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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.

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I. MÉTROLOGIE (PROTOCOLES PRELEVEMENTS / ANALYSES / MODELISATION)

I.1 Gaz inorganiques / métaux

Rubrique N°1

a. Radon / Thoron

1. Zdenka Stojanovska, Zora S. Zunic, Peter Bossew, Francesco Bochicchio, Carmela Carpentieri, Gennaro Venoso, Rosaline Mishra, R. P. Rout, B. K. Sapra, Bety D. Burghele, A. Cucos-Dinu, Blazo Boev and C. Cosma, **Results from time integrated measurements of indoor radon, thoron and their decay product concentrations in schools in the Republic of Macedonia** (**2014**), 162, 152-156.

As part of a survey on concentrations of radon, thoron and their decay products in different indoor environments of the Balkan region involving international collaboration, measurements were performed in 43 schools from 5 municipalities of the Republic of Macedonia. The time-integrated radon and thoron gas concentrations (CRn and CTn) were measured by CR-39 (placed in chambers with different diffusion barriers), whereas the equilibrium equivalent radon and thoron concentrations (EERC and EETC) were measured using direct radon-thoron progeny sensors consisting of LR-115 nuclear track detectors. The detectors were deployed at a distance of at least 0.5 m from the walls as well as far away from the windows and doors in order to obtain more representative samples of air from the breathing zone; detectors were exposed over a 3-month period (March-May 2012). The geometric mean (GM) values [and geometric standard deviations (GSDs)] of CRn, CTn, EERC and EETC were 76 (1.7), 12 (2.3), 27 (1.4) and 0.75 Bq m(-3) (2.5), respectively. The equilibrium factors between radon and its decay products (FRn) and thoron and its decay products (FTn (>0.5 m)) were evaluated: FRn ranged between 0.10 and 0.84 and FTn (>0.5 m) ranged between 0.003 and 0.998 with GMs (and GSDs) equal to 0.36 (1.7) and 0.07 (3.4), respectively. The Author 2014. Published by Oxford University Press.

2. I. Csige, Z. Szabo and C. Szabo, **Experimental technique to measure thoron generation rate of building material samples using RAD7 detector**, (2013)

Radiation Measurements. Vol.: 59, pp 201-204.

Thoron (Rn-220) is the second most abundant radon isotope in our living environment. In some dwellings it is present in significant amount which calls for its identification and remediation. Indoor thoron originates mainly from building materials. In this work we have developed and tested an experimental technique to measure thoron generation rate in building material samples using RAD7 radon-thoron detector. The mathematical model of the measurement technique. provides the thoron concentration response of RAD7 as a function of the sample thickness. For experimental validation of the technique an adobe building material sample was selected for measuring the thoron concentration at nineteen different sample thicknesses. Fitting the parameters of the model to the measurement results, both the generation rate and the diffusion length of thoron was estimated. We have also determined the optimal sample thickness for estimating the thoron generation rate from a single measurement.

I.2 COV, COSemi-Volatils

Rubrique N°2

b. COV/Aldéhydes

3. E. M. Carter, M. C. Jackson, L. E. Katz and G. E. Speitel, **A coupled sensor-spectrophotometric device for continuous measurement of formaldehyde in indoor environments** (**2014**), 24, 305-310.

Despite long-standing awareness of adverse health effects associated with chronic human exposure to formaldehyde, this hazardous air pollutant remains a challenge to measure in indoor environments. Traditional analytical techniques evaluate formaldehyde concentrations over several hours to several days in a single location in a residence, making it difficult to characterize daily temporal and spatial variation in human exposure to formaldehyde. There is a need for portable, easy-to-use devices that are specific and sensitive to gas-phase formaldehyde over short sampling periods so that dynamic processes governing formaldehyde fate, transport, and potential remediation in indoor environments may be studied more effectively. A recently developed device couples a chemical sensor element with spectrophotonnetric analysis for detection and quantification of part per billion (ppb(v)) gas-phase formaldehyde concentrations. This study established the ability of the coupled sensor-spectrophotometric device (CSSD) to report formaldehyde concentrations accurately and continuously on a 30-min sampling cycle at low ppbv concentrations previously untested for this device in a laboratory setting. Determination of the method detection limit (MDL), based on 40 samples each at test concentrations of 5 and 10 ppb(v), was found to be 1.9 and 2.0 ppb(v), respectively. Performance of the CSSD was compared with the dinitrophenylhydrazine (DNPH) derivatization method for formaldehyde concentrations ranging from 5-50 ppb(v), and a linear relationship with a coefficient of determination of 0.983 was found between these two analytical techniques. The CSSD was also used to monitor indoor formaldehyde concentrations in two manufactured homes. During this time, formaldehyde concentrations varied from below detection limit to 65 ppbv and were above the US National Institute for Occupational Safety and Health (NIOSH) recommended exposure limit (REL) of 16 ppb(v) which is also the exposure limit value now adopted by the US Federal Emergency Management Agency (FEMA) to procure manufactured housing, 80% and 100% of the time, respectively.

4. E. Y. Companioni-Damas, F. J. Santos and M. T. Galceran, **Linear and cyclic methylsiloxanes in air by concurrent solvent recondensation-large volume injection-gas chromatography-mass spectrometry**, (2014)

Talanta. Vol.: 118, pp 245-252.

In the present work, a simple and fast method for the analysis of linear and cyclic methylsiloxanes in ambient air based on active sampling combined with gas chromatography - mass spectrometry (GC-MS) was developed. The retention efficiency of five sampling sorbents (activated coconut charcoal, Carbopack B, Cromosorb 102, Cromosorb 106 and Isolute ENV+) was evaluated and Isolute ENV+ was found to be the most effective. A volume of 2700 L of air can be sampled without significant losses of the most volatile methylsiloxanes. To improve the sensitivity of the GC-MS method, concurrent solvent recondensation - large volume injection (CSR-LVI), using volumes up to 30 mu l of sample extract, is proposed and limits of quantification down to 0.03-0.45 ng m(-3), good linearity (r > 0.999) and precision (RSD % <9%) were obtained. The developed method was applied to the analysis of ambient air. Concentrations of linear and cyclic methylsiloxanes in indoor air ranging from 3.9 to 319 ng m(-3) and between 48 and 292668 ng m(-3), were obtained, respectively, while levels from 6 to 22 ng m(-3) for linear and between 2.2 and 439 ng m(-3) for cyclic methylsiloxanes in outdoor air from Barcelona (Spain), were found.

5. M. Sassine, B. Picquet-Varrault, E. Perraudin, L. Chiappini, J. F. Doussin and C. George, **A new device for formaldehyde and total aldehydes real-time monitoring,** (2014)

Environmental Science and Pollution Research. Vol.: 21, pp 1258-1269.

A new sensitive technique for the quantification of formaldehyde (HCHO) and total aldehydes has been developed in order to monitor these compounds, which are known to be involved in air quality issues and to have health impacts. Our approach is based on a colorimetric method where aldehydes are initially stripped from the air into a scrubbing solution by means of a turning coil sampler tube and then derivatised with 3-methylbenzothiazolinone-2-hydrazone in acid media (pH = -0.5). Hence, colourless aldehydes are transformed into blue dyes that are detected by UV-visible spectroscopy at 630 nm. Liquid core waveguide LCW TeflonA (R) AF-2400 tube was used as innovative optical cells providing a HCHO detection limit of 4 pptv for 100 cm optical path with a time resolution of 15 min. This instrument showed good correlation with commonly used techniques for aldehydes analysis such as DNPH derivatisation chromatographic techniques with off-line and on-line samplers, and DOAS techniques (with deviation below 6 %) for both indoor and outdoor conditions. This instrument is associated with simplicity and low cost, which is a prerequisite for indoor monitoring.

6. I. Ueta, E. L. Samsudin, A. Mizuguchi, H. Takeuchi, T. Shinki, S. Kawakubo and Y. Saito, **Double-bed-type extraction needle packed with activated-carbon-based sorbents for very volatile organic compounds**, (2014)

Journal of Pharmaceutical and Biomedical Analysis. Vol.: 88, pp 423-428.

A novel needle-type sample preparation device was developed for the determination of very volatile organic compounds (VVOCs) in gaseous samples by gas chromatography-mass spectrometry (GC-MS). Two types of activated-carbon-based sorbents, Carbopack X and a carbon molecular sieve (CMS), were investigated as the extraction medium. A double-bed-type extraction needle showed successful extraction and desorption performance for all investigated VVOCs, including acetaldehyde, isoprene, pentane, acetone, and ethanol. Sensitive and reliable determination of VVOCs was achieved by systematically optimizing several desorption conditions. In addition, the effects of sample humidity on the extraction and desorption of analytes were investigated with the needle-type extraction devices. Only the CMS packed extraction needle was adversely affected by sample humidity during the desorption process; on the other hand the double-bed-type extraction needle was unaffected by sample humidity. Finally, the developed double-bed-type extraction needle was successfully applied to the analysis of breath VVOCs of healthy subjects. (C) 2013 Elsevier B.V. All rights reserved.

7. W. J. Wei, J. Y. Xiong, W. P. Zhao and Y. P. Zhang, **A framework and experimental study of an improved VOC/formaldehyde emission reference for environmental chamber tests**, (2014)

Atmospheric Environment. Vol.: 82, pp 327-334.

Environmental chamber systems are usually employed in the testing of volatile organic compound (VOC) and formaldehyde emissions from building materials. The measurement accuracy of environmental chamber systems can be evaluated by VOC/formaldehyde emission references. However, the available VOC/formaldehyde emission references all have some limitations for applications to various scales of chambers. A framework for designing and using a target VOC/formaldehyde emission references to evaluate the performance of chamber systems for measuring VOC/formaldehyde emissions from building materials is studied. Liquid-inner tube diffusion-film-emission (LIFE) reference is improved in this study to meet the requirements of a target VOC/formaldehyde emission reference, such as reliability, similarity as building materials,

efficiency for measurement. Equivalent emission characteristic parameters are designed for a toluene LIFE reference to perform similar to a building material. Chamber test of the LIFE reference is made in a 30 m(3) stainless steel ventilated environmental chamber at 23 +/- 1 degrees C and 50 +/- 5% relative humidity. The experimental data match the predictions using LIFE emission model as well as building material emission model. The improvement of the LIFE reference enables its application for the evaluation of the performance of all kinds of environmental chambers as a general reference in tests of VOCs/formaldehyde emissions from building materials. (C) 2013 Elsevier Ltd. All rights reserved.

a. Semi-volatils

REVIEW

8. C. Rauert, B. Lazarov, S. Harrad, A. Covaci and M. Stranger, **A review of chamber experiments for determining specific emission rates and investigating migration pathways of flame retardants,** (2014)

Atmospheric Environment. Vol.: 82, pp 44-55.

The widespread use of flame retardants (FRs) in indoor products has led to their ubiquitous distribution within indoor microenvironments with many studies reporting concentrations in indoor air and dust. Little information is available however on emission of these compounds to air, particularly the measurement of specific emission rates (SERs), or the migration pathways leading to dust contamination. Such knowledge gaps hamper efforts to develop understanding of human exposure. This review summarizes published data on SERs of the following FRs released from treated products: polybrominated diphenyl ethers (PBDEs), hexabromocyclododecanes (HBCDs), tetrabromobisphenol-A (TBBPA), novel brominated flame retardants (NBFRs) and organophosphate flame retardants (PFRs), including a brief discussion of the methods used to derive these SERs. Also reviewed are published studies that utilize emission chambers for investigations/measurements of mass transfer of FRs to dust, discussing the chamber configurations and methods used for these experiments. A brief review of studies investigating correlations between concentrations detected in indoor air/dust and possible sources in the microenvironment is included along with efforts to model contamination of indoor environments. Critical analysis of the literature reveals that the major limitations with utilizing chambers to derive SERs for FRs arise due to the physicochemical properties of FRs. In particular, increased partitioning to chamber surfaces, airborne particles and dust, causes loss through "sink" effects and results in long times to reach steady state conditions inside the chamber. The limitations of chamber experiments are discussed as well as their potential for filling gaps in knowledge in this area. (C) 2013 Elsevier Ltd. All rights reserved.

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9. X. Y. Liu, Z. S. Guo and N. F. Roache, **Experimental method development for estimating solid-phase diffusion coefficients and material/air partition coefficients of SVOCs** (**2014**), 89, 76-84.

The solid-phase diffusion coefficient (D-m) and material/air partition coefficient (K-ma) are key parameters for characterizing the sources and transport of semivolatile organic compounds (SVOCs) in the indoor environment. In this work, a new experimental method was developed to estimate parameters D-m and K-ma. The SVOCs chosen for study were polychlorinated biphenyl (PCB) congeners, including PCB-52, PCB-66, PCB-101, PCB-110, and PCB-118. The test materials included polypropylene, high density polyethylene, low density polyethylene, polytetrafluoroethylene, polyether ether ketone, glass, stainless steel and concrete. Two 53-L environmental chambers were connected in series, with the relatively stable SVOCs source in the source chamber and the test materials, made as small "buttons", in the test chamber. Prior to loading the test chamber with the test materials, the test chamber had been dosed with SVOCs for 12 days to "coat" the chamber walls. During the tests, the material buttons were removed from the test chamber at different exposure

times to determine the amount of SVOC absorbed by the buttons. SVOC concentrations at the inlet and outlet of the test chamber were also monitored. The data were used to estimate the partition and diffusion coefficients by fitting a sink model to the experimental data. The parameters obtained were employed to predict the accumulation of SVOCs in the sink materials using an existing mass transfer model. The model prediction agreed reasonably well with the experimental data. Published by Elsevier Ltd.

10. C. Rauert, S. Harrad, G. Suzuki, H. Takigami, N. Uchida and K. Takata, **Test chamber and forensic microscopy investigation of the transfer of brominated flame retardants into indoor dust via abrasion of source materials** (**2014**), 493, 639-648.

Abstract Brominated flame retardants (BFRs) have been detected in indoor dust in many studies, at concentrations spanning several orders of magnitude. Limited information is available on the pathways via which BFRs migrate from treated products into dust, yet the different mechanisms hypothesized to date may provide an explanation for the range of reported concentrations. In particular, transfer of BFRs to dust via abrasion of particles or fibers from treated products may explain elevated concentrations (up to 210 mg gâˆ’ 1) of low volatility BFRs like decabromodiphenyl ether (BDE-209). In this study, an indoor dust sample containing a low concentration of hexabromocyclododecane, or HBCD, (110 ng gâˆ’ 1 Î£HBCDs) was placed on the floor of an in-house test chamber. A fabric curtain treated with HBCDs was placed on a mesh shelf 3 cm above the chamber floor and abrasion induced using a stirrer bar. This induced abrasion generated fibers of the curtain, which contaminated the dust, and Î£HBCD concentrations in the dust increased to between 4020 and 52 500 ng gâˆ’ 1 for four different abrasion experiment times. The highly contaminated dust (Î£HBCD at 52 500 ng gâˆ’ 1) together with three archived dust samples from various UK microenvironments, were investigated with forensic microscopy techniques. These techniques included Micro X-ray fluorescent spectroscopy, scanning emission microscopy coupled with an energy dispersive X-ray spectrometer, Fourier transform infrared spectroscopy with further BFR analysis on LC-MS/MS. Using these techniques, fibers or particles abraded from a product treated with BFRs were identified in all dust samples, thereby accounting for the elevated concentrations detected in the original dust (3500 to 88 800 ng gâˆ’ 1 Î£HBCD and 24 000 to 1â€…438 000 ng gâˆ’1 for BDE-209). This study shows how test chamber experiments alongside forensic microscopy techniques, can provide valuable insights into the pathways via which BFRs contaminate indoor dust.

a. Réactions chimiques

11. C. Y. Wang and M. S. Waring, **Secondary organic aerosol formation initiated from reactions between ozone and surface-sorbed squalene** (**2014**), 84, 222-229.

Previous research has shown that ozone reactions on surface-sorbed D-limonene can promote gas phase secondary organic aerosol (SOA) formation indoors. In this work, we conducted 13 steady state chamber experiments to measure the SOA formation entirely initiated by ozone reactions with squalene sorbed to glass, at chamber ozone of 57-500 ppb for two relative humidity (RH) conditions of 21% and 51%, in the absence of seed particles. Squalene is a nonvolatile compound that is a component of human skin oil and prevalent on indoor surfaces and in settled dust due to desquamation. The size distributions, mass and number secondary emission rates (SER), aerosol mass fractions (AMF), and aerosol number fractions (ANF) of formed SOA were quantified. The surface AMF and ANF are defined as the change in SOA mass or number formed, respectively, per ozone mass consumed by ozone squalene reactions. All experiments but one exhibited nucleation and mass formation. Mass formation was relatively small in magnitude and increased with ozone, most notably

for the RH = 51% experiments. The surface AMF was a function of the chamber aerosol concentration, and a multi-product model was fit using the 'volatility basis set' framework. Number formation was relatively strong at low ozone and low RH conditions. Though we cannot extrapolate our results because experiments were conducted at high air exchange rates, we speculate that this process may enhance particle number more than mass concentrations indoors.

b. Émission des matériaux

12. Mariusz Marć, Jacek Namieśnik and Bożena Zabiegała, **Small-scale passive emission chamber for screening studies on monoterpene emission flux from the surface of wood-based indoor elements** (**2014**), 481, 35-46.

Abstract Analysis of literature data published in the last few years leads to the conclusion that in the process of assessment of emission flux of organic compounds emitted from different types of equipment and finishing materials, new types of devices, among which small-scale passive emission chambers for the performance of in-situ research are designed and applied on a larger scale. These devices can be successfully used for the assessment of emission flux of organic compounds in any location of an apartment, with no interference with its normal exploitation. In the following article the possibility of application of a designed and constructed small-scale passive emission chamber for the evaluation of emission flux of organic compounds (mainly monoterpenes) emitted from the surface of wood-based material made of laminated chipboard has been presented. The emission chamber made from polished stainless steel of the inner volume of 3.65 dm3 allows for the examination/assessment of emission flux from the surface of 452 cm2. A diffusive passive sampler was installed inside of the small-scale chamber, which enables collecting samples of the analytes emitted from the examined surface of indoor material. The working time of the passive emission chamber equaled 300 min. The results of preliminary studies show that, the constructed device can be successfully used for screening studies, related with the determination of emission flux of monoterpenes from any type of wood-based flat surface located indoors.

13. C. Y. Park, C. H. Choi, J. H. Lee, S. Kim, K. W. Park and J. H. Cho, **Evaluation of Formaldehyde Emissions and Combustion Behaviors of Wood-Based Composites Subjected to Different Surface Finishing Methods**, (2013)

Bioresources. Vol.: 8, pp 5515-5523.

To use wood-based panels as a final product, they must undergo surface finishing via various processes, such as low pressure laminate (LPL), polyvinyl chloride (PVC), coating paper (CP), direct coating (DC), or veneer overlay/UV coating (VO-UVC). Tests were conducted to look for any reduction of formaldehyde emissions and in combustion behaviors with the use of five different surface finishing methods. To determine formaldehyde emissions, the desiccator method was used according to the Korean Standard KS M 1998. The combustion behaviors of wood-based panels were investigated using a cone calorimeter. The formaldehyde emissions of VO-UVC were lower than those of the other methods. In the burning tests, the heat release rate (HRR) with DC was higher than that with the other methods. The mass loss rate (MLR) when the product with DC was burned was higher than that for the other finishing materials.

I.3 Particules et fibres

14. D. Landsittel, Z. Zhuang, W. Newcomb and R. B. Ann, **Determining Sample Size and a Passing Criterion for Respirator Fit-Test Panels**, (2014) Journal of Occupational and Environmental Hygiene. Vol.: 11, pp 77-84.

Few studies have proposed methods for sample size determination and specification of passing criterion (e.g., number needed to pass from a given size panel) for respirator fit-tests. One approach is to account for between- and within- subject variability, and thus take full advantage of the multiple donning measurements within subject, using a random effects model. The corresponding sample size calculation, however, may be difficult to implement in practice, as it depends on the model-specific and test panel-specific variance estimates, and thus does not yield a single sample size or specific cutoff for number needed to pass. A simple binomial approach is therefore proposed to simultaneously determine both the required sample size and the optimal cutoff for the number of subjects needed to achieve a passing result. The method essentially conducts a global search of the type I and type II errors under different null and alternative hypotheses, across the range of possible sample sizes, to find the lowest sample size which yields at least one cutoff satisfying, or approximately satisfying all pre-determined limits for the different error rates. Benchmark testing of 98 respirators (conducted by the National Institute for Occupational Safety and Health) is used to illustrate the binomial approach and show how sample size estimates from the random effects model can vary substantially depending on estimated variance components. For the binomial approach, probability calculations show that a sample size of 35 to 40 yields acceptable error rates under different null and alternative hypotheses. For the random effects model, the required sample sizes are generally smaller, but can vary substantially based on the estimate variance components. Overall, despite some limitations, the binomial approach represents a highly practical approach with reasonable statistical properties.

15. M. S. Dundar, H. Altundag, O. Yilmazcan and S. Kaygaldurak, **Determination of Some Heavy Metal Contents in Pm1 and Pm10 Airborne Particulate Matters by Aas Analysis**, (2013)

Fresenius Environmental Bulletin. Vol.: 22, pp 3179-3183.

In the present study, airborne particulate matters based on particle sizes were aimed to be investigated experimentally. Sample solutions were FAAS-analyzed for Cd, Cr, Cu, Fe, Mn, Ni, Pb and Zn elemental contents. According to the data obtained, the highest values of PM1 for Fe and Pb in Yesiltepe region were 2.918 and 0.153 mu g/m(3) in August, respectively. In the Campus area, Cr was measured as 0.049 mu g/m(3) in October, and Zn as 4.805 mu g/m(3) in June. Cu, Mn and Ni had high values of 0.88, 11.03 and 3.19 mu g/m(3), respectively, for PM1 in November found in Ozanlar region. In November, 21.73 and 6.07 mu g/m(3) were recorded for Mn and Ni, respectively. The highest values of PM10 for Fe and Zn were 5.460 and 7.245 mu g/m(3) in June, in the Campus area, respectively. Pb was found as 0.750 mu g/m(3) in November, and Cr as 0.106 mu g/m(3) in June, both in the Campus area. Cu was measured to be 2.09 mu g/m(3) in PM10 particles, also being highest in June at Campus region.

I.4 Biocontaminants

16. S. W. Zhu, J. Srebric, S. N. Rudnick, R. L. Vincent and E. A. Nardell, Numerical Investigation of Upper-Room UVGI Disinfection Efficacy in an Environmental Chamber with a Ceiling Fan, (2013)*Photochemistry and Photobiology*. Vol.: 89, pp 782-791.

This study investigated the disinfection efficacy of the upper-room ultraviolet germicidal irradiation (UR-UVGI) system with ceiling fans. The investigation used the steady-state computational fluid dynamics (CFD) simulations to solve the rotation of ceiling fan with a rotating reference frame. Two ambient air exchange rates, 2 and 6 air changes per hour (ACH), and four downward fan rotational speeds, 0, 80, 150 and 235rpm were considered. In addition, the passive scalar concentration simulations incorporated ultraviolet (UV) dose by two methods: one based on the total exposure time and average UV fluence rate, and another based on SVE3* (New Scale for Ventilation Efficiency 3), originally defined to evaluate the mean age of the air from an air supply opening. Overall, the CFD results enabled the evaluation of UR-UVGI disinfection efficacy using different indices, including the fraction of remaining microorganisms, equivalent air exchange rate, UR-UVGI effectiveness and tuberculosis infection probability by the Wells-Riley equation. The results indicated that air exchange rate was the decisive factor for determining UR-UVGI performance in disinfecting indoor air. Using a ceiling fan could also improve the performance in general. Furthermore, the results clarified the mechanism for the ceiling fan to influence UR-UVGI disinfection efficacy.

17. J. H. Jung and J. E. Lee, **In situ real-time measurement of physical characteristics of airborne bacterial particles**, (2013)

Atmospheric Environment. Vol.: 81, pp 609-615.

Bioaerosols, including aerosolized bacteria, viruses, and fungi, are associated with public health and environmental problems. One promising control method to reduce the harmful effects of bioaerosols is thermal inactivation via a continuous-flow high-temperature short-time (HTST) system. However, variations in bioaerosol physical characteristics - for example, the particle size and shape - during the continuous-flow inactivation process can change the transport properties in the air, which can affect particle deposition in the human respiratory system or the filtration efficiency of ventilation systems. Real-time particle monitoring techniques are a desirable alternative to the time-consuming process of microscopic analysis that is conventionally used in sampling and particle characterization. Here, we report in situ real-time optical scattering measurements of the physical characteristics of airborne bacteria particles following an HTST process in a continuous-flow system. Our results demonstrate that the aerodynamic diameter of bacterial aerosols decreases when exposed to a high-temperature environment, and that the shape of the bacterial cells is significantly altered. These variations in physical characteristics using optical scattering measurements were found to be in agreement with the results of scanning electron microscopy analysis.

18. S. Yooseph, C. Andrews-Pfannkoch, A. Tenney, J. McQuaid, S. Williamson, M. Thiagarajan, D. Brami, L. Zeigler-Allen, J. Hof, **A Metagenomic Framework for the Study of Airborne Microbial Communities**, (2013) *Plos One*. Vol.: 8, pp 13.

Understanding the microbial content of the air has important scientific, health, and economic implications. While studies have primarily characterized the taxonomic content of air samples by sequencing the 16S or 18S ribosomal RNA gene, direct analysis of the genomic content of airborne microorganisms has not been possible due to the extremely low density of biological material in airborne environments. We developed sampling and amplification methods to enable adequate DNA recovery to allow metagenomic profiling of air samples collected from indoor and outdoor environments. Air samples were collected from a large urban building, a medical center, a house, and a pier. Analyses of metagenomic data generated from these samples reveal airborne communities with a high degree of diversity and different genera abundance profiles. The identities of many of the taxonomic groups and protein families also allows for the identification of the likely sources of the sampled airborne bacteria.

I.5 Ventilation

Pas d'article pertinent dans cette rubrique

II. CONNAISSANCES DES CONCENTRATIONS ET DES EXPOSITIONS

II.1 Logement

Rubrique N°3

a. Radon

19. C. Demoury, G. Ielsch, D. Hemon, O. Laurent, D. Laurier, J. Clavel and J. Guillevic, **A statistical evaluation of the influence of housing characteristics and geogenic radon potential on indoor radon concentrations in France**, (2013) *Journal of Environmental Radioactivity*. Vol.: 126, pp 216-225.

Radon-222 is a radioactive natural gas produced by the decay of radium-226, known to be the main contributor to natural background radiation exposure. Effective risk management needs to determine the areas in which the density of buildings with high radon levels is likely to be highest. Predicting radon exposure from the location and characteristics of a dwelling could also contribute to epidemiological studies. Beginning in the nineteen-eighties, a national radon survey consisting in more than 10,000 measurements of indoor radon concentrations was conducted in French dwellings by the Institute for Radiological Protection and Nuclear Safety (IRSN). Housing characteristics, which may influence radon accumulation in dwellings, were also collected. More recently, the IRSN generated a French geogenic radon potential map based on the interpretation of geological features. The present study analyzed the two datasets to investigate the factors influencing indoor radon concentrations using statistical modeling and to determine the optimum use of the information on geogenic radon potential that showed the best statistical association with indoor radon concentration. The results showed that the variables associated with indoor radon concentrations were geogenic radon potential, building material, year of construction, foundation type, building type and floor level. The model, which included the surrounding geogenic radon potential (i.e. the average geogenic radon potential within a disc of radius 20 km centered on the indoor radon measurement point) and variables describing house-specific factors and lifestyle explained about 20% of the overall variability of the logarithm of radon concentration. The surrounding geogenic radon potential was fairly closely associated with the local average indoor radon concentration. The prevalence of exposure to radon above specific thresholds and the average exposures to radon clearly increased with increasing classes of geogenic radon potential. Combining the two datasets enabled improved assessment of radon exposure in a given area in France.

b. COV

20. S. J. Maisey, S. M. Saunders, N. West and P. J. Franklin, **An extended baseline examination of indoor VOCs in a city of low ambient pollution: Perth, Western Australia**, (2013)

Atmospheric Environment. Vol.: 81, pp 546-553.

This study of indoor air quality reports VOC concentrations in 386 suburban homes located in Perth Western Australia, a city of low ambient pollution and temperate climate. Details of indoor VOC concentrations, temperature, relative humidity, and information on house characteristics and occupant activities were collected during the sampling periods. The concentration of VOCs observed in typical homes was low and individual compounds rarely exceeded 5 mu g m(-3). Median individual VOC concentrations ranged from 0.06 mu g m(-3) for 1,1,1 trichloroethane and butyl ether to 26.6 mu g m(-3) for cis/trans 2-butene. Recently renovated homes had higher concentrations of VOCs than non renovated homes, including Sigma VOCs (p = 0.026), Sigma BTEX (p = 0.03), Sigma xylene (p

= 0.013), toluene (p = 0.05), cyclohexane (p = 0.039), and propyl benzene (p = 0.039). Statistical analyses showed house age and attached garages were not significant factors for any of the VOCs tested. The concentrations of indoor VOCs in Perth were lower than overseas observations and those reported in recent Australian studies, with inferences made to differences in the climate and the occupant behaviour. The results are a baseline profile of indoor VOCs over the period 2006-2011, in an Australian city of low population density and of generally low ambient pollution. (C) 2013 Elsevier Ltd. All rights reserved.

c. COSV

21. V. Ashok, T. Gupta, S. Dubey and R. Jat, **Personal exposure measurement of students to various microenvironments inside and outside the college campus** (**2014**), 186, 735-750.

This study characterizes the exposure of a typical Indian Institute of Technology Kanpur student to particulate matter and gaseous co-pollutants like carbon monoxide, volatile organic compounds, and nitrogen dioxide in various microenvironments, within and outside the college campus. Chemical analysis of filter, used for the particulate matter measurement, was also carried out to determine the concentration of various elements such as Ca, Cd, Cr, Cu, Fe, Mg, Pb, Zn, and anions like F-, Cl-, NO3 (-), and SO4 (2-). Furthermore, time activity diary along with temperature data was maintained for the precise evaluation and analysis of results for various microenvironments. The results showed PM10 and PM2.5 concentrations to be higher at some outdoor microenvironments, particularly near the Ganga riverbank. From the chemical analysis, concentrations of chloride and fluoride were found higher in indoor microenvironments as compared to outdoors. Also, nitrate concentrations were quite higher within the laboratory premises. Concentrations of Ca, Fe, and Mg were significant outdoors, whereas Na, Ca, Fe, and K were prominent indoors. The study highlights the real-time personal exposure of a student cohort to various toxic pollutants typically found within their breathing levels and their potential sources both indoors and outdoors.

22. Shuji Tajima, Atsuko Araki, Toshio Kawai, Tazuru Tsuboi, Yu Ait Bamai, Eiji Yoshioka, Ayako Kanazawa, Shi Cong and Reiko Kishi, **Detection and intake assessment of organophosphate flame retardants in house dust in Japanese dwellings**, (2014) *Science of The Total Environment*. Vol.: 478, pp 190-199.

Abstract The demand for phosphorus flame retardants (PFRs) has recently increased as an alternative to polybrominated diphenyl ether (PBDE). PFRs have been detected in house dust, but little is known about the concentrations of PFRs in private homes and the effects on human health. We measured the levels of 10 PFRs in indoor floor dust and upper surface dust from 128 Japanese dwellings of families with children in elementary school. The median (minâ€“max) concentrations (Î¼g/g) of PFRs were as follows: tris(2-butoxyethyl) phosphate (TBOEP), 30.88 (< 0.61â€“936.65); tris(2-chloro-iso-propyl) phosphate (TCIPP), 0.74 (< 0.56â€“392.52); and triphenyl phosphate (TPHP), 0.87 (< 0.80â€“23.35). These values exceeded 50% detection rates, and the rates are median over the LOD in floor dust. The concentrations (Î¼g/g) of TBOEP 26.55 (< 0.61â€“1933.24), TCIPP 2.23 (< 0.56â€“621.23), TPHP 3.13 (< 0.80â€“27.47), tris(2-chloroethyl) phosphate (TCEP) 1.17 (< 0.65â€–92.22), and tributyl phosphate (TNBP) 0.74 (< 0.36â€–60.64) exceeded 50% detection rates in the upper surface dust. A significant positive correlation (P < 0.05) between the concentrations of TCIPP and TBOEP was shown in floor dust and upper surface dust (n = 48). Estimated median and 95th percentile daily intake was calculated for toddlers and elementary school children and was compared with reference dose values (RfD) from the literature. For TBOEP, the estimated 95th percentile intake from floor dust was 14% of RfD for toddlers and 4% for school children. The estimated intake from upper surface dust was somewhat lower. Estimated median intake of TBOEP

and median intake for the other PFRs were less than 1% of the RfD. TBOEP, TCIPP and TPHP were the main PFRs in the dust. The median levels of PFRs are well below the RfD values.

d. Biocontaminants

23. Atin Adhikari, Eric M. Kettleson, Stephen Vesper, Sudhir Kumar, David L. Popham, Christopher Schaffer, Reshmi Indugula, Kanistha Chatterjee, Karteek K. Allam, Sergey A. Grinshpun and Tiina Reponen, **Dustborne and airborne Gram-positive and Gram-negative bacteria in high versus low ERMI homes** (**2014**), 482â€“483, 92-99.

The study aimed at investigating Gram-positive and Gram-negative bacteria in moldy and non-moldy homes, as defined by the home's Environmental Relative Moldiness Index (ERMI) value. The ERMI values were determined from floor dust samples in 2010 and 2011 and homes were classified into low (< 5) and high (> 5) ERMI groups based on the average ERMI values as well as 2011 ERMI values. Dust and air samples were collected from the homes in 2011 and all samples were analyzed for Gram-positive and Gram-negative bacteria using QPCR assays, endotoxin by the LAL assay, and N-acetyl-muramic acid using HPLC. In addition, air samples were analyzed for culturable bacteria. When average ERMI values were considered, the concentration and load of Gram-positive bacteria determined with QPCR in house dust, but not air, were significantly greater in high ERMI homes than in low ERMI homes. Furthermore, the concentration of endotoxin, but not muramic acid, in the dust was significantly greater in high ERMI than in low ERMI homes. In contrast, when ERMI values of 2011 were considered, Gram-negative bacteria determined with QPCR in air, endotoxin in air, and muramic acid in dust were significantly greater in high ERMI homes. The results suggest that both short-term and long-term mold contamination in homes could be linked with the bacterial concentrations in house dust, however, only the current mold status was associated with bacterial concentrations in air. Although correlations were found between endotoxin and Gram-negative bacteria as well as between muramic acid and Gram-positive bacteria in the entire data set, diverging associations were observed between the different measures of bacteria and the home moldiness. It is likely that concentrations of cells obtained by QPCR and concentrations of cell wall components are not equivalent and represent too broad categories to understand the bacterial composition and sources of the home microbiota.

24. Congrong He, Heidi Salonen, Xuan Ling, Leigh Crilley, Nadeesha Jayasundara, Hing Cho Cheung, Megan Hargreaves, Flavia Huygens, Luke D. Knibbs, Godwin A. Ayoko and Lidia Morawska, **The impact of flood and post-flood cleaning on airborne microbiological and particle contamination in residential houses** (**2014**), 69, 9-17.

Abstract In January 2011, Brisbane, Australia, experienced a major river flooding event. We aimed to investigate its effects on air quality and assess the role of prompt cleaning activities in reducing the airborne exposure risk. A comprehensive, multi-parameter indoor and outdoor measurement campaign was conducted in 41 residential houses, 2 and 6 months after the flood. The median indoor air concentrations of supermicrometer particle number (PN), PM10, fungi and bacteria 2 months after the flood were comparable to those previously measured in Brisbane. These were 2.88 p cmâˆ’ 3, 15 Î¼g mâˆ’ 3, 804 cfu mâˆ’ 3 and 177 cfu mâˆ’ 3 for flood-affected houses (AFH), and 2.74 p cmâˆ’ 3, 15 Î¼g mâˆ’ 3, 547 cfu mâˆ’ 3 and 167 cfu mâˆ’ 3 for non-affected houses (NFH), respectively. The I/O (indoor/outdoor) ratios of these pollutants were 1.08, 1.38, 0.74 and 1.76 for AFH and 1.03, 1.32, 0.83 and 2.17 for NFH, respectively. The average of total elements (together with transition metals) in indoor dust was 2296 Â± 1328 Î¼g mâˆ’ 2 for AFH and 1454 Â± 678 Î¼g mâˆ’ 2 for NFH,

respectively. In general, the differences between AFH and NFH were not statistically significant, implying the absence of a measureable effect on air quality from the flood. We postulate that this was due to the very swift and effective cleaning of the flooded houses by 60,000 volunteers. Among the various cleaning methods, the use of both detergent and bleach was the most efficient at controlling indoor bacteria. All cleaning methods were equally effective for indoor fungi. This study provides quantitative evidence of the significant impact of immediate post-flood cleaning on mitigating the effects of flooding on indoor bioaerosol contamination and other pollutants.

25. D. W. Li, G. H. Zhao, C. Yang, A. Jalsrai and B. Kerin, **Four noteworthy hyphomycetes from indoor environments**, (2013)

Mycotaxon. Vol.: 125, pp 111-121.

Four interesting hyphomycetes (Nalanthamala vermoesenii, Parascedosporium putredinis, Stachybotrys elegans, Triadelphia australiensis) have been collected from indoor fungal investigations. Among these fungi, Triadelphia australiensis represents a new record for Canada and the USA. Parascedosporium putredinis and Stachybotrys elegans are reported for the first time from indoor environments.

e. Particules/métaux

26. A. Gens, J. F. Hurley, J. T. Tuomisto and R. Friedrich, **Health impacts due to personal exposure to fine particles caused by insulation of residential buildings in Europe** (**2014**), 84, 213-221.

The insulation of residential buildings affects human exposure to fine particles. According to current EU guidelines, insulation is regulated for energy saving reasons. As buildings become tighter, the air exchange rate is reduced and, thus, the indoor concentration of pollutants is increased if there are significant indoor sources. While usually the effects of heat insulation and increase of the air-tightness of buildings on greenhouse gas emissions are highlighted, the negative impacts on human health due to higher indoor concentrations are not addressed. Thus, we investigated these impacts using scenarios in three European countries, i.e. Czech Republic, Switzerland and Greece. The assessment was based on modelling the human exposure to fine particles originating from sources of particles within outdoor and indoor air, including environmental tobacco smoke. Exposure response relationships were derived to link (adverse) health effects to the exposure. Furthermore, probable values for the parameters influencing the infiltration of fine particles into residential buildings were modelled. Results show that the insulation and increase of the air-tightness of residential buildings leads to an overall increase of the mean population exposure and consequently adverse health effects in all considered countries (ranging for health effects from 0.4% in Czech Republic to 11.8% in Greece for 100% insulated buildings) due to an accumulation of particles indoors, especially from environmental tobacco smoke. Considering only the emission reductions in outdoor air (omitting changes in infiltration parameters) leads to a decrease of adverse health effects. This study highlights the importance of ensuring a sufficient air exchange rate when insulating buildings, e. g. by prescribing heat ventilation and air conditioning systems in new buildings and information campaigns on good airing practice in renovated buildings. It also shows that assessing policy measures based on the exposure may provide different recommendations compared to an assessment based on only the outdoor air concentration.

27. Shahana S. Khurshid, Jeffrey A. Siegel and Kerry A. Kinney, **Indoor particulate reactive oxygen species concentrations** (**2014**), 132, 46-53.

Abstract Despite the fact that precursors to reactive oxygen species (ROS) are prevalent indoors, the concentration of ROS inside buildings is unknown. ROS on PM2.5 was measured inside and outside twelve residential buildings and eleven institutional and retail buildings. The mean (Â±s.d.) concentration of ROS on PM2.5 inside homes (1.37Â±1.2 nmoles/m3) was not significantly different from the outdoor concentration (1.41Â±1.0 nmoles/m3). Similarly, the indoor and outdoor concentrations of ROS on PM2.5 at institutional buildings (1.16Â±0.38 nmoles/m3 indoors and 1.68Â±1.3 nmoles/m3 outdoors) and retail stores (1.09Â±0.93 nmoles/m3 indoors and 1.12Â±1.1 nmoles/m3 outdoors) were not significantly different and were comparable to those in residential buildings. The indoor concentration of particulate ROS cannot be predicted based on the measurement of other common indoor pollutants, indicating that it is important to separately assess the concentration of particulate ROS in air quality studies. Daytime indoor occupational and residential exposure to particulate ROS dominates daytime outdoor exposure to particulate ROS. These findings highlight the need for further study of ROS in indoor microenvironments.

28. Jun Yoshinaga, Kumiko Yamasaki, Ayumi Yonemura, Yuri Ishibashi, Takaya Kaido, Kodai Mizuno, Mai Takagi and Atsushi Tanaka, **Lead and other elements in house dust of Japanese residences â€“ Source of lead and health risks due to metal exposure** (**2014**), 189, 223-228.

Abstract The levels of 25 elements in house dust collected from 100 general Japanese residences were measured. Factor analysis was applied on the multi-element data to explore source of Pb (median concentration 49.1Â mg/kg) in house dust. Six factors were extracted and Pb was found to have great loading on the fifth factor with Sb and Sn, suggesting solder (Sn), and plastic and metals (Sb) may be the sources of Pb in the house dust of Japanese residences. No significant loading was found on soil-related factors indicating non-significant contribution of Pb in track-in soil. Seven heavy metals (Cd, Cu, Mo, Pb, Sb, Sn, and Zn) were found in house dust at >10 times more condensed than crustal abundance. Health risk of these elements to children via the ingestion of house dust was estimated based on the comparison with tolerable daily intake and found to be non-significant for most of the elements.

f. Pesticides/biocides

Pas d'article pertinent dans cette rubrique

II.2 Transports

Rubrique N°4

Pas d'article pertinent dans cette rubrique

II.3 Bureaux

Pas d'article pertinent dans cette rubrique

II.4 ERP

Rubrique N°5

g. Centre de soins

29. Ptbs Branco, M. C. M. Alvim-Ferraz, F. G. Martins and S. I. V. Sousa, **Indoor air quality in urban nurseries at Porto city: Particulate matter assessment** (**2014**), 84, 133-143.

Indoor air quality in nurseries is an interesting case of study mainly due to children's high vulnerability to exposure to air pollution (with special attention to younger ones), and because nursery is the public environment where young children spend most of their time. Particulate matter (PM) constitutes one of the air pollutants with greater interest. In fact, it can cause acute effects on children's health, as well as may contribute to the prevalence of chronic respiratory diseases like asthma. Thus, the main objectives of this study were: i) to evaluate indoor concentrations of particulate matter (PM1, PM2.5, PM10 and PMTotal) on different indoor microenvironments in urban nurseries of Porto city; and ii) to analyse those concentrations according to guidelines and references for indoor air quality and children's health. Indoor PM measurements were performed in several class and lunch rooms in three nurseries on weekdays and weekends. Outdoor PMio concentrations were also obtained to determine I/O ratios. PM concentrations were often found high in the studied classrooms, especially for the finer fractions, reaching maxima hourly mean concentrations of 145 mu g m(-3) for PM1 and 158 mu g m(-3) PM2.5, being often above the limits recommended by WHO, reaching 80% of exceedances for PM2.5, which is concerning in terms of exposure effects on children's health. Mean I/O ratios were always above I and most times above 2 showing that indoor sources (re-suspension phenomena due to children's activities, cleaning and cooking) were clearly the main contributors to indoor PM concentrations when compared with the outdoor influence. Though, poor ventilation to outdoors in classrooms affected indoor air quality by increasing the PM accumulation. So, enhancing air renovation rate and performing cleaning activities after the occupancy period could be good practices to reduce PM indoor air concentrations in nurseries and, consequently, to improve children's health and welfare. (C) 2013 Elsevier Ltd. All rights reserved.

30. A. Berrube, L. Mosqueron, D. Cavereau, J. P. Gangneux and O. Thomas, **Methodology for semi-quantitative chemical risk assessments in healthcare facilities**, (2013) *Environnement Risques & Sante*. Vol.: 12, pp 508-520.

The diversity of chemicals used in hospitals (detergents-disinfectants, alcohol-based hand sanitizers, drugs, etc.) and recent developments in indoor air quality regulation of public-access buildings require a better understanding of chemical risks in this particular environment. We developed a methodology for semi-quantitative chemical risk assessments in this environment to prioritize inhalation risks by sector and chemical. This methodology is based on a similar approach in the workplace that defines classes of exposures and of hazards. Their combination produces a risk matrix. Four criteria were used to determine the exposure classes: quantity and frequency of the chemical's use, volatility (vapor pressure), and the type of collective protective equipment associated with each area. The hazard class is also derived from four criteria: classification as carcinogenic, mutagenic, or toxic to reproduction, the existence of a toxicity reference value, occupational exposure limit values, and risk phrases (official risk descriptions, on labels, data sheets, etc). This methodology was tested in the Rennes University Hospital (Rennes, France) in five different hospital areas, with a specific survey undertaken to collect data about chemicals in each area. The results show the spatial specificity of chemical risks. Among the various sites analysed, the chemical risks of two require priority attention: the parasitology-mycology laboratory and patients' rooms. Because of their wide use in the hospital and the volatility of some of their components (alcohols), detergents-

disinfectants contribute to increasing risk levels in all areas. The model is therefore discriminatory in terms of areas and substances.

31. A. Haliki-Uztan, M. Ates, O. A. Gunyar, O. Gulbahar, B. Baydal and H. Boyacioglu, **Air-Borne Microfungus Flora Determined in the Different Units of the Department of Internal Diseases, Ege University Hospital**, (2013) Fresenius Environmental Bulletin. Vol.: 22, pp 3251-3257.

In the Medical Faculty of Ege University, indoor airborne fungal concentrations and the types of fungi have been determined in the two parts and the intensive care unit where patients who are admitted to the Department of Internal diseases, Department of Endocrinology, Department of Hematology, Department of Immunology, Department of Nephrology, Department of Rheumatology, Department of Oncology, Department of Gastroenterology and Department of Geriatrics, are treated. For this purpose, air samples were collected in 19 different locations, each month for 6 months, with the Merck MAS 100. Upon the identification of isolates obtained from 3,167 microfungus colonies counted, 43 different species belonging to 13 genera were determined. Of them, the most frequent genera were Aspergillus, Penicillium, Cladosporium and Alternaria. Concentrations of air-borne fungi in several wards of the intensive care unit ranged between 120 and 2,100 cfu/m(3). In another part of wards, fungal load was found to be between 20 and 2,280 cfu/m(3). When the fungal loads in the intensive care unit and in the other units were compared, no significant difference was found (P = 0.266> 0.05). According to the descriptive statistics kept in April, May and June, there was a large increase in maximum values compared to the other months.

32. E. Karwowska, E. Miaskiewicz-Peska and D. Andrzejewska-Morzuch, **Microbiological Air Contamination in Premises of the Primary Health-Care**, (2013) Archives of Environmental Protection. Vol.: 39, pp 51-58.

The aim of this research was to evaluate the microbiological indoor air contamination level in chosen facilities of the primary health-care for adults and children. The total numbers of mesophilic bacteria, staphylococci, coli-group bacteria and moulds in both surgery rooms and patients' waiting rooms were determined. Air samples were collected with a MAS 100 impactor and the concentration of microorganisms was estimated by a culture method. The microbiological air contamination level was diverse: the number of mesophilic bacteria ranged from 320 to 560 CFU/m(3), number of staphylococci - 10-305 CFU/m(3), coli group bacteria - 0-15 CFU/m(3) and moulds - 15-35 CFU/m(3). The bacteriological contamination level of the air in examined community health centers was higher than described in the literature for hospitals and exceeded the acceptable values proposed for the surgery objects.

h. Ecoles / université

33. F. Amato, I. Rivas, M. Viana, T. Moreno, L. Bouso, C. Reche, M. Àvarez-Pedrerol, A. Alastuey, J. Sunyer and X. Querol, **Sources of indoor and outdoor PM2.5 concentrations in primary schools** (**2014**), 490, 757-765.

Children spend a third of their day in the classroom, where air pollution levels may differ substantially from those outdoors due to specific indoor sources. Air pollution exposure assessments based on atmospheric particle mass measured outdoors may therefore have little to do with the daily PM dose received by school children. This study aims to investigate outdoor and indoor sources of PM2.5 measured at 39 primary schools in Barcelona during 2012. On average 47% of indoor PM2.5 measured concentrations was found to be generated indoors due to continuous resuspension of soil particles (13%) and a mixed source (34%)

comprising organic (skin flakes, clothes fibers, possible condensation of VOCs) and Ca-rich particles (from chalk and building deterioration). Emissions from seven outdoor sources penetrated easily indoors being responsible for the remaining 53% of measured PM2.5 indoors. Unpaved playgrounds were found to increase mineral contributions in classrooms by 5â€“6 Î¼g/m3 on average with respect to schools with paved playgrounds. Weekday traffic contributions varied considerably across Barcelona within ranges of 1â€“14 Î¼g/m3 outdoor and 1â€“10 Î¼g/m3 indoor. Indoors, traffic contributions were significantly higher (more than twofold) for classrooms with windows oriented directly to the street, rather than to the interior of the block or to playgrounds. This highlights the importance of urban planning in order to reduce childrenâ€™s exposure to traffic emissions.

34. P. V. Dorizas, E. Kapsanaki-Gotsi, M. N. Assimakopoulos and M. Santamouris, **Correlation of Particulate Matter with Airborne Fungi in Schools in Greece,** (2013) International Journal of Ventilation. Vol.: 12, pp 1-15.

The concentration levels of particulate matter (PM), airborne fungi, carbon dioxide as well as temperature and relative humidity were investigated in the indoor and outdoor environment of two schools in Athens, Greece during the period January to May 2011. The overall concentration ranges of the indoor measured pollutants were: PM10: 14.92-166.18 mu g/m(3), PM2.5: 3.16-31.27 mu g/m(3), PM1: 0.72-9.01 mu g/m(3), UFP: 4188-63093 pt/cm(3), total airborne fungi: 28-2098 CFU/m(3) and CO2: 389-1717 ppm. The relationships between PM and airborne fungi were mainly examined, and bivariate correlations of all the measured environmental parameters are also reported. The results indicate that PM of certain aerodynamic diameters significantly correlate to the total airborne fungi and their prevalent genera, Penicillium, Cladosporium and Aspergillus. Principal Component Analysis (PCA) was conducted so as to cluster variables of common characteristics. Furthermore, simple and multiple linear regression models were developed to investigate several cases of dependent variables to be used for prediction purposes in health risk assessments.

35. A. Fischer, E. Ljungstrom and S. Langer, **Ozone removal by occupants in a classroom**, (2013) Atmospheric Environment. Vol.: 81, pp 11-17.

Ozone concentrations were measured in a classroom with and without occupants, with the purpose to quantify effects on indoor 0_3 concentrations. The teacher and 24 11-year old pupils each removed 03 at a rate, first order in O-3, corresponding to a rate constant of (2.5 +/- 0.6) x 10(-5) s(-1) in the present locality and to a deposition velocity of 0.45 cm s(-1). The O-3-removal caused by the occupants was approximately 2.6 times larger than that of the available surfaces belonging to the classroom and its furniture. Observation of 6-methyl-5-hepten-2-one and 4-oxopentanal at maximum concentrations of 0.2 ppb and 0.7 ppb, respectively, suggested squalene from human skin oil as a reactive, ozone-consuming substance. There are indications of a source of 4-oxopentanal in the classroom, even some time after the pupils left for the day. The work presented is important for a proper description of indoor exposure, both to ozone itself and some of its reaction products when trying to quantify relations between exposure and health effects.

36. B. Polednik, **Variations in Particle Concentrations and Indoor Air Parameters in Classrooms in the Heating and Summer Seasons**, (2013) *Archives of Environmental Protection*. Vol.: 39, pp 15-28.

Simultaneous measurements of the indoor and outdoor particle mass (PM) and particle number (PN) concentrations as well as the air temperature, relative humidity (RH), and CO, concentrations have been conducted in 6 occupied (L) and unoccupied (V) classrooms in 3 secondary schools in Lublin, Poland, in the heating (H) and summer (S) seasons. The, schools were located in residential areas

where the majority of private houses are heated by means of coal-burning stoves. The ratios of the average particle concentrations in occupied and unoccupied classrooms (L/V) were higher during the heating season measurements. The ratios of the average particle concentrations during the measurements in the heating and summer seasons (HIS) were higher in occupied classrooms. In both seasons the average PM and PN concentrations amounted to 239 mu g/m(3) and 7.4x10(3)/cm(3) in the occupied classrooms, and to 76 mu g/m(3) and 5.4x10(3)/cm(3) in the unoccupied classrooms, respectively. The particle exposures experienced by students were higher in the monitored classrooms than outdoors and were on average about 50% higher in the heating than in the summer season. A positive correlation between mass concentrations of coarse particles and indoor air temperature, RH and CO2 concentrations in both seasons was observed. The concentrations of fine particles were negatively correlated with the indoor air parameters in the heating season, and positively correlated in the summer season.

37. O. Ramalho, C. Mandin, J. Riberon and G. Wyart, **Air Stuffiness and Air Exchange Rate in French Schools and Day-Care Centres**, (2013) *International Journal of Ventilation*. Vol.: 12, pp 175-180.

A pilot survey was undertaken from September 2009 to June 2011 in 310 schools and day-care centres distributed in all regions of France including overseas departments. This experimental survey was carried out as part of the preparation of the mandatory control of indoor air quality in public buildings. Three parameters were measured in 896 classrooms or child playrooms: benzene, formaldehyde and carbon dioxide (CO2). The last enables the determination of degree of air 'stuffiness' during children occupancy as well as the night-time air change rate. The level of air stuffiness was represented by a score from 0 (no stuffy air) to 5 (extremely stuffy air), which depends on both the occurrence and intensity of CO2 concentration. Moreover, a simple audit of each building was undertaken in order to describe its characteristics, the equipment, user behaviour and outdoor environment. Results show varying levels of air stuffiness from one room to another: low or no air stuffiness was recorded in 30% of rooms, medium to high air stuffiness in 48% of rooms, and very high to extreme air stuffiness in 21% of rooms. The air in day-care centres was generally found to be less stuffy than in schools, because of more favourable ventilation conditions and lower children density per square metre. At the opposite, the air in elementary schools was found to be generally more stuffy than in the other establishments. Air change rates were estimated from the decay of CO2 concentration by an automated method. The observed carbon dioxide values were low at a median level around 0.2 air changes per hour (ac/h) in day-care centres and 0.1 ac/h in nursery or elementary schools. Mechanical ventilation systems were installed in all the day-care centres and used for 60% of the time. They were also installed in the monitored nursery and elementary schools where they were used, on average, for 20% of the time. The most common mechanical systems were based on exhaust ventilation or balanced ventilation directly in the rooms.

38. J. T. M. Rosbach, M. Vonk, F. Duijm, J. T. van Ginkel, U. Gehring and B. Brunekreef, **A ventilation intervention study in classrooms to improve indoor air quality: the FRESH study,** (2013) *Environmental Health*. Vol.: 12, pp 110-110.

Background: Classroom ventilation rates often do not meet building standards, although it is considered to be important to improve indoor air quality. Poor indoor air quality is thought to influence both children's health and performance. Poor ventilation in The Netherlands most often occurs in the heating season. To improve classroom ventilation a tailor made mechanical ventilation device was developed to improve outdoor air supply. This paper studies the effect of this intervention. Methods: The FRESH study (Forced-ventilation Related Environmental School Health) was designed to investigate the effect of a CO2 controlled mechanical ventilation intervention on classroom CO2 levels using a longitudinal cross-over design. Target CO2 concentrations were 800 and 1200 parts per million (ppm), respectively. The study included 18 classrooms from 17 schools from

the north-eastern part of The Netherlands, 12 experimental classrooms and 6 control classrooms. Data on indoor levels of CO2, temperature and relative humidity were collected during three consecutive weeks per school during the heating seasons of 2010 2012. Associations between the intervention and weekly average indoor CO2 levels, classroom temperature and relative humidity were assessed by means of mixed models with random school-effects. Results: At baseline, mean CO2 concentration for all schools was 1335 ppm (range: 763-2000 ppm). The intervention was able to significantly decrease CO2 levels in the intervention classrooms (F (2,10) = 17.59, p < 0.001), with a mean decrease of 491 ppm. With the target set at 800 ppm, mean CO2 was 841 ppm (range: 743-925 ppm); with the target set at 1200 ppm, mean CO2 was 975 ppm (range: 887-1077 ppm). Conclusions: Although the device was not capable of precisely achieving the two predefined levels of CO2, our study showed that classroom CO2 levels can be reduced by intervening on classroom ventilation using a CO2 controlled mechanical ventilation system.

II.5 Autres lieux de vie / loisirs

Rubrique N°6

39. M. Almeida-Silva, H. T. Wolterbeek and S. M. Almeida, **Elderly exposure to indoor air pollutants** (**2014**), 85, 54-63.

The aim of this work was to characterize the indoor air quality in Elderly Care Centers (ECCs) in order to assess the elders' daily exposure to air pollutants. Ten ECCs hosting 384 elderly were selected in Lisbon and Loures. Firstly, a time-budget survey was created based on questionnaires applied in the studied sites. Results showed that in average elders spend 95% of their time indoors splitted between bedrooms and living-rooms. Therefore, a set of physical and chemical parameters were measured continuously during the occupancy period in these two indoor micro-environments and in the outdoor. Results showed that indoor was the main environment contributing for the elders' daily exposure living in ECCs. In the indoor, the principal micro-environment contributing for the elders' daily exposure varied between bedrooms and living-rooms depending not only on the characteristics of the ECCs but also on the pollutants. The concentrations of CO2, VOCt, O-3 and PM10 exceeded the limit values predominantly due to the insufficient ventilation preconized in the studied sites.

40. Anna J. Buczynska, Agnieszka Krata, Rene Van Grieken, Andrew Brown, Gabriela Polezer, Karolien De Wael and Sanja Potgieter-Vermaak, **Composition of PM2.5 and PM1 on high and low pollution event days and its relation to indoor air quality in a home for the elderly** (**2014**), 490, 134-143.

Abstract Many studies probing the link between air quality and health have pointed towards associations between particulate matter (PM) exposure and decreased lung function, aggravation of respiratory diseases like asthma, premature death and increased hospitalisation admissions for the elderly and individuals with cardiopulmonary diseases. Of recent, it is believed that the chemical composition and physical properties of PM may contribute significantly to these adverse health effects. As part of a Belgian Science Policy project (â€œHealth effects of particulate matter in relation to physicalâ€“chemical characteristics and meteorologyâ€), the chemical composition (elemental and ionic compositions) and physical properties (PM mass concentrations) of PM were investigated, indoors and outdoors of old age homes in Antwerp. The case reported here specifically relates to high versus normal/low pollution event periods. PM mass concentrations for PM1 and PM2.5 fractions were determined gravimetrically after collection via impaction. These same samples were hence analysed by EDXRF spectrometry and IC for their elemental and ionic compositions, respectively. During high pollution event days, PM mass concentrations inside the old age home reached 53 Î¼g mâˆ’3 and 32 Î¼g mâˆ’3 whilst outside concentrations were 101 Î¼g mâˆ’3 and 46 Î¼g mâˆ’3 for PM2.5 and PM1, respectively. The sum of nss-sulphate, nitrate and ammonium,

dominate the composition of PM, and contribute the most towards an increase in the PM during the episode days constituting 64% of ambient PM2.5 (52 Î¼g mâˆ’3) compared to 39% on non-episode days (10 Î¼g mâˆ’3). Other PM components, such as mineral dust, sea salt or heavy metals were found to be considerably higher during PM episodes but relatively less important. Amongst heavy metals Zn and Pb were found at the highest concentrations in both PM2.5 and PM1. Acidâ€“base ionic balance equations were calculated and point to acidic aerosols during event days and acidic to alkaline aerosols during non-event days. No significant sources of indoor pollutants could be identified inside the old-age home as high correlations were found between outdoor and indoor PM, confirming mainly the outdoor origin of indoor air.

41. G. de Gennaro, L. de Gennaro, A. Mazzone, F. Forcelli and M. Tutino, **Indoor air quality in hair salons: Screening of volatile organic compounds and indicators based on health risk assessment** (**2014**), 83, 119-126.

Volatile organic compounds (VOCs) are common ingredients in cosmetic products which can impact human health. This study monitored 12 hairdressing salons in order to assess the individual exposure of the people working in or frequenting these environments as well as identify the main products or activities responsible for the presence of these compounds. In each site halogenated, oxygenated, aliphatic and aromatic compounds were monitored during the work week with diffusive samplers suitable for thermal desorption and analysed using GC MS. The study of indoor outdoor concentration ratios and a knowledge of the composition of most of the products, whether ecological or traditional, used in the hair salons verified the presence of compounds linked to hairdressing activities. In particular, compounds widely used in products for hair care as spray lacquer and foam (butane), shampoo, balms, hair masks and oils (camphene, camphor, limonene, eucalyptol, alpha pinene, 1-methoxy-2-propanol, n-butanol and menthol), and hair dye (benzyl alcohol, isopropanol, limonene, hexane and methyl ethyl ketone) were found at much higher levels inside rather than outside the salons (mean I/O> 10). The importance of this finding is linked to the potential health hazards of some of the VOCs detected. Integrated indicators of health risk were proposed in this study to assess the criticality level and rank the investigated environments accordingly. The results of this study indicate that the level of VOC concentrations was most affected by the type of products used while the size of the environment, the efficiency of air exchange and the number of customers had less impact on those levels.

II.6 Modélisation

Rubrique N°7

42. A. C. Terry, N. Carslaw, M. Ashmore, S. Dimitroulopoulou and D. C. Carslaw, **Occupant exposure to indoor air pollutants in modern European offices: An integrated modelling approach,** (2014)

Atmospheric Environment. Vol.: 82, pp 9-16.

A new model (INDAIR-CHEM) has been developed by combining a detailed indoor air chemistry model with a physical and probabilistic multi-compartment indoor/outdoor air exposure model. The detailed indoor air chemistry model was used to produce a simplified chemistry scheme for INDAIR-CHEM, which performs well for key indoor air pollutants under a range of conditions when compared to the parent model. INDAIR-CHEM was used to compare indoor pollutant concentrations in naturally ventilated offices in 8 European cities for typical outdoor conditions in summer, with those experienced during the European heat-wave in August 2003 for different air exchange rates. We also investigated the effect of cleaning with limonene based products on the subsequent exposure to secondary reaction products from limonene degradation. Extreme climatic conditions, such as a heat-wave which often leads to poor outdoor air quality, can increase personal exposure to both

primary and secondary species indoors. Occupant exposure to indoor air pollutants may also be exacerbated by poor ventilation in offices. Reduced ventilation reduces maximum exposure to ozone, as there is less ingress from outdoors, but allows secondary species to persist indoors for much longer. The balance between these two processes may mean that cumulative exposures for office workers increase as ventilation decreases. Cleaning staff are at lower risk of exposure to secondary oxidation products if they clean before office hours rather than after office hours, since ozone is generally at lower outdoor (and hence indoor) concentrations during the early morning compared to late afternoon. However, from the viewpoint of office workers, reduced exposure would occur if cleaning was performed at the end of the working day.

43. S. Crawford and C. T. Lungu, **Application and limitations of a mass transfer VOC emission model for a dry building material**, (2013) *Atmospheric Environment*. Vol.: 81, pp 25-31.

Volatile organic compound (VOC) emission from building materials into air has been quantified, characterized and modeled. Internal diffusion of VOC through a material based on Fick's law of diffusion is the basis for mass transfer modeling of diffusive emission used to estimate VOC concentrations in air over time. Current mass transfer models have been shown to appropriately estimate air VOC concentrations at approximate room temperature, while other research has shown that temperature has a profound effect on the diffusion coefficient, D, of VOC in a material. Here, a mass transfer model is operated at 23 degrees C and 40 degrees C using input parameters applicable for each temperature. The model estimates are validated against environmental test chamber data for styrene emission from a vinyl ester resin thermoset composite material. The model correlates well with the 23 degrees C chamber data, but underestimates chamber data by as much as 10(-4) at 264 h for the 40 degrees C modeling. This suggests that the model requires adjustment for predicting VOC air concentrations at temperatures other than 23 degrees C.

44. N. Mustafa, K. G. Mumford, J. I. Gerhard and D. M. O'Carroll, **A three-dimensional numerical model for linking community-wide vapour risks**, (2014)

Journal of Contaminant Hydrology. Vol.: 156, pp 38-51.

A three-dimensional (3D) numerical model that couples contaminant transport in the saturated zone to vapour transport in the vadose zone and vapour intrusion into buildings was developed. Coupling these processes allows the simulation of vapour intrusion, arising from volatilization at the water table, associated with temporally and spatially variable groundwater plumes. In particular, the model was designed to permit, for the first time, 3D simulations of risk at receptors located in the wider community (i.e., kilometre scale) surrounding a contaminated site. The model can account for heterogeneous distributions of permeability, fraction organic carbon, sorption and biodegradation in the vadose and saturated zones. The model formulation, based upon integration of a number of widely accepted models, is presented along with verification and benchmarking tests. In addition, a number of exploratory simulations of benzene and naphthalene transport in a 1000 m long domain (aquifer cross-section: 500 m x 14 m) are presented, which employed conservative assumptions consistent with the development of regulatory guidance. Under these conservative conditions, these simulations demonstrated, for example, that whether houses in the community were predicted to be impacted by groundwater and indoor air concentrations exceeding regulatory standards strongly depended on their distance downgradient from the source and lateral distance from the plume centreline. In addition, this study reveals that the degree of reduction in source concentration (i.e., remediation) required to achieve compliance with standards is less if the risk receptor is in the wider community than at the site boundary. However, these example scenarios suggest that, even considering community receptors, sources with initially high concentrations still required substantial

remediation (i.e., >99% reductions in source concentration). Overall, this work provides insights and a new tool for considering the relationships between contaminated site source zones and community-wide risk assessment that allows for development of policies and technical approaches for contaminated site management. It is anticipated that this coupled model not only will allow significant convenience, for example in running suites of Monte Carlo simulations for complex scenarios, but will also allow the investigation of vapour intrusion under conditions where soil gas concentrations may change over the same timescale as an evolving plume.

45. J. Milner, C. Shrubsole, P. Das, B. Jones, I. Ridley, Z. Chalabi, I. Hamilton, B. Armstrong, M. Davies and P. Wilkinson, **Home energy efficiency and radon related risk of lung cancer: modelling study**, (2014)

Bmj-British Medical Journal. Vol.: 348, pp 12.

Objective To investigate the effect of reducing home ventilation as part of household energy efficiency measures on deaths from radon related lung cancer. Design Modelling study. Setting England. Intervention Home energy efficiency interventions, motivated in part by targets for reducing greenhouse gases, which entail reduction in uncontrolled ventilation in keeping with good practice guidance. Main outcome measures Modelled current and future distributions of indoor radon levels for the English housing stock and associated changes in life years due to lung cancer mortality, estimated using life tables. Results Increasing the air tightness of dwellings (without compensatory purpose-provided ventilation) increased mean indoor radon concentrations by an estimated 56.6%, from 21.2 becquerels per cubic metre (Bq/m(3)) to 33.2 Bq/m(3). After the lag in lung cancer onset, this would result in an additional annual burden of 4700 life years lost and (at peak) 278 deaths. The increases in radon levels for the millions of homes that would contribute most of the additional burden are below the threshold at which radon remediation measures are cost effective. Fitting extraction fans and trickle ventilators to restore ventilation will help offset the additional burden but only if the ventilation related energy efficiency gains are lost. Mechanical ventilation systems with heat recovery may lower radon levels and the risk of cancer while maintaining the advantage of energy efficiency for the most airtight dwellings but there is potential for a major adverse impact on health if such systems fail. Conclusion Unless specific remediation is used, reducing the ventilation of dwellings will improve energy efficiency only at the expense of population wide adverse impact on indoor exposure to radon and risk of lung cancer. The implications of this and other consequences of changes to ventilation need to be carefully evaluated to ensure that the desirable health and environmental benefits of home energy efficiency are not compromised by avoidable negative impacts on indoor air quality.

II.7 Air extérieur – Air intérieur

Rubrique N°8

46. Angelo Cecinato, Paola Romagnoli, Mattia Perilli, Claudia Patriarca and Catia Balducci, **Psychotropic substances in indoor environments** (**2014**), 71, 88-93.

Abstract The presence of drugs in outdoor air has been established, but few investigations have been conducted indoors. This study focused on psychotropic substances (PSs) at three schools, four homes and one office in Rome, Italy. The indoor drug concentrations and the relationships with the outdoor atmosphere were investigated. The optimised monitoring procedure allowed for the determination of cocaine, cannabinoids and particulate fractions of nicotine and caffeine. In-field experiments were performed during the winter, spring and summer seasons. Psychotropic substances were observed in all indoor locations. The indoor concentrations often exceeded those recorded both outdoors at the same sites and at the atmospheric pollution control network stations, indicating that the drugs were

released into the air at the inside sites or were more persistent. During winter, the relative concentrations of cannabinol, cannabidiol and tetrahydrocannabinol depended on site and indoor/outdoor location at the site.

47. N. Hodas, Q. Y. Meng, M. M. Lunden and B. J. Turpin, **Toward refined estimates of ambient PM2.5 exposure: Evaluation of a physical outdoor-to-indoor transport model** (**2014**), 83, 229-236.

Because people spend the majority of their time indoors, the variable efficiency with which ambient PM2.5 penetrates and persists indoors is a source of error in epidemiologic studies that use PM2.5 concentrations measured at central-site monitors as surrogates for ambient PM2.5 exposure. To reduce this error, practical methods to model indoor concentrations of ambient PM2.5 are needed. Toward this goal, we evaluated and refined an outdoor-to-indoor transport model using measured indoor and outdoor PM2.5 species concentrations and air exchange rates from the Relationships of Indoor, Outdoor, and Personal Air Study. Herein, we present model evaluation results, discuss what data are most critical to prediction of residential exposures at the individual-subject and populations levels, and make recommendations for the application of the model in epidemiologic studies. This paper demonstrates that not accounting for certain human activities (air conditioning and heating use, opening windows) leads to bias in predicted residential PM2.5 exposures at the individual-subject level, but not the population level. The analyses presented also provide quantitative evidence that shifts in the gas-particle partitioning of ambient organics with outdoor-to-indoor transport contribute significantly to variability in indoor ambient organic carbon concentrations and suggest that methods to account for these shifts will further improve the accuracy of outdoor-to-indoor transport models.

48. D. Montagne, G. Hoek, M. Nieuwenhuijsen, T. Lanki, T. Siponen, M. Portella, K. Meliefste and B. Brunekreef, **Temporal associations of ambient PM2.5 elemental concentrations with indoor and personal concentrations** (**2014**), 86, 203-211.

Time series studies increasingly evaluate health relevance of the elemental composition of particles smaller than 2.5 mu m (PM2.5). Validation studies have documented that temporal variation of outdoor PM2.5 concentration is correlated with temporal variation of personal exposure, but very few papers have investigated the temporal correlation between outdoor concentration and personal exposure for the elemental composition of PM2.5. We evaluated the temporal association between outdoor concentration and personal exposure for the elements copper (Cu), zinc (Zn), iron (Fe), potassium (K), nickel (Ni), vanadium (V), silicon (Si) and sulfur (S) in three European cities. In Helsinki (Finland), Utrecht (the Netherlands) and Barcelona (Spain) five participants from urban background, five from suburban/rural background and five from busy street sites were selected (15 participants per city). Six outdoor, indoor and personal 96-h average PM2.5 concentrations were measured simultaneously in three different seasons (winter, summer and spring/autumn). Concurrently, samples were collected at a central reference site, reflecting urban background air pollution levels. The temporal variation at the central site was highly correlated with personal exposure for all elements, except Cu. The highest correlations (Pearson's R) were found for S and V (R between 0.87 and 0.98). Lower correlations were found for the elements Cu, Fe and Si associated with non-tailpipe traffic emissions and road dust (Pearson's R between 0.34 and 0.79). For PM2.5 mass the R was lower (between -0.37 and 0.70). Exclusion of observations most affected by indoor sources increased the personal to central site correlations but did not fully explain differences between elements. The generally high correlation between temporal variation of the outdoor concentration and personal exposure supports the use of a central site for assessing exposure of PM components in time series studies for most elements. The different correlations found for the eight elements suggests that

epidemiological associations are affected by differences in measurement error. (C) 2014 Elsevier Ltd. All rights reserved.

49. C. Reche, M. Viana, I. Rivas, L. Bouso, M. Ã€lvarez-Pedrerol, A. Alastuey, J. Sunyer and X. Querol, **Outdoor and indoor UFP in primary schools across Barcelona** (**2014**), 493, 943-953.

Abstract Indoor and outdoor measurements of real-time ultrafine particles (UFP; N10â€“700 in this study) number concentration and average diameter were collected twice at 39 primary schools located in Barcelona (Spain), with classrooms naturally ventilated under warm weather conditions. Simultaneous outdoor N concentration measurements at schools under different traffic exposures showed the important role of this source, with higher levels by 40% on average at schools near heavy traffic, highlighting thus the increased exposure of children due to urban planning decisions. A well-defined spatial pattern of outdoor UFP levels was observed. Midday increases in outdoor N levels mainly attributed to nucleation processes have been recorded both at high and low temperatures in several of the outdoor school sites (increasing levels by 15%â€“70%). The variation of these increases also followed a characteristic spatial pattern, pointing at schools' location as a key variable in terms of UFP load owing to the important contribution of traffic emissions. Indoor N concentrations were to some extent explained by outdoor N concentrations during school hours, together with average temperatures, related with natural ventilation. Outdoor midday increases were generally mimicked by indoor N concentrations, especially under warm temperatures. At specific cases, indoor concentrations during midday were 30%â€“40% higher than outdoor. The time scale of these observations evidenced the possible role of: a) secondary particle formation enhanced by indoor precursors or conditions, maybe related with surface chemistry reactions mediated by O3, and/or b) UFP from cooking activities. Significant indoor N increases were detected after school hours, probably associated with cleaning activities, resulting in indoor N concentrations up to 3 times higher than those in outdoor. A wide variability of indoor/outdoor ratios of N concentrations and mean UFP sizes was detected among schools and measurement periods, which seems to be partly associated with climatic conditions and O3 levels, although further research is required.

50. M. S. Hassanvand, K. Naddafi, S. Faridi, M. Arhami, R. Nabizadeh, M. H. Sowlat, Z. Pourpak, N. Rastkari, F. Momeniha, H. Kashani, A. Gholampour, S. Nazmara, M. Alimohammadi, G. Goudarzi and M. Yunesian, **Indoor/outdoor relationships of PM10, PM2.5, and PM1 mass concentrations and their water-soluble ions in a retirement home and a school dormitory**, (2014)

Atmospheric Environment. Vol.: 82, pp 375-382.

Indoor/outdoor particulate matter (PM10. PM2.5, and PM1) and their water-soluble ions were measured in a retirement home and a school dormitory in Tehran, from May 2012 to January 2013. Hourly indoor/outdoor PM concentrations were measured using GRIMM dust monitors and 24-h aerosol samples were collected by low-volume air samplers. Water-soluble ions were determined using an ion chromatography (IC) instrument. Although the mean outdoor PM concentrations in both sampling sites were almost equal, the mean indoor PM10 in the school dormitory was approximately 1.35 times higher than that in the retirement home. During a Middle Eastern dust storm, the 24-h average PM10, PM2.5, and PM1 concentrations were respectively 3.4, 2.9, and 1.9 times as high as those in normal days outdoors and 3.4, 2.8, and 1.6 times indoors. The results indicated that secondary inorganic aerosols were the dominant water-soluble ions of indoor and outdoor PM. We found that the smaller the particle, the higher the percentage of secondary inorganic aerosols. Except for PM10 in the school dormitory, strong correlations were found between indoor and outdoor PM. We estimated that nearly 45% of PM10, 67% of PM2.5. and 79% of PM1 in the

retirement home, and 32% of PM10, 76% of PM2.5, and 83% of PM1 in the school dormitory originated from outdoor environment. (C) 2013 Elsevier Ltd. All rights reserved.

51. E. Krugly, D. Martuzevicius, R. Sidaraviciute, D. Ciuzas, T. Prasauskas, V. Kauneliene, I. Stasiulaitiene and L. Kliucininkas, **Characterization of particulate and vapor phase polycyclic aromatic hydrocarbons in indoor and outdoor air of primary schools**, (2014)

Atmospheric Environment. Vol.: 82, pp 298-306.

The indoor air of schools is considered as one of the most important factors affecting the health of children. The aim of the presented research was to characterize polycyclic aromatic hydrocarbons (PAHs) in indoor and outdoor air of schools. The sampling campaign was conducted during the heating season of 2011/2012. Five primary schools from various urban settings in the city of Kaunas, Lithuania. 150 daily samples of particulate and vapor phases were collected during the sampling period. The ultrasonic extractions followed by the gas chromatography and mass spectroscopy (GS/MS) analyses were used for the determination of PAHs. The concentration of total PAHs in the PM2.5 fraction ranged from 203 to 131.1 ng m(-3), while total suspended particles (TSP) fraction contained from 19.9 to 803 ng m(-3) of total PAHs. The vapor phase concentration of PAHs ranged from 67.2 to 372.5 ng m(-3). The most abundant PAH in both phases was naphthalene. In order to define sources of indoor and outdoor PAHs several source apportionment methods were applied. The analysis revealed that emissions from motor vehicles and fuel burning for heating purposes were the major sources of PAHs in the city of Kaunas. (C) 2013 Elsevier Ltd. All rights reserved.

52. M. A. S. Laidlaw, S. Zahran, N. Pingitore, J. Clague, G. Devlin and M. P. Taylor, **Identification of lead sources in residential environments: Sydney Australia,** (2014) *Environmental Pollution*. Vol.: 184, pp 238-246.

Interior and exterior dust, soil and paint were analysed at five brick urban Sydney homes over 15 months to evaluate temporal variations and discriminate sources of lead (Pb) exposure. Exterior dust gauge Pb loading rates (mu g/m(2)/28 days), interior vacuum dust Pb concentrations (mg/kg) and interior petri-dish Pb loading rates (mu g/m(2)/28 days), were correlated positively with soil Pb concentrations. Exterior dust gauge Pb loading rates and interior vacuum dust Pb concentrations peaked in the summer. Lead isotope and Pb speciation (XAS) were analysed in soil and vacuum dust samples from three of the five houses that had elevated Pb concentrations. Results show that the source of interior dust lead was primarily from soil in two of the three houses and from soil and Pb paint in the third home. IEUBK child blood Pb modelling predicts that children's blood Pb levels could exceed 5 mu g/dL in two of the five houses. (C) 2013 Elsevier Ltd. All rights reserved.

III. RISQUE ET IMPACT SUR LA SANTE

III.1 Toxicologie

53. I. Hagerman, C. Isaxon, A. Gudmundsson, A. Wierzbicka, K. Dierschke, M. Berglund, J. Pagels, J. Nielsen, E. Assarsson, U. B. K. Andersson, Y. Y. Xu, B. A. G. Jonsson and M. Bohgard, **Effects on heart rate variability by artificially generated indoor nano-sized particles in a chamber study** (**2014**), 88, 165-171.

Background: Airborne particles are associated with increased morbidity and mortality due to respiratory and cardiovascular diseases in polluted areas. There is a growing interest in nano-sized particles with diameter < 100 nm and their potential health effects. Heart rate variability (HRV) is a noninvasive method for cardiovascular risk prediction in high prevalent groups. Aim of study: The aim was to evaluate the impact of nano-sized indoor air particles on HRV for healthy and adult females. Methods: All exposures were performed as controlled chamber experiments with particle exposure from burning candles, terpene + ozone reactions or filtered air in a double-blind cross over design. Twenty-two healthy females were investigated during 10 min periods at different exposures and the reactivity in high frequency (HF) spectral band of HRV were computed. Results: Heart rate was unchanged from baseline values in all groups during all experimental settings. HF power of HRV tended to increase during exposure to particles from burning candle while particles from terpene + ozone reactions tended to decrease HF power. Conclusions: Exposure to nano-sized particles of burning candles or terpene + ozone reactions results in different patterns of heart rate variability, with signs of altered autonomic cardiovascular control. Practical implications: This study indicates that the HRV method may be used for information on physiological responses of exposure to different nano-sized particles and contribute to the understanding of mechanisms behind health effects of particle exposures. (C) 2014 The Authors. Published by Elsevier Ltd.

54. S. Punsmann, V. Liebers, A. Lotz, T. Bruning and M. Raulf, **Ex Vivo Cytokine Release and Pattern Recognition Receptor Expression of Subjects Exposed to Dampness: Pilot Study to Assess the Outcome of Mould Exposure to the Innate Immune System**, (2013)

Plos One. Vol.: 8, pp 10.

In rooms with moisture damage, the indoor air can be enriched with microorganisms causing a variety of symptoms. Due to the highly diverse composition of bioaerosols and the multiple effects on humans, an assessment of the health risk is not sufficiently possible. The aim of this study was to characterize the features of innate immunity using blood from subjects exposed to moisture damage compared to control subjects living in houses without visible moisture damage. We investigated the expression of TLR-2, TLR-4 and dectin-1 on the surface of monocytes from both fresh blood and after in vitro stimulation with the model substances E. coli endotoxin, zymosan A, Pam(3)Cys and Aspergillus versicolor in 25 exposed subjects and 25 control subjects. In vitro stimulation of whole blood with the same components was performed for 20 h and the release of inflammatory mediators IL-8 and IL-1 beta were quantified. In addition to an enhanced number of blood leucocytes, the expression of the receptors TLR-2, TLR-4 and dectin-1 on blood monocytes was significantly enhanced in exposed subjects. In contrast, no different alteration in expression was detected between exposed and control group after in vitro stimulation with the model substances. The release of IL-8 and IL-1 beta after stimulation of whole blood with A. versicolor was increased in subjects exposed to moisture damage. Furthermore, in the exposed subjects the IL-1 beta release was significantly enhanced after in vitro stimulation with E. coli endotoxin (1000 pg/mL). In conclusion, features of the innate immune system (receptor expression and mediator release of monocytes) are

altered in subjects exposed to moisture damage which may be a potential explanation for the increased incidence of respiratory health diseases observed in these populations.

54. E. J. Jo, M. Y. Kim, S. E. Lee, S. Y. Lee, M. H. Kim, W. J. Song, S. H. Kim, H. R. Kang, Y. S. Chang, S. H. Cho and K. U. Min, **Eosinophilic Airway Inflammation and Airway Hyperresponsiveness According to Aeroallergen Sensitization Pattern in Patients With Lower Airway Symptoms**, (2014)

Allergy Asthma & Immunology Research. Vol.: 6, pp 39-46.

Purpose: Sensitization to specific allergens may be important in the development of allergic airway inflammation and airway hyperresponsiveness (AHR). We evaluated the effect of specific aeroallergen sensitization on eosinophilic airway inflammation and AHR. Methods: We reviewed retrospectively the clinical data of subjects who underwent skin prick tests to aeroallergens, induced sputum analysis, and methacholine bronchial provocation tests to evaluate lower airway symptoms as well as analyzed the associations between the pattern of aeroallergen sensitization and sputum eosinophilia or AHR. Results: Of the 1,202 subjects be enrolled, 534 (44.4%) were sensitized to at least one aeroallergen in skin tests. AHR was demonstrated in 23.5% and sputum eosinophilia in 38.8%. Sputum eosinophilia was significantly associated with sensitization to perennial allergens (OR, 1.9; 95% CI, 1.4-2.5), house dust mite (OR, 1.7; 95% CI, 1.3-2.3), dog (OR, 1.9; 95% CI, 1.1-3.3), and cat (OR, 2.1; 95% CI, 1.4-3.4). AHR was associated with sensitization to perennial allergens (OR, 2.7; 95% CI, 2.0-3.7), house dust mite (OR, 2.2; 95% CI, 1.6 3.2), Altemaria (OR, 2.3; 95% CI, 1.2-4.7), and cat (OR, 2.7; 95% CI, 1.7-4.3). Sensitization to more perennial allergens increased the risk for sputum eosinophilia and AHR. There was no relationship with individual seasonal allergens. Conclusion: The development of airway eosinophilic inflammation and AHR in an adult Korean population was associated with sensitization to perennial allergens rather than seasonal allergens.

III.2 Expologie

Rubrique N° 9

55. Yu Ait Bamai, Eiji Shibata, Ikue Saito, Atsuko Araki, Ayako Kanazawa, Kanehisa Morimoto, Kunio Nakayama, Masatoshi Tanaka, Tomoko Takigawa, Takesumi Yoshimura, Hisao Chikara, Yasuaki Saijo and Reiko Kishi, **Exposure to house dust phthalates in relation to asthma and allergies in both children and adults** (**2014**), 485â€“486, 153-163.

Abstract Although an association between exposure to phthalates in house dust and childhood asthma or allergies has been reported in recent years, there have been no reports of these associations focusing on both adults and children. We aimed to investigate the relationships between phthalate levels in Japanese dwellings and the prevalence of asthma and allergies in both children and adult inhabitants in a cross-sectional study. The levels of seven phthalates in floor dust and multi-surface dust in 156 single-family homes were measured. According to a self-reported questionnaire, the prevalence of bronchial asthma, allergic rhinitis, allergic conjunctivitis, and atopic dermatitis in the 2 years preceding the study was 4.7%, 18.6%, 7.6%, and 10.3%, respectively. After evaluating the interaction effects of age and exposure categories with generalized liner mixed models, interaction effects were obtained for DiNP and bronchial asthma in adults (Pinteraction = 0.028) and for DMP and allergic rhinitis in children (Pinteraction = 0.015). Although not statistically significant, children had higher ORs of allergic rhinitis for DiNP, allergic conjunctivitis for DEHP, and atopic dermatitis for DiBP and BBzP than adults, and liner associations were observed (Ptrend < 0.05). On the other hand, adults had a higher OR for atopic dermatitis and DEHP compared to children. No significant associations were found in phthalates levels collected from multi-surfaces.

This study suggests that the levels of DMP, DEHP, DiBP, and BBzP in floor dust were associated with the prevalence of allergic rhinitis, conjunctivitis, and atopic dermatitis in children, and children are more vulnerable to phthalate exposure via household floor dust than are adults. The results from this study were shown by cross-sectional nature of the analyses and elaborate assessments for metabolism of phthalates were not considered. Further studies are needed to advance our understanding of phthalate toxicity.

56. A. Barraza-Villarreal, M. C. Escamilla-Nunez, A. Schilmann, L. Hernandez-Cadena, Z. Li, L. Romanoff, A. Sjodin, B. E. Del Rio-Navarro, D. Diaz-Sanchez, F. Diaz-Barriga, P. Sly and I. Romieu, **Lung Function, Airway Inflammation, and Polycyclic Aromatic Hydrocarbons Exposure in Mexican Schoolchildren A Pilot Study** (**2014**), 56, 415-419.

Objective: To determine the association of exposure to polycyclic aromatic hydrocarbons (PAHs) with lung function and pH of exhaled breath condensate (EBC) in Mexican schoolchildren. Methods: A pilot study was performed in a subsample of 64 schoolchildren from Mexico City. Lung function and pH of EBC were measured and metabolites of PAHs in urine samples were determined. The association was analyzed using robust regression models. Results: A 10% increase in the concentrations of 2-hydroxyfluorene was significantly negatively associated with forced expiratory volume in 1 second (-11.2 mL, 95% CI: -22.2 to -0.02), forced vital capacity (-11.6 mL, 95% CI: -22.9 to -0.2), and pH of EBC (-0.035, 95% CI: -0.066 to -0.005). Conclusion: Biomarkers of PAHs exposure were inversely associated with lung function and decrease of ph of EBC as a marker of airway inflammation in Mexican schoolchildren.

57 .M. S. Breen, T. C. Long, B. D. Schultz, J. Crooks, M. Breen, J. E. Langstaff, K. K. Isaacs, Y. M. Tan, R. W. Williams, Y. Cao, A. M. Geller, R. B. Devlin, S. A. Batterman and T. J. Buckley, **GPS-based microenvironment tracker (MicroTrac) model to estimate time location of individuals for air pollution exposure assessments: Model evaluation in central North Carolina** (**2014**), 24, 412-420.

A critical aspect of air pollution exposure assessment is the estimation of the time spent by individuals in various microenvironments (ME). Accounting for the time spent in different ME with different pollutant concentrations can reduce exposure misclassifications, while failure to do so can add uncertainty and bias to risk estimates. In this study, a classification model, called MicroTrac, was developed to estimate time of day and duration spent in eight ME (indoors and outdoors at home, work, school; inside vehicles; other locations) from global positioning system (GPS) data and geocoded building boundaries. Based on a panel study, MicroTrac estimates were compared with 24-h diary data from nine participants, with corresponding GPS data and building boundaries of home, school, and work. MicroTrac correctly classified the ME for 99.5% of the daily time spent by the participants. The capability of MicroTrac could help to reduce the time location uncertainty in air pollution exposure models and exposure metrics for individuals in health studies.

58. D. Hammond, C. Croghan, H. Shin, R. Burnett, R. Bard, R. D. Brook and R. Williams, **Cardiovascular impacts and micro-environmental exposure factors associated with continuous personal PM2.5 monitoring** (**2014**), 24, 337-345.

The US Environmental Protection Agency's (US EPA) Detroit Exposure and Aerosol Research Study (DEARS) has provided extensive data on human exposures to a wide variety of air pollutants and their impact on human health. Previous analyses in the DEARS revealed select cardiovascular (CV) health outcomes such as increase in heart rate (HR) associated with hourly based continuous personal fine particulate matter (PM2.5) exposures in this adult, non-smoking cohort. Examination of time activity diary (TAD), follow-up questionnaire (FQ) and the continuous PM2.5 personal monitoring data provided the means to more fully examine the impact of discreet human activity patterns on personal PM2.5 exposures and changes in CV outcomes. A total of 329 343 min-based PM2.5 personal measurements involving 50 participants indicated that 75% of these total events resulted in exposures <35 mu g/m(3). Cooking and car-related events accounted for nearly 10% of the hourly activities that were identified with observed peaks in personal PM2.5 exposures. In-residence cooking often resulted in some of the highest incidents of 1 min exposures (33.5-17.6,mu g/m(3)), with average peaks for such events in excess of 209,mu g/m(3). PM2.5 exposure data from hourly based personal exposure activities (for example cooking, cleaning and household products) were compared with daily CV data from the DEARS subject population. A total of 1300 hourly based lag risk estimates associated with changes in brachial artery diameter and flow-mediated dilatation (BAD and FMD, respectively), among others, were defined for this cohort. Findings indicate that environmental tobacco smoke (ETS) exposures resulted in significant HR changes between 3 and 7h following the event, and exposure to smells resulted in increases in BAD on the order of 0.2-0.7 mm/mu g/m(3). Results demonstrate that personal exposures may be associated with several biological responses, sometimes varying in degree and direction in relation to the extent of the exposure.

59. E. Dons, M. Van Poppel, B. Kochan, G. Wets and L. I. Panis, Implementation and validation of a modeling framework to assess personal exposure to black carbon, (2013)

Environment International. Vol.: 62, pp 64-71.

Because people tend to move from one place to another during the day, their exposure to air pollution will be determined by the concentration at each location combined with the exposure encountered in transport. In order to estimate the exposure of individuals in a population more accurately, the activity-based modeling framework for Black Carbon exposure assessment, AB(2)C, was developed. An activity-based traffic model was applied to model the whereabouts of individual agents. Exposure to black carbon (BC) in different microenvironments is assessed with a land use regression model, combined with a fixed indoor/outdoor factor for exposure in indoor environments. To estimate exposure in transport, a separate model was used taking into account transport mode, timing of the trip and degree of urbanization. The modeling framework is validated using weeklong time-activity diaries and BC exposure as revealed from a personal monitoring campaign with 62 participants. For each participant in the monitoring campaign, a synthetic population of 100 model-agents per day was made up with all agents meeting similar preconditions as each real-life agent. When these model-agents pass through every stage of the modeling framework, it results in a distribution of potential exposures for each individual. The AB(2)C model estimates average personal exposure slightly more accurately compared to ambient concentrations as predicted for the home subzone; however the added value of a dynamic model lies in the potential for detecting short term peak exposures rather than modeling average exposures. The latter may bring new opportunities to epidemiologists: studying the effect of frequently repeated but short exposure peaks on long term exposure and health.

- ***Biomarqueurs***

60. A. J. Wheeler, N. A. Dobbin, M. E. Heroux, M. Fisher, L. Sun, C. F. Khoury, R. Hauser, M. Walker, T. Ramsay, J. F. Bienvenu, A. LeBlanc, E. Daigle, E. Gaudreau, P. Belanger, M. Feeley, P. Ayotte and T. E. Arbuckle, **Urinary and breast milk biomarkers to assess exposure to naphthalene in pregnant women: an investigation of personal and indoor air sources** (**2014**), 13, 30-30.

Background: Naphthalene exposures for most non-occupationally exposed individuals occur primarily indoors at home. Residential indoor sources include pest control products (specifically moth balls), incomplete combustion such as cigarette smoke, woodstoves and cooking, some consumer and building products, and emissions from gasoline sources found in attached garages. The study aim was to assess naphthalene exposure in pregnant women from Canada, using air measurements and biomarkers of exposure. Methods: Pregnant women residing in Ottawa, Ontario completed personal and indoor air sampling, and questionnaires. During pregnancy, pooled urine voids were collected over two 24-hour periods on a weekday and a weekend day. At 2-3 months post-birth, they provided a spot urine sample and a breast milk sample following the 24-hour air monitoring. Urines were analyzed for 1-naphthol and 2-naphthol and breast milk for naphthalene. Simple linear regression models examined associations between known naphthalene sources, air and biomarker samples. Results: Study recruitment rate was 11.2% resulting in 80 eligible women being included. Weekday and weekend samples were highly correlated for both personal ($r = 0.83$, $p < 0.0001$) and indoor air naphthalene ($r = 0.91$, $p < 0.0001$). Urine specific gravity (SG)-adjusted 2-naphthol concentrations collected on weekdays and weekends ($r = 0.78$, $p < 0.001$), and between pregnancy and postpartum samples ($r = 0.54$, $p < 0.001$) were correlated. Indoor and personal air naphthalene concentrations were significantly higher post-birth than during pregnancy ($p < 0.0001$ for signed rank tests); concurrent urine samples were not significantly different. Naphthalene in breast milk was associated with urinary 1-naphthol: a 10% increase in 1-naphthol was associated with a 1.6% increase in breast milk naphthalene (95% CI: 0.2%-3.1%). No significant associations were observed between naphthalene sources reported in self-administered questionnaires and the air or biomarker concentrations. Conclusions: Median urinary concentrations of naphthalene metabolites tended to be similar to (1-naphthol) or lower (2-naphthol) than those reported in a Canadian survey of women of reproductive age. Only urinary 1-naphthol and naphthalene in breast milk were associated. Potential reasons for the lack of other associations include a lack of sources, varying biotransformation rates and behavioural differences over time.

61. S. Langer, G. Beko, C. J. Weschler, L. M. Brive, J. Toftum, M. Callesen and G. Clausen, **Phthalate metabolites in urine samples from Danish children and correlations with phthalates in dust samples from their homes and daycare centers**, (2013)

International Journal of Hygiene and Environmental Health. Vol.: 217, pp 78-87.

Around the world humans use products that contain phthalates, and human exposure to certain of these phthalates has been associated with various adverse health effects. The aim of the present study has been to determine the concentrations of the metabolites of diethyl phthalate (DEP), di(n-butyl) phthalate (DnBP), di(iso-butyl) phthalate (DiBP), butyl benzyl phthalate (BBzP) and di(2-ethylhexyl) phthalate (DEHP) in urine samples from 441 Danish children (3-6 years old). These children were subjects in the Danish Indoor Environment and Children's Health study. As part of each child's medical examination, a sample from his or her first morning urination was collected. These samples were subsequently analyzed for metabolites of the targeted phthalates. The measured concentrations of each metabolite were approximately log-normally distributed, and the metabolite concentrations significantly correlated with one another. Additionally, the mass fractions of DEP, DnBP, DiBP and BBzP in dust collected from the children's bedrooms and daycare centers

significantly correlated with the concentrations of these phthalates' metabolites (monoethyl phthalate (MEP), mono-n-butyl phthalate (MnBP), mono-isobutyl phthalate (MiSP) and monobenzyl phthalate (MBzP), respectively) in the children's urine. Such correlations indicate that indoor exposures meaningfully contributed to the Danish children's intake of DEP, DnBP, DiBP and BBzP. This was not the case for DEHP. The urine concentrations of the phthalate metabolites measured in the present study were remarkably similar to those measured in urine samples from children living in countries distributed over four continents. These similarities reflect the globalization of children's exposure to phthalate containing products.

III.3 Épidémiologie

Rubrique N°10

a. COV et COSV

62. K. H. Jung, M. Perzanowski, A. Rundle, K. Moors, B. Z. Yan, S. N. Chillrud, R. Whyatt, D. Camann, F. P. Perera and R. L. Miller, Polycyclic aromatic hydrocarbon exposure, obesity and childhood asthma in an urban cohort, (2014)

Environmental Research. Vol.: 128, pp 35-41.

Background: Exposure to traffic-related air pollutants, including polycyclic aromatic hydrocarbons (PAHs) from traffic emissions and other combustion sources, and childhood obesity, have been implicated as risk factors for developing asthma. However, the interaction between these two on asthma among young urban children has not been studied previously. Methods: Exposure to early childhood PAHs was measured by two week residential indoor monitoring at age 5-6 years in the Columbia Center for Children's Environmental Health birth cohort (n=311). Semivolatile [e.g., methylphenanthrenes] and nonvolatile [e.g., benzo(a)pyrene] PAHs were monitored. Obesity at age 5 was defined as a body mass index (BMI) greater than or equal to the 95th percentile of the year 2000 age- and sex-specific growth charts (Center for Disease Control). Current asthma and recent wheeze at ages 5 and 7 were determined by validated questionnaires. Data were analyzed using a modified Poisson regression in generalized estimating equations (GEE) to estimate relative risks (RR), after adjusting for potential covariates. Results: Neither PAH concentrations or obesity had a main effect on asthma or recent wheeze. In models stratified by presence/absence of obesity, a significant positive association was observed between an interquartile range (IQR) increase in natural log-transformed 1-methylphenanthrene (RR [95% CI]: 2.62 [1.17-5.88] with IQR(ln)=0.76), and 9-methylphenanthrene (2.92 [1.09-7.82] with IQR(ln)=0.73) concentrations and asthma in obese children (n=63). No association in non-obese (n=248) children was observed at age 5 (P-interaction < 0.03). Similar associations were observed for 3-methylphenanthrene, 9-methylphenanthrene, and 3,6-dimethylphenanthrene at age 7. Conclusions: Obese young children may be more likely to develop asthma in association with greater exposure to PAHs, and methylphenanthrenes in particular, than non-obese children.

b. SBS

63. J. Wilson, S. L. Dixon, D. E. Jacobs, J. Breysse, J. Akoto, E. Tohn, M. Isaacson, A. Evens and Y. Hernandez, Watts-to-Wellbeing: does residential energy conservation improve health?, (2013)

Energy Efficiency. Vol.: 7, pp 151-160.

Residential energy conservation has been increasing in number of houses treated, frequency, and scope, but few studies have examined whether modern energy conservation measures improve the

health status of the occupants. We measured self-reported general, respiratory, cardiovascular, and mental health via structured telephone interviews using an adaptation of the National Health Interview Survey at baseline and follow-up in 2009-2012 [n = 248 households in Boston, Chicago, and New York City (248 adults and 75 children)]. Housing included buildings with one to three units (n = 106 units) located in Boston and buildings with > 3 units/building (n = 142) located in Chicago and New York. The energy conservation typically included insulation, heating equipment, and ventilation improvements. Adult respondents reported a 0.29-point improvement in the mean general health score (1 = excellent, 2 = very good, 3 = good, 4 = fair, 5 = poor) (3.07 to 2.78, $p < 0.001$). Sinusitis, hypertension, overweight, and reduced use of asthma medication during asthma attacks showed 5 %, 14 %, 11 %, and 20 % differentials between improvement and worsening ($p = 0.038$, $p < 0.001$, $p < 0.001$, and $p = 0.077$, respectively). Forty-two adult respondents reported doctor-diagnosed asthma at baseline. Two measures of asthma severity worsened (days with problems sleeping-differential between improvement and worsening -28 %, $p = 0.009$; and frequency of symptoms such as cough, wheezing, and shortness of breath-differential between improvement and worsening -26 %, $p = 0.031$). Nitrogen dioxide, carbon monoxide, and carbon dioxide were low and showed no significant changes from baseline to follow-up in 41 housing units. This study found that residential energy conservation work conducted by trained professionals that balances energy efficiency and indoor environmental quality improves general health, sinusitis, and reduced asthma medication. Further research is needed to understand asthma-related outcomes.

III.4 Populations sensibles

64. S. E. Frey, H. Destaillats, S. Cohn, S. Ahrentzen and M. P. Fraser, **Characterization of indoor air quality and resident health in an Arizona senior housing apartment building** (**2014**), 64, 1251-1259.

A survey of key indoor air quality (IAQ) parameters and resident health was carried out in 72 apartments within a single low-income senior housing building in Phoenix, Arizona. Air sampling was carried out simultaneously with a questionnaire on personal habits and general health of residents. Mean PM10 concentrations are 66 +/- 16, 58 +/- 13, and 24 +/- 3 mu g/m(3) and mean PM2.5 concentrations are 62 +/- 16, 53 +/- 13, and 20 +/- 2 mu g/m(3) for the living room, kitchen, and outdoor balcony, respectively. Median PM10 concentrations are 17, 18 and 17 mu g/m(3) and median PM2.5 concentrations are 13, 14, and 13 mu g/m(3), respectively. The initial results indicate that increased indoor particle concentrations coincide with residents who report smoking cigarettes. Indoor formaldehyde concentrations revealed median levels of 36.9, 38.8, and 4.3 ppb in the living room, kitchen, and balcony, respectively. Results show that 36% of living room samples and 44% of kitchen samples exceeded the Health Canada REL for chronic exposure to formaldehyde (40 ppb). Associations between occupants' behavior, self-reported health conditions, and IAQ are evaluated

65. R. Habre, E. Moshier, W. Castro, A. Nath, A. Grunin, A. Rohr, J. Godbold, N. Schachter, M. Kattan, B. Coull and P. Koutrakis, **The effects of PM2.5 and its components from indoor and outdoor sources on cough and wheeze symptoms in asthmatic children** (**2014**), 24, 380-387.

Particulate matter with aerodynamic diameter <2.5 mu m (PM2.5) is associated with asthma exacerbation. In the Children's Air Pollution Asthma Study, we investigated the longitudinal association of PM2.5 and its components from indoor and outdoor sources with cough and wheeze symptoms in 36 asthmatic children. The sulfur tracer method was used to estimate infiltration factors. Mixed proportional Odds models for an ordinal response were used to relate daily cough and wheeze scores to PM2.5 exposures. The odds ratio associated with being above a given symptom

score for a SD increase in PM2.5 from indoor sources (PMis) was 1.24(95% confidence interval: 0.92-1.68) for cough and 1.63 (1.11-2.39) for wheeze. Ozone was associated with wheeze (1.82, 1.19-2.80), and cough was associated, with indoor PM2.5 components from outdoor sources (denoted with subscript "OS") bromine (Bros: 1.32, 1.05-1.67), chlorine (Clos: 1.27, 1.02-1.59) and pyrolyzed organic carbon (01305: 1.49, 1.12-1.99). The highest effects were seen in the winter for cough with sulfur (Sos: 2.28, 1.01-5.16) and wheeze with organic carbon fraction 2 (OC2os: 7.46, 1.19-46.60). Our results indicate that exposure to components originating from outdoor sources of photochemistry, diesel and fuel oil combustion is associated with symptom's exacerbation, especially in the winter. PM2.5 mass of indoor origin was more strongly associated with wheeze than with cough.

66. D. G. Karottki, M. Spilak, M. Frederiksen, L. Gunnarsen, E. V. Brauner, B. Kolarik, Z. J. Andersen, T. Sigsgaard, L. Barregard, B. Strandberg, G. Sallsten, P. Moller and S. Loft, **An indoor air filtration study in homes of elderly: cardiovascular and respiratory effects of exposure to particulate matter**, (2013)

Environmental Health. Vol.: 12, pp 116-116.

Background: Exposure to particulate air pollution increases respiratory and cardiovascular morbidity and mortality, especially in elderly, possibly through inflammation and vascular dysfunction. Methods: We examined potential beneficial effects of indoor air filtration in the homes of elderly, including people taking vasoactive drugs. Forty-eight nonsmoking subjects (51 to 81 years) in 27 homes were included in this randomized, double-blind, crossover intervention study with consecutive two-week periods with or without the inclusion of a high-efficiency particle air filter in re-circulating custom built units in their living room and bedroom. We measured blood pressure, microvascular and lung function and collected blood samples for hematological, inflammation, monocyte surface and lung cell damage markers before and at day 2, 7 and 14 during each exposure scenario. Results: The particle filters reduced the median concentration of PM2.5 from approximately 8 to 4 mu g/m(3) and the particle number concentration from 7669 to 5352 particles/cm(3). No statistically significant effects of filtration as category were observed on microvascular and lung function or the biomarkers of systemic inflammation among all subjects, or in the subgroups taking (n = 11) or not taking vasoactive drugs (n = 37). However, the filtration efficacy was variable and microvascular function was within 2 days significantly increased with the actual PM2.5 decrease in the bedroom, especially among 25 subjects not taking any drugs. Conclusion: Substantial exposure contrasts in the bedroom and no confounding by drugs appear required for improved microvascular function by air filtration, whereas no other beneficial effect was found in this elderly population.

III.5 Évaluation des risques

Rubrique N°11

67. A. W. Norgaard, J. D. Kudal, V. Kofoed-Sorensen, I. K. Koponen and P. Wolkoff, **Ozone-initiated VOC and particle emissions from a cleaning agent and an air freshener: Risk assessment of acute airway effects** (**2014**), 68, 209-218.

Abstract Emissions of volatile organic compounds and ultrafine particles from a kitchen cleaning agent (cream) and plug-in air freshener were investigated in a 20 m3 walk-in climate chamber at low (~ 5 ppb) and high ozone (~ 50 ppb) test concentrations and 0.6 air exchange rate. The products emitted terpenes, inter alia limonene, dihydromyrcenol, geraniol, linalool, and glycol ethers. The ozone-initiated reaction products of these compounds were measured by air sampling on Tenax TA

followed by thermal desorption GCâ€“MS and air sampling on DNPH cartridges followed by liquid extraction and HPLCâ€“UV analysis. Particle formation was monitored simultaneously. A number of oxygenated and poly-oxygenated reaction products were identified and risk assessed for acute airway effects: formaldehyde, acetaldehyde, acetone, 4-acetyl-1-methylcyclohexene, 6-methyl-5-heptene-2-one, 3-isopropenyl-6-oxo-heptanal, and 4-oxo-pentanal. These compounds generally increased initially at the high ozone concentration, while the terpenes decayed, concurrent with their consumption of ozone. At high ozone concentration, the plug-in air freshener resulted in concentrations of formaldehyde and 4-oxopentanal that may give rise to concern about sensory irritation and airflow limitation, respectively. At high ozone concentration, the kitchen cleaning agent and air freshener resulted in peak particle mass concentrations at 81 Î¼g/m3 (8.5 Ã— 105 #/cm3) and 24 Î¼g/m3 (2.3 Ã— 104 #/cm3), respectively. At low ozone concentration, the particle concentration peaked at 4 Î¼g/m3 (1.0 Ã— 105 #/cm3) after the application of the kitchen cleaning agent, while no increase was observed for the air freshener. The particles, in view of their organic composition and concentration, are not considered to cause acute airway effects. Testing under realistic conditions that mimic user pattern behavior is warranted to obtain acute and longer-term exposure data at realistic indoor ozone concentrations.

68. P. Wargocki, **The Effects of Ventilation in Homes on Health,** (2013)

International Journal of Ventilation. Vol.: 12, pp 101-118.

It is estimated that people in the developed world spend more than 85-90% of their time indoors. Of this, most is spent in homes. To minimize health risks from pollutants occurring in homes, exposures should be controlled. The most effective way to achieve this is to control sources of pollutants and to reduce emissions. Often, especially in existing buildings, this strategy is difficult to implement, in which case exposures are controlled by providing sufficient, presumably clean, outdoor ventilation air to dilute and remove the contaminants. The present paper attempts to find out how much ventilation is needed in existing homes to reduce health risks. This is achieved by reviewing the published scientific literature investigating the association between measured ventilation rates and the measured and observed health problems. The paper concludes that, generally, there are very few studies on this issue and many of them suffer from deficient experimental design, as well as a lack of proper characterization of actual exposures occurring indoors. Based on the available data, in the reviewed studies, it seems likely that health risks may occur when ventilation rates are below 0.4 air changes per hour in existing homes. No data were found indicating that buildings having dedicated natural ventilation systems perform less well than the dwellings in which mechanical ventilation systems are installed. Newly installed mechanical ventilation systems were observed to improve health conditions. In homes with existing ventilation systems this positive effect was less evident, probably due to poor performance of the system (too low ventilation rates and/or poor maintenance). Studies are recommended in which exposures are much better characterized (by for example measuring the pollutants indicated by the WHO Guidelines for Indoor Air Quality and improving ventilation measurements). Exposures should also be controlled using different ventilation methods for comparison. Future studies should also advance the understanding of how ventilation systems should be operated to achieve optimal performance. These data would create further input and support to the guidelines for ventilation based on health developed currently in the framework of the HealthVent project (www.healthvent.eu).

69. Kevin Fournier, Philippe Glorennec and Nathalie Bonvallot, **An exposure-based framework for grouping pollutants for a cumulative risk assessment approach: Case study of indoor semi-volatile organic compounds**, (2014)

Environmental Research. Vol.: 130, pp 20-28.

Abstract Humans are exposed to a large number of contaminants, many of which may have similar health effects. This paper presents a framework for identifying pollutants to be included in a cumulative risk assessment approach. To account for the possibility of simultaneous exposure to

chemicals with common toxic modes of action, the first step of the traditional risk assessment process, i.e. hazard identification, is structured in three sub-steps: (1a) Identification of pollutants people are exposed to, (1b) identification of effects and mechanisms of action of these pollutants, (1c) grouping of pollutants according to similarity of their mechanism of action and health effects. Based on this exposure-based grouping we can derive "multi-pollutant" toxicity reference values, in the "dose/response assessment" step. The approach proposed in this work is original in that it is based on real exposures instead of a limited number of pollutants from a unique chemical family, as traditionally performed. This framework is illustrated by the case study of semi-volatile organic compounds in French dwellings, providing insights into practical considerations regarding the accuracy of the available toxicological information. This case study illustrates the value of the exposure-based approach as opposed to the traditional cumulative framework, in which chemicals with similar health effects were not always included in the same chemical class.

70. M. Mesa-Frias, Z. Chalabi and A. M. Foss, **Quantifying uncertainty in health impact assessment: A case-study example on indoor housing ventilation**, (2014) *Environment International*. Vol.: 62, pp 95-103.

Quantitative health impact assessment (HIA) is increasingly being used to assess the health impacts attributable to an environmental policy or intervention. As a consequence, there is a need to assess uncertainties in the assessments because of the uncertainty in the HIA models. In this paper, a framework is developed to quantify the uncertainty in the health impacts of environmental interventions and is applied to evaluate the impacts of poor housing ventilation. The paper describes the development of the framework through three steps: (i) selecting the relevant exposure metric and quantifying the evidence of potential health effects of the exposure; (ii) estimating the size of the population affected by the exposure and selecting the associated outcome measure; (iii) quantifying the health impact and its uncertainty. The framework introduces a novel application for the propagation of uncertainty in HIA, based on fuzzy set theory. Fuzzy sets are used to propagate parametric uncertainty in a non-probabilistic space and are applied to calculate the uncertainty in the morbidity burdens associated with three indoor ventilation exposure scenarios: poor, fair and adequate. The case-study example demonstrates how the framework can be used in practice, to quantify the uncertainty in health impact assessment where there is insufficient information to carry out a probabilistic uncertainty analysis.

IV. GESTION / DIVERS

IV.1 Systèmes de ventilation

Rubrique N°12

Pas d'article pertinent dans cette rubrique

IV.2 Analyse coût-bénéfice

Rubrique N°13

71. B. R. Loomis, P. R. Shafer and M. van Hasselt, **The Economic Impact of Smoke-Free Laws on Restaurants and Bars in 9 States**, (2013) - Preventing Chronic Disease. Vol.: 10, pp 8.

Smoke-free air laws in restaurants and bars protect patrons and workers from involuntary exposure to secondhand smoke, but owners often express concern that such laws will harm their businesses. The primary objective of this study was to estimate the association between local smoke-free air laws and economic outcomes in restaurants and bars in 8 states without statewide smoke-free air laws: Alabama, Indiana, Kentucky, Mississippi, Missouri, South Carolina, Texas, and West Virginia. A secondary objective was to examine the economic impact of a 2010 statewide smoke-free restaurant and bar law in North Carolina. Methods Using quarterly data from 2000 through 2010, we estimated dynamic panel data models for employment and sales in restaurants and bars. The models controlled for smoke-free laws, general economic activity, cigarette sales, and seasonality. We included data from 216 smoke-free cities and counties in the analysis. During the study period, only North Carolina had a statewide law banning smoking in restaurants or bars. Separate models were estimated for each state. Results In West Virginia, smoke-free laws were associated with a significant increase of approximately 1% in restaurant employment. In the remaining 8 states, we found no significant association between smoke-free laws and employment or sales in restaurants and bars. Conclusion Results suggest that smoke-free laws did not have an adverse economic impact on restaurants or bars in any of the states studied; they provided a small economic benefit in 1 state. On the basis of these findings, we would not expect a statewide smoke-free law in Alabama, Indiana, Kentucky, Missouri, Mississippi, South Carolina, Texas, or West Virginia to have an adverse economic impact on restaurants or bars in those states.

IV.3 Technique

Rubrique N°14

72. S. Wei, Z. Hua, G. Kai, W. Dong and Z. Xingxiang, **Acrylonitrile-Vinylidene Chloride Copolymer Film with Activated Carbon and MnO2 for Formaldehyde Degradation**, (2014)

Materials Testing. Vol.: 56, pp 65-69.

Acrylonitrile-vinylidene chloride (AN-VDC) copolymer films containing activated carbon, manganese dioxide nanoparticles were fabricated via casting method. The formaldehyde degradation capacity of copolymer film was investigated. The results showed that formaldehyde eliminating rate was obviously improved when copolymer film was blended with MnO2 or activated carbon, respectively. The HCHO removal rate increased with concentration of MnO2 or activated carbon. HCHO degradation rate of AN-VDC copolymer film without addition was 45 % for 48 h, while it was up to 90-95 % with the treatment time of 36 h after 3 wt.-% MnO2 or activated carbon addition. Furthermore, the complex effect of MnO2 and activated carbon on the degradation has also been studied. When 3 wt.-% MnO2 and 1 wt.-% activated carbon was mixed into copolymer, the HCHO removal rate was about 90 % for 36 h treatment. The results demonstrated that the formaldehyde

eliminating rate was enhanced by complex addition of both MnO2 and activated carbon compared to films with single additions. The enhancement of HCHO eliminating efficiency occured due to a double effect of physical absorption of activated carbon and catalytic oxidation of MnO2.

73. S. L. Miller, J. Linnes and J. Luongo, **Ultraviolet Germicidal Irradiation: Future Directions for Air Disinfection and Building Applications**, (2013)

Photochemistry and Photobiology. Vol.: 89, pp 777-781.

sk wheat Ultraviolet germicidal irradiation (UVGI) for air disinfection applications has relied on low-pressure mercury vapor lamps for decades. New design requirements have generated the need for alternatives in some uses. This study describes the current state of UVGI technology and describes future directions for technology development, including the use of lamps produced from nontoxic materials and light-emitting diode lamps. Important applications are discussed such as the use of ultraviolet germicidal lamps in developing countries, in heating, ventilating and air-conditioning systems to improve energy efficiency and indoor air quality, and for whole room disinfection.

74. R. P. Chauhan and A. Kumar, **Radon resistant potential of concrete manufactured using Ordinary Portland Cement blended with rice husk ash**, (2013)

Atmospheric Environment. Vol.: 81, pp 413-420.

The emission of radon from building materials and soil depends upon the radium content, porosity, moisture content and radon diffusion length of materials. Several techniques have been used to reduce the radon emission from the soil using different flooring materials. But the effectiveness of radon shielding depends upon the diffusion of radon through these materials. The present study proposes a method for producing a radon resistant material for decreasing radon diffusion through it. The method involves rice husk ash (RHA) in addition to cement for the preparation of concrete used for flooring and walls. The radon diffusion, exhalation and mechanical property of concrete prepared by rice husk ash blended cement were studied. The addition of RHA caused the reduction in radon diffusion coefficient, exhalation rates, porosity and enhanced the compressive strength of concrete. The bulk radon diffusion coefficient of cementitious concrete was reduced upto 69% by addition of rice husk ash as compare to that of control concrete.

75. Ranjit K. Nath, M. F. M. Zain, Abdul Amir H. Kadhum and A. B. M. A. Kaish, **An investigation of LiNbO3 photocatalyst coating on concrete surface for improving indoor air quality,** (2014)

Construction and Building Materials. Vol.: 54, pp 348-353.

Abstract The photocatalytic degradation of volatile organic compounds (VOCs) from the indoor air is an established method for improving the indoor environment. This paper investigates the photocatalytic degradation of ethyl benzene and toluene by using a new photocatalyst LiNbO3. LiNbO3 is applied as a coating material on the concrete surface and investigate its effectiveness under various operational parameters like the depth of coating, and initial concentration of VOCs. The efficiency of VOCs degradation is measured by gas chromatographyâ€“flame ionization detector (GC-FID) and scanning electron microscope (SEM) observations. Test results show that the performance of LiNbO3 is better than that of widely used photocatalyst TiO2 in removing VOCs from indoor environment. Degradation rate of VOC increases with the increase of depth of coating. Therefore, LiNbO3 can be used as a promising photocatalyst to remove VOCs from the indoor air.

76. Wararat Sriprapat, Parinda Suksabye, Sirintip Areephak, Polawat Klantup, Atcharaphan Waraha, Anuchit Sawattan and Paitip Thiravetyan, **Uptake of toluene and ethylbenzene by plants: Removal of volatile indoor air contaminants**, (2014)

Ecotoxicology and Environmental Safety. Vol.: 102, pp 147-151.

Abstract Air borne uptake of toluene and ethylbenzene by twelve plant species was examined. Of the twelve plant species examined, the highest toluene removal was found in Sansevieria trifasciata, while the ethylbenzene removal from air was with Chlorophytum comosum. Toluene and ethylbenzene can penetrate the plant×³s cuticle. However, the removal rates do not appear to be correlated with numbers of stomata per plant. It was found that wax of S. trifasciata and Sansevieria hyacinthoides had greater absorption of toluene and ethylbenzene, and it contained high hexadecanoic acid. Hexadecanoic acid might be involved in toluene and ethylbenzene adsorption by cuticles wax of plants. Chlorophyll fluorescence analysis or the potential quantum yield of PSII (Fv/Fm) in toluene exposed plants showed no significant differences between the control and the treated plants, whereas plants exposed to ethylbenzene showed significant differences or those parameters, specifically in Dracaena deremensis (Lemon lime), Dracaena sanderiana, Kalanchoe blossfeldiana, and Cordyline fruticosa. The Fv/Fm ratio can give insight into the ability of plants to tolerate (indoor) air pollution by volatile organic chemicals (VOC). This index can be used for identification of suitable plants for treating/sequestering VOCs in contaminated air.

IV.4 Réglementaire

Rubrique N°15

77. Sophia S. Konstantopoulou, Panagiotis K. Behrakis, Andreas C. Lazaris and Polyxeni Nicolopoulou-Stamati, **Indoor air quality in a bar/restaurant before and after the smoking ban in Athens**, Greece, (2014)

Science of The Total Environment. Vol.: 476-477, pp 136-143.

Abstract In this study we compared indoor air pollutant concentrations in a bar/restaurant in Greece before and after the enactment of a smoking ban legislation of 2008. This was done to investigate whether the separation of the venue into smoking and non-smoking areas will have an impact on workers and customers from secondhand smoke (SHS) exposure (null hypothesis). The study was completed within an 8-month period beginning in March 2010 and ending on November 2010. We compared the average of the measured PM0.1 concentrations in the smoking zones between the pre-ban and post-ban periods. Overall reduction in the number of particles was 18% between pre-ban and post-ban periods. The mean of the 36 total CO2 measurements for the pre- and the post-ban period was 611 ppm. We calculated the ventilation rates per occupant (Vo in l/s/occ) and found it to be higher in the post-ban period (19.4 l/s/occ), thus complying with the ASHARAE standard for Vo of 15 l/s/occ at maximum occupancy, than in the pre-ban period (10.7 l/s/occ). The mean of the 36 total CO measurements for the pre-ban period was 2 ppm. CO measurements in the post-ban period were less than the detection limit of 1 ppm. Emissions of nitrogen dioxide and formaldehyde weren't detected in any of the zones. It was observed there was about 50% distribution of pollutants from the smoking zones to the smoke-free zones. The smoking ban effect on the occupancy levels was initially reduced by 16%, but based on other similar studies this transition period will be followed by an increase in the occupancy. Passive smoking and associated risks were significantly reduced but not totally eliminated, indicating the need for stronger enforcement or complete partition between smoking and non-smoking areas.

78. B. A. King, S. R. Dube and D. M. Homa, **Smoke-Free Rules and Secondhand Smoke Exposure in Homes and Vehicles Among US Adults, 2009-2010, (2013) - Preventing Chronic Disease**. Vol.: 10, pp 12.

An increasing number of US states and localities have implemented comprehensive policies prohibiting tobacco smoking in all indoor areas of public places and worksites. However, private settings such as homes and vehicles remain a major source of exposure to secondhand smoke (SHS) for many people. This study assessed the prevalence and correlates of voluntary smoke-free rules and SHS exposure in homes and vehicles among US adults. Methods We obtained data from the 2009-2010 National Adult Tobacco Survey, a landline and cellular-telephone survey of adults aged 18 years or older residing in the 50 US states or the District of Columbia. We calculated national and state estimates of smoke-free rules and past-7-day SHS exposure in homes and vehicles and examined national estimates by sex, age, race/ethnicity, and education. Results The national prevalence of voluntary smoke-free home rules was 81.1% (state range, 67.9%-92.9%), and the prevalence of household smoke-free vehicle rules was 73.6% (state range, 58.6%-85.8%). Among nonsmokers, the prevalence of SHS exposure was 6.0% in homes (state range, 2.4%-13.0%) and 9.2% in vehicles (state range, 4.8%-13.7%). SHS exposure among nonsmokers was greatest among men, younger adults, non-Hispanic blacks, and those with a lower level of education. Conclusion Most US adults report having voluntary smoke-free home and vehicle rules; however, millions of people remain exposed to SHS in these environments. Disparities in exposure also exist among certain states and subpopulations. Efforts are needed to warn about the dangers of SHS and to promote voluntary smoke-free home and vehicle rules.

IV.5 Divers

79. F. C. Fuoco, G. Buonanno, **L. Stabile and P. Vigo, Influential parameters on particle concentration and size distribution in the mainstream of e-cigarettes,** (2014)

Environmental Pollution. Vol.: 184, pp 523-529.

Electronic cigarette-generated mainstream aerosols were characterized in terms of particle number concentrations and size distributions through a Condensation Particle Counter and a Fast Mobility Particle Sizer spectrometer, respectively. A thermodilution system was also used to properly sample and dilute the mainstream aerosol. Different types of electronic cigarettes, liquid flavors, liquid nicotine contents, as well as different puffing times were tested. Conventional tobacco cigarettes were also investigated. The total particle number concentration peak (for 2-s puff), averaged across the different electronic cigarette types and liquids, was measured equal to 4.39 +/- 0.42 x 10(9) part. cm(-3), then comparable to the conventional cigarette one (3.14 +/- 0.61 x 10(9) part. cm(-3)). Puffing times and nicotine contents were found to influence the particle concentration, whereas no significant differences were recognized in terms of flavors and types of cigarettes used. Particle number distribution modes of the electronic cigarette-generated aerosol were in the 120-165 nm range, then similar to the conventional cigarette one.

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