resurfacer age. DiSCmini measured higher decay and emission rates than P-Trak due to their different measuring mechanisms and size ranges

II.6 Modélisation

Rubrique N°9

55. A Framework for Modelling Non-Steady-State Concentrations of Semivolatile Organic Compounds Indoors - I: Emissions from Diffusional Sources and Sorption by Interior Surfaces

Author(s): Guo, ZS (Guo, Zhishi)

Source: INDOOR AND BUILT ENVIRONMENT **Volume:** 22 **Issue:** 4 **Pages:** 685-700 **DOI:** 10.1177/1420326X13488123 **Published:** AUG 2013

Abstract: Over the past two decades, more than 20 mass transfer models have been developed for building materials, furnishings, and consumer products as contaminant sources, sinks, and barriers. While these models have greatly improved our understanding of contaminant movements in buildings, their applications in the real world have been somewhat limited because of the incompatibility and computational complexity of the models. In this paper, a framework is proposed for modelling the dynamic concentrations of semivolatile organic compounds in indoor media. Based on a discretization method, which transfers continuous models into discrete counterparts, this framework can perform the functions of the existing mass transfer models and, at the same time, solves the model incompatibility problem and reduces the computational complexity. This framework complements and supplements the existing multimedia semivolatile organic compound models by providing more details of the distribution of semivolatile organic compounds among indoor media, helping check the validity of certain assumptions that have been used in those steady-state models, and providing more flexibility to allow evaluation of risk management options such as source removal, encapsulation, and variable ventilation rate. This framework will be described in two parts. Part I, this paper, discusses the representation of diffusional sources and sorption by interior surfaces. Interactions of semivolatile organic compounds with particulate matter will be discussed in a subsequent publication

56. Lagrangian modeling of the particle residence time in indoor environment

Author(s): Chang, TJ (Chang, Tsang-Jung)^[1,2]; Kao, HM (Kao, Hong-Ming)^[1]; Yam, RSW (Yam, Rita Sau-Wai)^[1]

Source: BUILDING AND ENVIRONMENT **Volume:** 62 **Pages:** 55-62 **DOI:** 10.1016/j.buildenv.2013.01.006
Published: APR 2013

Abstract: This study develops a new methodology to investigate the particle residence time in indoor environment with the Lagrangian modeling. So far, the particle residence time has been only developed in terms of the Eulerian-based advection-diffusion approach, which is easy to use but is only valid for the transport of fine, neutrally buoyant, non-inertial particles that exactly follow indoor airflows. However, for practical indoor air pollution problems, there exists a wide range of particle sizes. To extend the engineering application range of the particle residence time, a new Lagrangian-based approach, which adopts the kernel concentration estimation method, is herein proposed to model the particle residence time in indoor environment. This new approach can transfer Lagrangian particle trajectories into an Eulerian form of particle concentrations at a given point, and thus provide the mean particle residence time. The commonly used Eulerian-based advection-diffusion approach is also considered for numerical comparison. Two representative particle sizes of 10- μ m coarse particles and 1- μ m fine particles are input into the two approaches to investigate the effect of particle size on the mean particle residence time. The simulated results indicate that this new Lagrangian approach can give more reasonable prediction on the particle residence time than the Eulerian-based advection-diffusion approach. (C) 2013 Elsevier Ltd. All rights reserved.

II.7 Air extérieur – Air intérieur

Rubrique N°10

57. A new exposure metric for traffic-related air pollution? An analysis of determinants of hopanes in settled indoor house dust

Author(s): Sbihi, H (Sbihi, Hind)^[1]; Brook, JR (Brook, Jeffrey R.)^[2]; Allen, RW (Allen, Ryan W.)^[3]; Curran, JH (Curran, Jason H.)^[1]; Dell, S (Dell, Sharon)^[4]; Mandhane, P (Mandhane, Piush)^[5]; Scott, JA (Scott, James A.)^[6]; Sears, MR (Sears, Malcolm R.)^[7]; Subbarao, P (Subbarao, Padmaja)^[4]; Takaro, TK (Takaro, Timothy K.)^[3]; Turvey, SE (Turvey, Stuart E.)^[8,9]; Wheeler, AJ (Wheeler, Amanda J.)^[10]; Brauer, M (Brauer, Michael)^[1]

Source: ENVIRONMENTAL HEALTH **Volume:** 12 **Pages:** 48-48 **Published:** JUN 19 2013

Abstract: Background: Exposure to traffic-related air pollution (TRAP) can adversely impact health but epidemiologic studies are limited in their abilities to assess long-term exposures and incorporate variability in indoor pollutant infiltration.

Methods: In order to examine settled house dust levels of hopanes, engine lubricating oil byproducts found in vehicle exhaust, as a novel TRAP exposure measure, dust samples were collected from 171 homes in five Canadian cities and analyzed by gas chromatography-mass spectrometry. To evaluate source contributions, the relative abundance of the highest concentration hopane monomer in house dust was compared to that in outdoor air. Geographic variables related to TRAP emissions and outdoor NO₂ concentrations from city-specific TRAP land use regression (LUR) models were calculated at each georeferenced residence location and assessed as predictors of variability in dust hopanes.

Results: Hopanes relative abundance in house dust and ambient air were significantly correlated (Pearson's $r = 0.48$, $p < 0.05$), suggesting that dust hopanes likely result from traffic emissions. The proportion of variance in dust hopanes concentrations explained by LUR NO₂ was less than 10% in Vancouver, Winnipeg and Toronto while the correlations in Edmonton and Windsor explained 20 to 40% of the variance. Modeling with household factors such as air conditioning and shoe removal along with geographic predictors related to TRAP generally increased the proportion of explained variability (10-80%) in measured indoor hopanes dust levels.

Conclusions: Hopanes can consistently be detected in house dust and may be a useful tracer of TRAP exposure if determinants of their spatiotemporal variability are well-characterized, and when home-specific factors are considered

58. Indoor and outdoor particulate matter and endotoxin concentrations in an intensely agricultural county

Author(s): Pavidonis, BT (Pavidonis, Brian T.)^[1]; Anthony, TR (Anthony, T. Renee)^[1]; O'Shaughnessy, PT (O'Shaughnessy, Patrick T.)^[1]; Humann, MJ (Humann, Michael J.)^[1]; Merchant, JA (Merchant, James A.)^[1]; Moore, G (Moore, Genna)^[1]; Thorne, PS (Thorne, Peter S.)^[1]; Weisel, CP (Weisel, Clifford P.)^[2]; Sanderson, WT (Sanderson, Wayne T.)^[3]

Source: JOURNAL OF EXPOSURE SCIENCE AND ENVIRONMENTAL EPIDEMIOLOGY Volume: 23 Issue: 3 Pages: 299-305 Published: MAY-JUN 2013

Abstract: The objectives of this study were to characterize rural populations' indoor and outdoor exposure to particulate matter (PM)(10), PM2.5, and endotoxin and identify factors that influence these concentrations. Samples were collected at 197 rural households over five continuous days between 2007 and 2011. Geometric mean (GM) indoor PM10 (21.2 $\mu\text{g}/\text{m}^3$) and PM2.5 (12.2 $\mu\text{g}/\text{m}^3$) concentrations tended to be larger than outdoor PM10 (19.6 $\mu\text{g}/\text{m}^3$) and PM2.5 (8.2 $\mu\text{g}/\text{m}^3$) concentrations (PM10 $P=0.086$; PM2.5 $P<0.001$). Conversely, GM outdoor endotoxin concentrations (1.93 EU/m(-3)) were significantly larger than indoor (0.32 EU/m(3); $P<0.001$). Compared with measurements from previous urban Studies, indoor and outdoor concentrations of PM10 and PM2.5 in the study area tended to be smaller, whereas ambient endotoxin concentrations measured outside rural households were 3-10 times larger. Contrary to our initial hypothesis, seasonality did not have a significant effect on mean ambient PM10 concentrations; however, endotoxin concentrations in the autumn were almost seven times larger than winter. Excluding home cleanliness, the majority of agricultural and housing characteristics evaluated were found to be poorly associated with indoor and outdoor particulate and endotoxin concentrations. Journal of Exposure Science and Environmental Epidemiology (2013) 23,299-305; doi:10.1038/jes.2012.123; published online 16 January 2013

III. RISQUE ET IMPACT SUR LA SANTE

III.1 Toxicologie

59. Role of Transient Receptor Potential Ion Channels and Evoked Levels of Neuropeptides in a Formaldehyde-Induced Model of Asthma in Balb/c Mice

Author(s): Wu, Y (Wu, Yang)^{1,2,1}; You, HH (You, Huihui)^{1,1}; Ma, P (Ma, Ping)^{1,3,1}; Li, L (Li, Li)^{1,1}; Yuan, Y (Yuan, Ye)^{1,1}; Li, JQ (Li, Jinguan)^{1,1}; Ye, X (Ye, Xin)^{1,1}; Liu, XD (Liu, Xudong)^{1,1}; Yao, HC (Yao, Hanchao)^{1,1}; Chen, RC (Chen, Ruchong)^{1,2,1}; Lai, KF (Lai, Kefang); Yang, X (Yang, Xu)^{1,1}

Source: PLOS ONE **Volume:** 8 **Issue:** 5 **Article Number:** e62827 **DOI:** 10.1371/journal.pone.0062827
Published: MAY 9 2013

Abstract: Objective: Asthma is a complex pulmonary inflammatory disease characterized by the hyper-responsiveness, remodeling and inflammation of airways. Formaldehyde is a common indoor air pollutant that can cause asthma in people experiencing long-term exposure. The irritant effect and adjuvant effect are the two possible pathways of formaldehyde promoted asthma.

Methodology/Principal Findings: To explore the neural mechanisms and adjuvant effect of formaldehyde, 48 Balb/c mice in six experimental groups were exposed to (a) vehicle control; (b) ovalbumin; (c) formaldehyde (3.0 mg/m(3)); (d) ovalbumin+formaldehyde (3.0 mg/m(3)); (e) ovalbumin+formaldehyde (3.0 mg/m(3))+HC-030031 (transient receptor potential ankyrin 1 antagonist); (f) ovalbumin+formaldehyde (3.0 mg/m(3))+capsazepine (transient receptor potential vanilloid 1 antagonist). Experiments were conducted after 4 weeks of combined exposure and 1-week challenge with aerosolized ovalbumin. Airway hyper-responsiveness, pulmonary tissue damage, eosinophil infiltration, and increased levels of interleukin-4, interleukin-6, interleukin-1 beta, immunoglobulin E, substance P and calcitonin gene-related peptide in lung tissues were found in the ovalbumin+formaldehyde (3.0 mg/m(3)) group compared with the values seen in ovalbumin -only immunized mice. Except for interleukin-1 beta levels, other changes in the levels of biomarker could be inhibited by HC-030031 and capsazepine.

Conclusions/Significance: Formaldehyde might be a key risk factor for the rise in asthma cases. Transient receptor potential ion channels and neuropeptides have important roles in formaldehyde promoted-asthma.

60. Immunotoxicity of perfluorinated alkylates: calculation of benchmark doses based on serum concentrations in children

Author(s): Grandjean, P (Grandjean, Philippe)^{1,2,1}; Budtz-Jorgensen, E (Budtz-Jorgensen, Esben)^{1,3,1}

Source: ENVIRONMENTAL HEALTH **Volume:** 12 **Pages:** 35-35 **Published:** APR 19 2013

Abstract: Background: Immune suppression may be a critical effect associated with exposure to perfluorinated compounds (PFCs), as indicated by recent data on vaccine antibody responses in children. Therefore, this information may be crucial when deciding on exposure limits.

Methods: Results obtained from follow-up of a Faroese birth cohort were used. Serum-PFC concentrations were measured at age 5 years, and serum antibody concentrations against tetanus and diphtheria toxoids were obtained at age 7 years. Benchmark dose results were calculated in terms of serum concentrations for 431 children with complete data using linear and logarithmic curves, and sensitivity analyses were included to explore the impact of the low-dose curve shape.

Results: Under different linear assumptions regarding dose-dependence of the effects, benchmark dose levels were about 1.3 ng/mL serum for perfluorooctane sulfonic acid and 0.3 ng/mL serum for perfluorooctanoic acid at a benchmark response of 5%. These results are below average serum concentrations reported in recent population studies. Even lower results were obtained using logarithmic dose-response curves. Assumption of no effect below the lowest observed dose resulted in

higher benchmark dose results, as did a benchmark response of 10%

Conclusions: The benchmark dose results obtained are in accordance with recent data on toxicity in experimental models. When the results are converted to approximate exposure limits for drinking water, current limits appear to be several hundred fold too high. Current drinking water limits therefore need to be reconsidered.

61. Analysis of mRNA expression profiles highlights alterations in modulation of the DNA damage-related genes under butanal exposure in A549 human alveolar epithelial cells

Author(s): Lee, HS (Lee, Hyo-Sun)^{1,2,1}; Song, MK (Song, Mi-Kyung)^{1,1}; Choi, HS (Choi, Han-Seam)^{1,2,1}; Shin, CY (Shin, Chan-Young)^{1,1}; Lee, EI (Lee, Eun-Il)^{1,2,1}; Ryu, JC (Ryu, Jae-Chun)^{1,1}

Source: MOLECULAR & CELLULAR TOXICOLOGY **Volume:** 9 **Issue:** 1 **Pages:** 85-94 **DOI:** 10.1007/s13273-013-0012-5 **Published:** MAR 31 2013

Abstract: Butanal is a lower-molecular-weight saturated aliphatic aldehyde (LSAA) that is known as one of the important causes of indoor pollution. Although a few studies have been reported, the toxicity of butanal and its underlying mechanisms remain unclear. This study focused on toxicity of butanal with microarray analysis relationships of gene expression patterns between vehicle control and two different concentrations of butanal-treated groups. For a comprehensive examination of butanal effects on gene expression, we exposed human alveolar epithelial (A549) cells to IC5 and IC20 for 48 h and compared the gene expression of treated cells with that of vehicle controls using a human oligonucleotide chip. We identified genes that were changed by more than 1.5-fold through gene expression profile analysis. Transcriptomic profiling indicated different gene expression patterns in vehicle control and butanal-exposed groups and showed that the butanal-exposure group had a higher sensitivity to gene alteration than the control group. Through gene expression profile cluster analysis, we identified 2,998 (1,379 up- and 1,619 down-regulated) in the butanal IC5 groups and 3,200 genes (1,369 up- and 1,831 down-regulated) in the butanal IC20 groups, with 2,710 (1,281 up- and 1,429 down-regulated) specific genes in common. Through Gene Ontology (GO) analysis with these commonly expressed genes reported the several key biological processes which are known as related to DNA damage responses such as "regulation of apoptosis", "regulation of cell proliferation", "immune response", "inflammatory response". We confirmed the functional changes using a cellular assay.

Overall, butanal responses are primarily indicative for genotoxicity. This toxicity mechanism is linked to respiratory diseases such as cancer and chronic obstructive pulmonary disease (COPD). The present findings could be important in providing further understanding of the role of aldehydes in the onset of pulmonary diseases.

III.2 Expologie

Rubrique N°11

62. Daily time activity patterns in French homes: Baseline data for the assessment of indoor exposure

Author(s): Gregoire, A (Gregoire, Anthony)^{1,1}; Mandin, C (Mandin, Corinne)^{1,1}; Ramalho, O (Ramalho, Olivier)¹; Kirchner, S (Kirchner, Severine)^{1,1}

Source: ENVIRONNEMENT RISQUES & SANTE **Volume:** 12 **Issue:** 2 **Pages:** 129-138 **DOI:** 10.1684/ers.2013.0603 **Published:** MAR-APR 2013

Abstract: During the national survey conducted by the French Observatory of Indoor Air Quality in 2003-2005 in a representative sample of the housing stock, subjects completed daily diaries reporting for every 10-minute interval their domestic activities and the products used for them. The analysis of these diaries yields percentages of domestic activities and product use among i) individuals and ii) dwellings where at least one occupant performed the activity or used the product. Moreover, this

analysis provides for the individuals concerned, the daily frequency and cumulative duration of each activity and product use. These results are consistent with those of the time use survey conducted by the National Institute of Statistics and Economic Studies in 2009-2010, for the metropolitan population and for the activities common to both studies. The percentage of use of the products seems to be underestimated, while the individual durations of use are consistent with the data commonly used for consumer exposure assessment in Europe. These results provide exposure data specific to the French population, useful for risk assessment linked to domestic activities and residential use of consumer products.

63. Indoor environmental quality in a dynamic life cycle assessment framework for whole buildings: Focus on human health chemical impacts

Author(s): Collinge, W (Collinge, William)^[1]; Landis, AE (Landis, Amy E.)^[2]; Jones, AK (Jones, Alex K.)^[3]; Schaefer, LA (Schaefer, Laura A.)^[4]; Bilec, MM (Bilec, Melissa M.)^[1]

Abstract: A framework was developed for integrating indoor environmental quality (IEQ) into life cycle assessment (LCA). The framework includes three main impact types: 1) chemical-specific impacts directly comparable to conventional life cycle impact assessment (LCIA) human health categories, 2) non-chemical health impacts, and 3) productivity/performance impacts. The first part of the framework related to contaminant specific impacts was explored using a green university building as a case study, while the remaining categories will be the subject of future work. Results showed that including IEQ aspects in whole-building LCA revealed LCIA internal impacts in some categories comparable to external impacts. For human health respiratory effects, building-specific indoor impacts from the case study were 12% of global external impacts in conventional LCA. Building-specific indoor cancer toxicity impacts were greater than external impacts by an order of magnitude, and building-specific indoor noncancer toxicity impacts were lower than external impacts by an order of magnitude. Although internal impacts were greater than external impacts in one category cancer toxicity, the source of the contamination in the other two categories respiratory effects and noncancer toxicity was related to intake of outdoor air. The findings of this study underscore the importance of filtration or other treatment of mechanically supplied outdoor or recirculated indoor air, as well as control of pollution from indoor sources such as building materials or cleaning products. These findings may support the use of green building rating systems which include acknowledgment of the aforementioned IEQ-related features. (C) 2013 Elsevier Ltd. All rights reserved

→ lien avec article n°42 de Skaar bulletin précédent

• Biomarqueurs

64. TRIHALOMETHANES VARIATION IN URINE UNDER DIFFERENT CONDITIONS OF HUMAN EXPOSURE

Author(s): Gurzau, AE (Gurzau, Anca Elena)^[1]; Roman, CD (Roman, Cornelia Diana)^[2]; Dumitrascu, I (Dumitrascu, Irina)^[1]; Gurzau, ES (Gurzau, Eugen Stelian)^[1,2]

Source: ENVIRONMENTAL ENGINEERING AND MANAGEMENT JOURNAL **Volume:** 12 **Issue:** 2 **Pages:** 257-263 **Published:** FEB 2013

Abstract: Known as the most important byproducts of water disinfection with chlorigen chemicals, trihalomethanes (THMs) are incriminated in causing severe effects upon human health. The exposure pathways that can lead to potentially significant uptake of THMs include for adults ingestion of tap water and inhalation of THMs in vapor phase resulting from bathing, showering and washing. The purpose of this paper is the exposure assessment to THMs through ingestion, inhalation and dermal absorption in a group of people and to measure THMs in urine as biomarker of exposure for a group of volunteer subjects, under different condition of exposure. The subjects were investigated based on a questionnaire that included questions about drinking water consumption, lifestyle or other exposures to water. Along with the collection of urine samples, cold and hot tap water was taken from the subjects residences. The THMs from water and urine were measured by gas-chromatography technique. The results showed that the only THMs compound measured in urine of the subjects exposed to THMs (chloroform, bromodichloromethane and dibromochloromethane) from water was chloroform. It's identification in urine showed that the frequency and duration of exposure could be

more important than the concentration of the xenobiotic in water. The route of exposure having a decisive contribution to the daily intake of THMs was related to ingestion and secondary to inhalation for chloroform, or dermal absorption for bromodichloromethane. The presence of THMs in urine in different concentrations may be linked to the individual particularities of metabolism and elimination specific to each organism.

65. Organohalogenated contaminants (OHCs) in the serum and hair of pet cats and dogs: Biosentinels of indoor pollution

Author(s): Ali, N (Ali, Nadeem)¹; Malik, RN (Malik, Riffat Naseem)²; Mehdi, T (Mehdi, Toufeer)³; Egani, SAMA (Egani, Syed Ali Musstjab Akbei Shah)⁴; Javeed, A (Javeed, Aqeel)⁵; Neels, H (Neels, Hugo)¹; Covaci, A (Covaci, Adrian)¹

Source: SCIENCE OF THE TOTAL ENVIRONMENT **Volume:** 449 **Pages:** 29-36 **DOI:** 10.1016/j.scitotenv.2013.01.037 **Published:** APR 1 2013

Abstract: Concentrations of different classes of organohalogenated contaminants (OHCs) viz., polybrominated diphenyl ethers (PBDEs), novel brominated flame retardants (NBFRs), bromophenols (BPs), polychlorinated biphenyls (PCBs), organochlorine pesticides (OCPs) and their metabolites were determined in cat and dog serum and hair samples from Pakistan. The major DDT metabolite, p,p'-DDE, was the major OHC in cat serum (N=20) and ranged between 1 and 2150 ng/g lipid weight (lw). p,p'-DDE was not detected in dog serum (N=16). In contrary to other OHCs, levels of Sigma HO-PCBs were significantly higher in dog serum (median=6.0 ng/g lw) than cat serum (median=2.2 ng/g lw). Levels of most OHCs were significantly higher (p<0.05) in cat serum than those found in human serum from the same region, in particular for Sigma PBDEs (ranged 1-1280 ng/g lw). Significantly lower levels of OCPs (p<0.05) were detected in dog serum than in human serum. The concentrations of Sigma BPs were seven times higher in cat serum (median 112 ng/g lw) than dog serum (median 16 ng/g lw). To the best of our knowledge, this is the first time that NBFRs, e.g. 1,2-bis(2,4,6-tribromophenoxy)ethane (BTBPE), decabromodiphenylethane (DBDPE), and bis(2-ethylhexyl)-3,4,5,6-tetrabromophthalate (TBPH), were detected in cat and dog's hair. BTBPE had the highest detection frequency (30%) in the serum samples. In cat and dog hair samples, the order of importance of OHCs was Sigma OCPs> Sigma NBFRs> Sigma PBDEs> Sigma PCB, with the highest concentrations being around 38 ng/g hair. In paired hair-serum cat samples (N=12), Sigma DDTs (r=0.65, p=0.001) were significantly correlated, while for all other OHCs no significant correlations (p<0.001) were observed in both cats and dogs. Our findings on both hair and serum samples suggested that pet dogs do not bioaccumulate DDTs. Our results are also in agreement with the hypothesis that pets may serve as biosentinels for indoor pollution. This is the first study to document the presence of OHCs in pets from Pakistan and provides baseline information for future monitoring of OHCs in pets.

66. Household air pollution: a call for studies into biomarkers of exposure and predictors of respiratory disease

Author(s): Rylance, J (Rylance, Jamie)¹; Gordon, SB (Gordon, Stephen B.)¹; Naeher, LP (Naeher, Luke P.)²; Patel, A (Patel, Archana)³; Balmes, JR (Balmes, John R.)^{4,5}; Adetona, O (Adetona, Olorunfemi)²; Rogalsky, DK (Rogalsky, Derek K.)⁶; Martin, WJ (Martin, William J., II)⁷

Source: AMERICAN JOURNAL OF PHYSIOLOGY-LUNG CELLULAR AND MOLECULAR PHYSIOLOGY **Volume:** 304 **Issue:** 9 **Pages:** L571-L578 **DOI:** 10.1152/ajplung.00416.2012 **Published:** MAY 2013

Abstract: Household air pollution (HAP) from indoor burning of biomass or coal is a leading global cause of morbidity and mortality, mostly due to its association with acute respiratory infection in children and chronic respiratory and cardiovascular diseases in adults. Interventions that have significantly reduced exposure to HAP improve health outcomes and may reduce mortality. However, we lack robust, specific, and field-ready biomarkers to identify populations at greatest risk and to monitor the effectiveness of interventions. New scientific approaches are urgently needed to develop biomarkers of human exposure that accurately reflect exposure or effect. In this Perspective, we describe the global need for such biomarkers, the aims of biomarker development, and the state of development of tests that have the potential for rapid transition from laboratory bench to field use.

III.3 Épidémiologie

Rubrique N°12

a) COV et Semi-volatils

67. Volatile Organic Compounds and Nonspecific Conjunctivitis: A Population-Based Study

Author(s): Chang, CJ (Chang, Chia-Jen)^{1,2,1}; Yang, HH (Yang, Hsi-Hsien)^{1,3,1}; Chang, CA (Chang, Chin-An)^{1,1}; Tsai, HY (Tsai, Hsien-Yang)^{1,2,1}

Source: AEROSOL AND AIR QUALITY RESEARCH **Volume:** 13 **Issue:** 1 **Pages:** 237-242 **DOI:** 10.4209/aaqr.2012.07.0170 **Published:** FEB 2013

Abstract: Volatile Organic Compounds (VOCs) are present in both indoor and outdoor environments, and have the potential to adversely impact the health of all age groups of people that are exposed to them. This study examines and assesses the short-term effects of VOCs on nonspecific conjunctivitis. Data were collected from outpatient visits for nonspecific conjunctivitis in air-quality monitoring areas. Air quality data were collected from the Taiwan Environmental Protection Administration's air quality monitoring stations. To find the immediate and lag effects of VOCs, an area-specific, case-crossover analysis was performed and a meta-analysis with random effects was used to combine the area-specific results. The results show that toluene, m,p-xylene, o-xylene, propylene, and benzene had higher maximum incremental reactivity (MIR) values and concentrations in air than any of the other studied VOCs. These 5 VOCs also had the strongest short-term effects on outpatient visits for nonspecific conjunctivitis. The effect was strongest for toluene, and there was a 1.3% increase [95% confidence interval (CI), 0.4-2.2] for an interquartile range rise in concentration. The results showed no evident lag effects. This study, which combined and integrated VOC and ophthalmologic data to investigate associations between outpatient visits for nonspecific conjunctivitis and VOC levels, found that there was a correlation between these visits and the short-term effects of VOCs, suggesting possible causes for nonspecific conjunctivitis.

68. Socioeconomic disparities in indoor air, breath, and blood perchloroethylene level among adult and child residents of buildings with or without a dry cleaner

Author(s): Storm, JE (Storm, Jan E.)^{1,1}; Mazor, KA (Mazor, Kimberly A.)^{1,1}; Shost, SJ (Shost, Stephen J.)^{1,1}; Serle, J (Serle, Janet)^{1,4,1}; Aldous, KM (Aldous, Kenneth M.)^{1,2,1}; Blount, BC (Blount, Benjamin C.)^{1,3,1}

Source: ENVIRONMENTAL RESEARCH **Volume:** 122 **Pages:** 88-97 **DOI:** 10.1016/j.envres.2013.02.001 **Published:** APR 2013

Abstract: In many cities, dry cleaners using perchloroethylene are frequently located in multifamily residential buildings and often cause elevated indoor air levels of perchloroethylene throughout the building. To assess individual perchloroethylene exposures associated with co-located dry cleaners, we measured perchloroethylene in residential indoor air, and in blood and breath of adults and children residing in buildings with a dry cleaner as part of the New York City (NYC) Perc Project. We also measured perchloroethylene in indoor air, and in blood and breath of residents of buildings without a dry cleaner for comparison. Here, we evaluate whether an environmental disparity in perchloroethylene exposures is present. Study participants are stratified by residential building type (dry cleaner or reference) and socioeconomic characteristics (race/ethnicity and income); measures of perchloroethylene exposure are examined; and, the influence of stratified variables and other factors on perchloroethylene exposure is assessed using multivariate regression. All measures of perchloroethylene exposure for residents of buildings with a dry cleaner indicated a socioeconomic disparity. Mean indoor air perchloroethylene levels were about five times higher in minority (82.5 ug/m³) than in non-minority (16.5 ug/m³) households, and about six times higher in low-income (105.5 ug/m³) than in high income (17.8 ug/m³) households. Mean blood perchloroethylene levels in minority children (0.27 ng/mL) and adults (0.46 ng/mL) were about two and three times higher than in non-minority children (0.12 ng/mL) and adults (0.15 ng/mL), respectively. Mean blood perchloroethylene levels in low income children (0.34 ng/mL) and adults (0.62 ng/mL) were about three and four times higher than in high income children (0.11 ng/mL) and adults (0.14 ng/mL),

respectively. A less marked socioeconomic disparity was observed in perchloroethylene breath levels with minority and low income residents having slightly higher levels than non-minority and high income residents. Multivariate regression affirmed that indoor air perchloroethylene level in dry cleaner buildings was the single most important factor determining perchloroethylene in blood and breath. Neither age, gender, nor socioeconomic status significantly influenced perchloroethylene levels in breath or blood. We previously reported that increased indoor air, breath, and blood perchloroethylene levels among NYC Perc Project child participants were associated with an increased risk for slightly altered vision. Thus, the disproportionately elevated perchloroethylene exposures of minority and low-income child residents of buildings with a dry cleaner shown here constitutes an environmental exposure disparity with potential public health consequences. Among residents of buildings without a dry cleaner, we observed some small increases in perchloroethylene breath and blood levels among non-minority or high income residents compared to minority or low income residents. These differences were not attributable to differences in indoor air levels of perchloroethylene which did not differ across socioeconomic categories, but appear to be associated with more frequent exposures dry cleaned garments. (C) 2013 Elsevier Inc. All rights reserved.

b) Biocontaminants

69. A comparison of subject room dust with home vacuum dust for evaluation of dust-borne aeroallergens

Author(s): Barnes, C (Barnes, Charles)^{1,11}; Portnoy, JM (Portnoy, Jay M.)^{1,11}; Ciaccio, CE (Ciaccio, Christina E.)^{1,11}; Pacheco, F (Pacheco, Freddy)^{1,11}

Source: ANNALS OF ALLERGY ASTHMA & IMMUNOLOGY **Volume:** 110 **Issue:** 5 **Pages:** 375-379 **DOI:** 10.1016/j.anai.2013.02.010 **Published:** MAY 2013

Abstract: Background: Assessment of indoor allergen is valuable in exposure research and evaluation of allergic individuals. Collection methods range from grab vacuum samples to filtration devices located in the breathing range of an individual. For practical purposes, many research studies use analysis of collected house dust to evaluate allergen reservoirs. **Objective:** To test the hypothesis that house dust collected from the family vacuum is equivalent to house dust collected by a technician following standard protocol.

Methods: Homes from a healthy homes demonstration project (n = 41) were sampled using a specific Department of Housing and Urban Development-suggested protocol in the bedroom of the child with asthma and a simple grab procedure from the family vacuum. Samples were evaluated for the presence of 5 allergens, Bla g2, Can f1, Der f1, and Der p1 combined as total mite, Fel d1, and Mus m1. Samples were also evaluated for total antigenic protein from 4 fungal taxa, including *Alternaria*, *Aspergillus*, *Cladosporium*, and *Penicillium*. **Results:** All of the allergens and antigens tested showed good correlation between the 2 collection methods. Fungal antigens ranged up to 92,651 nanograms per gram of dust for *Aspergillus*, and allergens ranged up to 17,928 nanograms per gram of dust for Can f1. The best correlation was for *Cladosporium* (r = 0.91), and the weakest was for dust mite (r = 0.34). **Conclusion:** Allergens and antigens tested from samples collected by protocol and by grab sampling from the home vacuum were highly positively correlated. Grab samples taken from the family vacuum may be a good surrogate for evaluating home allergen exposure. (c) 2013 American College of Allergy, Asthma & Immunology. Published by Elsevier Inc. All rights reserved.

70. Endotoxin, extracellular polysaccharides, and (1-3)-glucan concentrations in dust and their determinants in four European birth cohorts: results from the HITEA project

Author(s): Casas, L (Casas, L.)^{1,2,3}; Tischer, C (Tischer, C.)⁴; Wouters, IM (Wouters, I. M.)⁵; Valkonen, M (Valkonen, M.)⁶; Gehring, U (Gehring, U.)⁵; Doekes, G (Doekes, G.)⁵; Torrent, M (Torrent, M.)⁷; Pekkanen, J (Pekkanen, J.)^{6,8}; Garcia-Esteban, R (Garcia-Esteban, R.)^{1,2,3}; Hyvarinen, A (Hyvaerinen, A.)⁶; Heinrich, J (Heinrich, J.)⁴; Sunyer, J (Sunyer, J.)^{1,2,3,9}

Source: INDOOR AIR **Volume:** 23 **Issue:** 3 **Pages:** 208-218 **DOI:** 10.1111/ina.12017 **Published:** JUN 2013

Abstract: Early-life exposure to microbial agents may play a protective role in asthma and allergies

development. Geographical differences in the prevalence of these diseases exist, but the differences in early-life indoor microbial agent levels and their determinants have been hardly studied. We aimed to describe the early-life levels of endotoxin, extracellular polysaccharides (EPS), and (1-3)-glucans in living room dust of four geographically spread European birth cohorts (LISA in Germany, PIAMA in the Netherlands, INMA in Spain, and LUKAS2 in Finland) and to assess their determinants. A total of 1572 dust samples from living rooms of participants were analyzed for endotoxin, *Penicillium/Aspergillus* EPS, and (1-3)-glucans. Information on potential determinants was obtained through questionnaires. Concentrations of endotoxin, EPS, and (1-3)-glucans were different across cohorts. Concentrations of endotoxin and EPS were respectively lower and higher in INMA than in other cohorts, while glucans were higher in LUKAS2. Season of sampling, dog ownership, dampness, and the number of people living at home were significantly associated with concentrations of at least one microbial agent, with heterogeneity of effect estimates of the determinants across cohorts. In conclusion, both early-life microbial exposure levels and exposure determinants differ across cohorts derived from diverse European countries.

c) **SBS**

Pas d'article

III.4 Populations sensibles

→ étude ISAAC phase II

71. Dampness and moulds in relation to respiratory and allergic symptoms in children: results from Phase Two of the International Study of Asthma and Allergies in Childhood (ISAAC Phase Two)

Author(s): Weinmayr, G (Weinmayr, G.)^[1]; Gehring, U (Gehring, U.)^[2]; Genuneit, J (Genuneit, J.)^[1]; Buchele, G (Buchele, G.)^[1]; Kleiner, A (Kleiner, A.)^[1]; Siebers, R (Siebers, R.)^[3]; Wickens, K (Wickens, K.)^[3]; Crane, J (Crane, J.)^[3]; Brunekreef, B (Brunekreef, B.)^[2,4]; Strachan, DP (Strachan, D. P.)^[5]

Group Author(s): ISAAC Phase Two Study Grp

Source: CLINICAL AND EXPERIMENTAL ALLERGY **Volume:** 43 **Issue:** 7 **Pages:** 762-774 **DOI:** 10.1111/cea.12107 **Published:** JUL 2013

Times Cited: 0 (from Web of Science)

Cited References: 61 [[view related records](#)] [Citation Map](#)

Abstract: Background Many studies report that damp housing conditions are associated with respiratory symptoms. Less is known about mechanisms and possible effect modifiers. Studies of dampness in relation to allergic sensitization and eczema are scarce. Objective We study the influence of damp housing conditions world-wide on symptoms and objective outcomes. Methods Cross-sectional studies of 8-12-year-old children in 20 countries used standardized methodology from Phase Two of the International Study of Asthma and Allergies in Childhood (ISAAC). Symptoms of asthma, rhinitis and eczema, plus residential exposure to dampness and moulds, were ascertained by parental questionnaires (n=46051). Skin examination, skin prick tests (n=26967) and hypertonic saline bronchial challenge (n=5713) were performed. In subsamples stratified by wheeze (n=1175), dust was sampled and analysed for house dust mite (HDM) allergens and endotoxin. Results Current exposure to dampness was more common for wheezy children (pooled odds ratio 1.58, 95% CI 1.40-1.79) and was associated with greater symptom severity among wheezers, irrespective of atopy. A significant (P<0.01) adverse effect of dampness was also seen for cough and phlegm, rhinitis and reported eczema, but not for examined eczema, nor bronchial hyperresponsiveness. HDM sensitization was more common in damp homes (OR 1.16, 1.03-1.32). HDM-allergen levels were higher in damp homes and were positively associated with HDM-sensitization, but not wheeze. Conclusion A consistent association of dampness with respiratory and other symptoms was found in both affluent and non-affluent countries, among both atopic and non-atopic children. HDM exposure and sensitization may contribute, but the link seems to be related principally to non-atopic mechanisms.

72. Norback, Zock et al. - Mould and dampness in dwelling places, and onset of asthma: the population-based cohort ECRHS.

Journal/Occupational and Environmental Medicine 70 5):325-331.

Objectives To study new onset of adult asthma in relation to dampness and moulds in dwelling places. **Methods** Totally, 7104 young adults from 13 countries who participated in the European Community Respiratory Health Survey (ECRHS I and II) who did not report respiratory symptoms or asthma at baseline were followed prospectively for 9 years. Asthma was assessed by questionnaire data on asthmatic symptoms and a positive metacholine challenge test at follow-up. Data on the current dwelling was collected at the beginning and at the end of the follow-up period by means of an interviewer-led questionnaire, and by inspection. Relative risks (RR) for new onset asthma were calculated with log-binomial models adjusted for age, sex, smoking and study centre. **Results** There was an excess of new asthma in subjects in homes with reports on water damage (RR 1.46; 95% CI 1.09 to 1.94) and indoor moulds (RR=1.30; 95% CI 1.00 to 1.68) at baseline. A dose-response effect was observed. The effect was stronger in those with multisensitisation and in those sensitised to moulds. Observed damp spots were related to new asthma (RR=1.49; 95% CI 1.00 to 2.22). The population-attributable risk was 3-10% for reported, and 3-14% for observed dampness/moulds. **Conclusions** Dampness and mould are common in dwellings, and contribute to asthma incidence in adults.

III.5 Évaluation des risques

Rubrique N°13

73. Risk assessment of non-dietary exposure to polycyclic aromatic hydrocarbons (PAHs) via house PM2.5, TSP and dust and the implications from human hair

Author(s): Wang, W (Wang, Wei)^[1,2,3]; Huang, MJ (Huang, Min-juan)^[2,3]; Chan, CY (Chan, Chuen-Yu)^[4]; Cheung, KC (Cheung, Kwai Chung)^[2,3]; Wong, MH (Wong, Ming Hung)^[1,2,3]

Source: ATMOSPHERIC ENVIRONMENT Volume: 73 Pages: 204-213 Published: JUL 2013

Abstract: To evaluate the cancer risk due to non-dietary PAHs exposure in home environment (inhalation and ingestion), exposure to fine particles (PM2.5) and polycyclic aromatic hydrocarbons (PAHs) of PM2.5, total suspended particles (TSP) and dust in homes at two urban centers of Pearl River Delta were assessed. House PM2.5 bound PAHs in Guangzhou (GZ) ranged from 10.0 to 61.9 ng m(-3) and 0.72 to 8.15 ng m(-3) in Hong Kong (HK). PAR profiles found in PM2.5, TSP and dust were different than that in hair (dominated by Nap and Phe). Pyr and Flu in house dust significantly correlated with that in hair ($r = 0.69; 0.55, p < 0.05$) but no correlation was found between PAHs in hair and PM2.5. High correlation coefficients ($r(2) = 0.97/0.95, p < 0.01$) were noted between dibenzo(a,h)anthracene (DBA) and Toxicity Equivalent Concentrations (TEQs) of dust and PM2.5. The lung cancer risks based on PM2.5 bound PAHs exposure in houses of GZ (10(-5)-10(-4)) were significantly higher than those of HK (10(-6)-10(-5)), which were also significantly higher than the cancer risks associated with house dust intake (10(-7)-10(-5)) in GZ. PAHs exposure via non-dietary route (PM2.5 and dust) was found to be 1-3 times higher than fish consumption for children and contributed to 52-76% of total PAHs intake for children and 24-50% for adults in GZ. (C) 2013 Elsevier Ltd. All rights reserved.

74. Influence of human activity patterns, particle composition, and residential air exchange rates on modeled distributions of PM_{2.5} exposure compared with central-site monitoring data

Authors: Baxter, LK; Burke, J; Lunden, M; Turpin, BJ; Rich, DQ; Thevenet-Morrison, K; Hodas, N; Ozkaynak, H

Source: JOURNAL OF EXPOSURE SCIENCE AND ENVIRONMENTAL EPIDEMIOLOGY , 23 (3):241-247; MAY-JUN 2013

Abstract: Central-site monitors do not account for factors such as outdoor-to-indoor transport and human activity patterns that influence personal exposures to ambient fine-particulate matter (PM_{2.5}). We describe and compare different ambient PM_{2.5} exposure estimation approaches that incorporate human activity patterns and time-resolved location-specific particle penetration and persistence indoors. Four approaches were used to estimate exposures to ambient PM_{2.5} for application to the New Jersey Triggering of Myocardial Infarction Study. These include: Tier 1, central-site PM_{2.5} mass; Tier 2A, the Stochastic Human Exposure and Dose Simulation (SHEDS) model using literature-based air exchange rates (AERs); Tier 2B, the Lawrence Berkeley National Laboratory (LBNL) Aerosol Penetration and Persistence (APP) and Infiltration models; and Tier 3, the SHEDS model where AERs were estimated using the LBNL Infiltration model. Mean exposure estimates from Tier 2A, 2B, and 3 exposure modeling approaches were lower than Tier 1 central-site PM_{2.5} mass. Tier 2A estimates differed by season but not across the seven monitoring areas. Tier 2B and 3 geographical patterns appeared to be driven by AERs, while seasonal patterns appeared to be due to variations in PM composition and time activity patterns. These model results demonstrate heterogeneity in exposures that are not captured by the central-site monitor. Journal of Exposure Science and Environmental Epidemiology (2013) 23, 241-247; doi:10.1038/jes.2012.118; published online 16 January 2013

IV. GESTION / DIVERS

IV.1 Systèmes de ventilation

Rubrique N°14

Pas d'article

IV.2 Analyse coût-bénéfice

Rubrique N°15

Pas d'article

IV.3 Technique

Rubrique N°16

75. Studying the fate of non-volatile organic compounds in a commercial plasma air purifier

Author(s): Schmid, S (Schmid, Stefan)^[1]; Seiler, C (Seiler, Cornelia)^[2]; Gerecke, AC (Gerecke, Andreas C.)^[2]; Hachler, H (Haechler, Herbert)^[3]; Hilbi, H (Hilbi, Hubert)^[4]; Frey, J (Frey, Joachim)^[5]; Weidmann, S (Weidmann, Simon)^[1]; Meier, L (Meier, Lukas)^[1]; Berchtold, C (Berchtold, Christian)^[1]; Zenobi, R (Zenobi, Renato)^[1]

Source: JOURNAL OF HAZARDOUS MATERIALS **Volume:** 256 **Pages:** 76-83 **DOI:** 10.1016/j.jhazmat.2013.04.021 **Published:** JUL 15 2013

Abstract: Degradation of non-volatile organic compounds-environmental toxins (methyltriclosane and phenanthrene), bovine serum albumin, as well as bioparticles (Legionella pneumophila, Bacillus subtilis, and Bacillus anthracis)-in a commercially available plasma air purifier based on a cold plasma was studied in detail, focusing on its efficiency and on the resulting degradation products. This system is capable of handling air flow velocities of up to 3.0 m s⁻¹ (3200 L min⁻¹), much higher than other plasma-based reactors described in the literature, which generally are limited to air flow rates below 10 L min⁻¹. Mass balance studies consistently indicated a reduction in concentration of the compounds/particles after passage through the plasma air purifier, 31% for phenanthrene, 17% for methyltriclosane, and 80% for bovine serum albumin. L. pneumophila did not survive passage through the plasma air purifier, and cell counts of aerosolized spores of B. subtilis and B. anthracis were reduced by 26- and 15-fold, depending on whether it was run at 10 Hz or 50 Hz, respectively. However rather than chemical degradation, deposition on the inner surfaces of the plasma air purifier occurred. Our interpretation is that putative "degradation" efficiencies were largely due to electrostatic precipitation rather than to decomposition into smaller molecules. (C) 2013 Elsevier B.V. All rights reserved.

76. Long/Short-Term Performance Test for Evaluating the Reduction of Indoor Formaldehyde Using Sorptive Building Materials

Author(s): Seo, J (Seo, Janghoo)^[1]; Ataka, Y (Ataka, Yuji)^[2]; Kato, S (Kato, Shinsuke)^[3]; Kim, JT (Kim, Jeong Tai)^[4]

Source: INDOOR AND BUILT ENVIRONMENT **Volume:** 22 **Issue:** 1 **Special Issue:** SI **Pages:** 52-60 **DOI:** 10.1177/1420326X12469551 **Published:** FEB 2013

Abstract: In this paper, a test method for evaluating the ability of sorptive building materials to reduce the concentration of formaldehyde is examined. The authors developed a new method that uses a small chamber to test the suppressive effect of sorptive building material on formaldehyde-emitting materials. Two small chambers were prepared, with the formaldehyde-emitting building material placed in one chamber and a composite building material comprised of sorptive building material

attached to the formaldehyde-emitting building material in the other. The formaldehyde emission factors of the two chambers were compared, and the equivalent ventilation rate $Q(ads)$ was calculated. The test method would enable the indoor concentration reducing performance and the suppressive performance of the sorptive building materials to be evaluated at the same time. The suppressive effects of several kinds of sorptive building materials were examined, and accordingly the validity of the test method was verified. The continuous reduction performance of indoor formaldehyde for sorptive building materials using sorption breakthrough capacity method was also evaluated

77. Removal of bacteria and odor gas by an alumina support catalyst and negative air ions

Author(s): Yun, SJ (Yun, Seong Jin)^{1,1}; Seo, Y (Seo, Youngjin)^{1,1}

Source: JOURNAL OF AEROSOL SCIENCE **Volume:** 58 **Pages:** 33-40 **DOI:** 10.1016/j.jaerosci.2012.12.006
Published: APR 2013

Abstract: Installation of high-performance filter systems in restrooms is necessary because of bacterial and odor gas contamination from feces. Presented herein is a sterilizing deodorizing filter (SDF) consisting of a negative air ion (NAI) filter and an alumina support catalyst (ASC) of copper and phosphoric acid. The *Escherichia coli* removal of the SDF was evaluated with three DC voltages (-3, -5, and -7 kV) at the space velocities of $1.6 \times 10(4)$, $2.8 \times 10(4)$, and $5.6 \times 10(4)$ h⁻¹. The performance of the SDF peaked at 99.9% at the high voltage of -7 kV and the high space velocity of $6 \times 10(4)$ h⁻¹ for bacteria removal. In addition, the average bacteria removal efficiency of the SDF was 1.2 times higher than the NAI filter alone at the space velocity of $5.6 \times 10(4)$ h⁻¹. The gas removal performance of the NAI filter remained the same regardless of the duration of the experiment, but was very low at 16.7% for ammonia and 12.7% for hydrogen sulfide. The SDF and ASC filter maintained the removal rate of 100% for the first 15 min of the experiment. However, after 300 min, the gas removal efficiencies of the former were higher than those of the latter by 28.8% and 15% for ammonia and hydrogen sulfide, respectively. The reason for this phenomenon is that the ASC improves performance by increasing contact with the NAIs as a result of gas adsorption and gas removal. (C) 2013 Elsevier Ltd. All rights reserved.

78. Sm2O3 doped-SnO2 nanoparticles, very selective and sensitive to volatile organic compounds

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Source: SENSORS AND ACTUATORS B-CHEMICAL **Volume:** 181 **Pages:** 910-918 **DOI:** 10.1016/j.snb.2013.02.101 **Published:** MAY 2013

Abstract: Sm2O3-doped SnO2 nanoparticles were prepared by a chloride solution combustion synthesis method and their gas sensing properties for detection of various VOCs, i.e. acetaldehyde, acetone, ethanol, toluene and trichloroethylene (TCE) were investigated. The samples were characterized by XRD, BET specific surface area, SEM, EDS, and photoluminescence (PL). Sm2O3-doping causes reduction in surface area, suppression of SnO2 crystal growth, and increase in degree of agglomeration ($d(BET)/d(XRD)$). According to PL spectra, concentration of oxygen vacancies increases dramatically with an increase in Sm2O3 content of the samples.

5.0 wt.% Sm2O3-doped SnO2 sample is the most sensitive sensor to acetaldehyde, ethanol and acetone and its response is about 5.5, 2.4 and 2.2 times higher than pure SnO2 for these gases, respectively. In the case of toluene and TCE, 10.0 wt.% Sm2O3-doped SnO2 sample shows the highest response and its response is about 3.0 and 3.7 times higher than that of pure SnO2 for these gases, respectively. The optimum operating temperature of Sm2O3-doped SnO2 sensors, is about 50-100 degrees C lower than that of pure SnO2 sensor. Moreover, with addition of 5.0 wt.% Sm2O3, selectivity to some VOCs at different temperatures improves considerably compared to pure SnO2. (c) 2013 Elsevier B.V. All rights reserved.

79. Inactivation of *Aspergillus niger* spores from indoor air by photocatalytic filters

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Source: APPLIED CATALYSIS B-ENVIRONMENTAL **Volume:** 134 **Pages:** 167-173 **DOI:** 10.1016/j.apcatb.2013.01.023 **Published:** MAY 2 2013

Abstract: The effects of UV-A and UV-C radiation on fungal spores were investigated before and after their germination in photocatalytic and non-photocatalytic air filters commonly used in heating, ventilating, and air conditioning (HVAC) systems.

Immediately after the coating of spores on filters, exposure to both types of UV radiation induced the appearance of an inactivation threshold for long durations of exposure probably resulting from the presence of *Aspergillus niger* spores inside the activated charcoal layer. The use of a thin photocatalytic filter without activated charcoal demonstrated a better disinfection efficiency with total inactivation of the spores, due to an optimal contact between spores and TiO₂ coating.

The effects of UV radiation were then assessed on spore germination for both types of filters. The inactivation of spores in illuminated photocatalytic filters resulted in an irreversible inhibition of the fungal germination under UV-A or UV-C radiation. In contrast, fungal spores were able to germinate in non-photocatalytic filters despite previous exposure to both types of UV radiation. The monitoring of ergosterol amounts, the major sterol of fungal membranes, corroborated these results.

Finally, UV-A or UV-C radiation exposure of filters after spore germination had a lesser disinfection efficiency than experiments whereby spores had just been applied onto the filters, due to the absence of contact between the biological pollutants and the photocatalyst coating.

Our results thus demonstrated the interest to use photocatalytic filters ensuring optimal contact between pollutants and TiO₂ coating to lead to a total inactivation of fungal spores in filters of HVAC systems. (C) 2013 Elsevier B.V. All rights reserved.

80. Filtration effectiveness of HVAC systems at near-roadway schools

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Source: INDOOR AIR **Volume:** 23 **Issue:** 3 **Pages:** 196-207 **DOI:** 10.1111/ina.12015 **Published:** JUN 2013

Abstract: Concern for the exposure of children attending schools located near busy roadways to toxic, traffic-related air pollutants has raised questions regarding the environmental benefits of advanced heating, ventilation, and air-conditioning (HVAC) filtration systems for near-road pollution. Levels of black carbon and gaseous pollutants were measured at three indoor classroom sites and at seven outdoor monitoring sites at Las Vegas schools. Initial HVAC filtration systems effected a 3166% reduction in black carbon particle concentrations inside three schools compared with ambient air concentrations. After improved filtration systems were installed, black carbon particle concentrations were reduced by 7497% inside three classrooms relative to ambient air concentrations. Average black carbon particle concentrations inside the schools with improved filtration systems were lower than typical ambient Las Vegas concentrations by 4996%. Gaseous pollutants were higher indoors than outdoors. The higher indoor concentrations most likely originated at least partially from indoor sources, which were not targeted as part of this intervention.

81. Phytoremediation of BTEX from Indoor Air by *Zamioculcas zamiifolia*

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Source: WATER AIR AND SOIL POLLUTION **Volume:** 224 **Issue:** 3 **Article Number:** 1482 **DOI:** 10.1007/s11270-013-1482-8 **Published:** MAR 2013

Abstract: *Zamioculcas zamiifolia* has the potential to reduce the concentration of benzene, toluene, ethylbenzene, and xylene (BTEX) from contaminated indoor air. It can remove all four pollutant gases. Benzene, toluene, ethylbenzene, and xylene uptake per unit area of *Z. zamiifolia* leaf were about 0.96±0.01, 0.93±0.02, 0.92±0.02, and 0.86±0.07 mmol m⁻² at 72 h of exposure, respectively. The physicochemical properties of each BTEX may affect its removal. Benzene, a smaller molecule, is taken up by plants faster than toluene, ethylbenzene, and xylene. The toxicity of BTEX on plant leaves and roots was not found. The chlorophyll fluorescence measurement (F_v/F_m) showed no significant difference between controlled and treated plants, indicating that a concentration of 20 ppm of each gas is not high enough to affect the photosynthesis of the plants. The ratio of stomata and cuticles showed that 80 % of benzene, 76 % of toluene, 75 % of ethylbenzene, and 73 % of xylene were removed by stomata pathways, while 20, 23, 25, and 26 % of them were removed by cuticles. The BTEX removal efficiency by well-watered *Z. zamiifolia* was involved with day stomata opening and night closing, while the BTEX removal efficiency by water-stressed *Z. zamiifolia* can occur both day and night at a slightly lower rate than well-watered plants.

82. Catalyzed Reactions on Mineral Plaster Materials Used for Indoor Air Purification

Author(s): Gunschera, J (Gunschera, Jan)^{1,1}; Markewitz, D (Markewitz, Doreen)^{1,1}; Koberski, U (Koberski, Ulrich)^{2,1}; Salthammer, T (Salthammer, Tunga)^{1,1}

Source: CLEAN-SOIL AIR WATER **Volume:** 41 **Issue:** 5 **Pages:** 437-446 **DOI:** 10.1002/clen.201100665 **Published:** MAY 2013

Abstract: Zeolites have been used for a long time for purification and catalytical purposes. Recently, first products appeared on the market using zeolites also for improving the indoor air quality so far volatile organic compounds (VOC) are concerned. However, porous compounds like zeolites can be found also in plaster material. Therefore, it was manifest to evaluate the capability of plaster with regard to air cleaning. In this article, the contribution of plaster compounds toward adsorption and catalytical decomposition of VOCs is evaluated using α -pinene, chlorobenzene, 2-ethoxyethylacetate, and pentanal as target substances under standard conditions (23 degrees C, 50%r.H.). These compounds were chosen because of their VOC typical physicochemical properties like molecular dimensions, density, boiling point, vapor pressure, and octanolwater distribution coefficient (log_{kw}). Hydrated lime and metakaolin were found out to have good adsorption properties under these circumstances. Also natural zeolites showed good results especially on pentanal. By investigations in environmental chambers the reduction potential of test plasters on chlorobenzene and 2-ethoxyethylacetate concentrations could be shown. Application of coatings had no or only temporary influence on the performance of the plaster. Additional tests in small chambers demonstrated the possibility to improve the properties of plasters with help of FAU- or MFI-type zeolites but the experiments also showed that α -pinene and pentanal undergo chemical reactions. Further effort should be made on investigations also toward other compounds, especially more volatile ones like formaldehyde. Also additional building materials like insulation material or boards should be taken into account.

IV.4 Réglementaire

Rubrique N°17

Pas d'article

IV.5 Divers

83. Do 'green' buildings have better indoor environments? New evidence

Author(s): Newsham, GR (Newsham, Guy R.)^[1]; Birt, BJ (Birt, Benjamin J.)^[1]; Arsenault, C (Arsenault, Chantal)^[1]; Thompson, AJL (Thompson, Alexandra J. L.)^[1]; Veitch, JA (Veitch, Jennifer A.)^[1]; Mancini, S (Mancini, Sandra)^[1]; Galasiu, AD (Galasiu, Anca D.)^[1]; Gover, BN (Gover, Bradford N.)^[1]; Macdonald, IA (Macdonald, Iain A.)^[1]; Burns, GJ (Burns, Gregory J.)^[1]

Source: BUILDING RESEARCH AND INFORMATION **Volume:** 41 **Issue:** 4 **Pages:** 415-434 **DOI:** 10.1080/09613218.2013.789951 **Published:** AUG 1 2013

Abstract: A post-occupancy evaluation (POE) of 12 green and 12 conventional office buildings across Canada and the northern United States was conducted. Occupants (N = 2545) completed an online questionnaire related to environmental satisfaction, job satisfaction and organizational commitment, health and well-being, environmental attitudes, and commuting. In each building on-site physical measurements at a sample of workstations (N= 974) were taken, including: thermal conditions, air quality, acoustics, lighting, workstation size, ceiling height, window access and shading, and surface finishes. Green buildings exhibited superior performance compared with similar conventional buildings. Better outcomes included: environmental satisfaction, satisfaction with thermal conditions, satisfaction with the view to the outside, aesthetic appearance, less disturbance from heating, ventilation and air-conditioning (HVAC) noise, workplace image, night-time sleep quality, mood, physical symptoms, and reduced number of airborne particulates. A variety of physical features led to improved occupant outcomes across all buildings, including: conditions associated with speech privacy, lower background noise levels, higher light levels, greater access to windows, conditions associated with thermal comfort, and fewer airborne particulates. Green building rating systems might benefit from further attention in several areas, including: credits related to acoustic performance, a greater focus on reducing airborne particulates, enhanced support for the interdisciplinary design process and development of POE protocols.

84. Exploring the consequences of climate change for indoor air quality

Author(s): Nazaroff, WW (Nazaroff, William W.)

Source: ENVIRONMENTAL RESEARCH LETTERS **Volume:** 8 **Issue:** 1 **Article Number:** 015022 **DOI:** 10.1088/1748-9326/8/1/015022 **Published:** JAN-MAR 2013

Abstract: Climate change will affect the concentrations of air pollutants in buildings. The resulting shifts in human exposure may influence public health. Changes can be anticipated because of altered outdoor pollution and also owing to changes in buildings effected in response to changing climate. Three classes of factors govern indoor pollutant levels in occupied spaces: (a) properties of pollutants; (b) building factors, such as the ventilation rate; and (c) occupant behavior. Diversity of indoor conditions influences the public health significance of climate change. Potentially vulnerable subpopulations include not only the young and the infirm but also those who lack resources to respond effectively to changing conditions. Indoor air pollutant levels reflect the sum of contributions from indoor sources and from outdoor pollutants that enter with ventilation air. Pollutant classes with important indoor sources include the byproducts of combustion, radon, and volatile and semivolatile organic compounds. Outdoor pollutants of special concern include particulate matter and ozone. To ensure good indoor air quality it is important first to avoid high indoor emission rates for all pollutants and second to ensure adequate ventilation. A third factor is the use of air filtration or air cleaning to achieve further improvements where warranted.

85. How Do Households Perceive Risks at the Scale of the Environment in Their Own Home?

Author(s): [Sennes, V](#) (Sennes, Vincent)^{1,1}; [Felonneau, ML](#) (Felonneau, Marie-Line)^{1,2,1}; [Gombert-Courvoisier, S](#) (Gombert-Courvoisier, Sandrine)^{1,1}; [Ribeyre, F](#) (Ribeyre, Francis)^{1,1}

Source: INDOOR AND BUILT ENVIRONMENT **Volume:** 22 **Issue:** 2 **Pages:** 422-432 **DOI:** 10.1177/1420326X11429474 **Published:** APR 2013

Abstract: Improving housing performance in ecological terms is a major objective of sustainable development policies. This paper looks at the perception that households have of their environment in their homes, in terms of diagnosis, damages and control. Based on a survey of 107 households, it shows that their environmental concerns only partly reflect current ecological and health risks and that people are finding it difficult to reduce these risks. In order to increase environmental awareness at the level of their homes, the authors highlight the importance of providing support on an individual basis and suggest several courses of action, which should be adapted to the four levels of awareness that were identified by the study.

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