2012 Number 2

ISIAQ NEWSLETTER

May 2012

Seven Weeks until "Healthy Buildings 2012" July 8-12, Brisbane, Australia

ISIAQ's Healthy Buildings 2012 conference is less than two months away. If you have not yet made plans to attend, it is time to consider seriously whether you can afford to miss this important conference. The Healthy Buildings conference series was started in 1988 to focus on translation of research results into their practical implications. ISIAQ began sponsoring the conference series which fits squarely within ISIAQ's mission to address the needs of practitioners as well as researchers and policy makers around the world.

Information on the conference is available on the conference web site, www.HB2012.org.

Annual General Meeting (AGM) July 9, 2012, Brisbane, Australia

The Annual General Meeting – AGM – will be held at 5:45 PM at the Brisbane Convention Center, site of the Healthy Buildings 2012 conference. The Annual Report of the Board to the Members will be sent out in advance of the meeting.

Board of Directors: Election

The ballot for the election of the Board of Directors has been issued by the Secretariat and is due by the closing date of May 17. The Nominating Committee's recommended slate of voting members of the Board of Directors is as follows:

Pawel Wargocki, President, 2 yr term
Carl-Gustaf Bornehag, Treasurer, 2 yr term
Anne Hyvarinen, Secretary, 2 yr term
David Cheong, VP Research, 4 yr term
Andrea Ferro, at-large position, 4 yr term
Carl Grimes, VP Practice, 4 yr term
Chris Chao, at large position, 4 yr term
Glenn Morrison, VP Policy, President elect, 4 yr total term
William Nazaroff, Academy President, 2 yr term

In addition to the 9 voting members, a student representative (yet to be elected); President of the Indoor Air 2014 conference Yuguo Li; immediate Past President Richard Shaughnessy; and, Indoor Air journal Editor William Nazaroff all hold non-voting positions on the Board of Directors.

Call for Nominations: Student Representative to Board of Directors

The ISIAQ Board includes one student representative. A call for student representatives is now posted on the ISIAQ web site. If you are a student with an interest in serving or if you know a student you would like to nominate, submit the nomination before June 1st. You can see the details for this call for nominations on the ISIAQ web site, www.isiaq.org

Call for Hosts for ISIAQ's Healthy Buildings 2015 Regional Conferences

ISIAQ's Board of Directors invites Letters of Interest to host the 2015 Regional Healthy Buildings conferences in each of its 3 regions, Europe, the Americas, and Asia Pacific. For more information and details of the inviation, visit ISIAQ's web site or contact the Secretariat directly, email: info@ISIAQ.org.

In this Issue

Indoor Air, Volume 22, Number 3 June 2012
Abstracts

Richard L. Corsi, Kerry A. Kinney and Hal Levin - Microbiomes of built environments: 2011 symposium highlights and workgroup recommendations

The air we breathe inside buildings dominates overall inhalation exposure to most air pollutants, whether of indoor or outdoor origin. The same is true for our exposure to microorganisms. Over the past three decades much has been learned about chemicals (in gas and particle phases) in building air, including typical levels, sources, fate, and control. Far less has been learned about the types, sources, and fate of microorganisms in buildings, and about how building design, and operation and maintenance affect microorganisms in buildings. Knowledge creation has been constrained by historical reliance on culture-based methods that can yield only partial or biased assessments of microbial community structure, sometimes dramatically underestimating uncultivable organisms, and failing to detect fragments of organisms that may themselves influence human health. However, in the past several years, advances in culture-independent analytical methods have significantly increased knowledge related to microbial communities and diversity in buildings. We are positioned to make even stronger gains in the coming years.

K. Abe - Assessment of home environments with a fungal index using hydrophilic and xerophilic fungi as biologic sensors

Abstract Previously, the author proposed a 'fungal index' that quantifies the capacity for fungal growth in a test environment where a device (fungal detector) encapsulating spores of a xerophilic sensor fungus *Eurotium herbariorum* was placed. It was also found that an extremely xerophilic fungus, *Aspergillus penicillioides*, was suitable as a sensor fungus at sites with lower relative humidity (RH). In this report, the hydrophilic fungus *Alternaria alternata* was added to sensor fungi for the determination of the index in extremely humid environments. Measurements of the index and observations of the formation of spores by the sensor fungi were made in stable climates in moisture chambers, under natural conditions in homes, and in bathrooms prepared in an artificial climate chamber. Higher index values and earlier sporulation were obtained at higher RH in stable climates. The hydrophilic *Alt. alternata* showed the greatest response at 100% and 97.3% RH, the moderately xerophilic *Eur. herbariorum*, at 94%, 84%, and 75% RH, and the extremely xerophilic *Asp. penicillioides*, at 71% RH. In homes, the hydrophilic fungus was most active in water-usage areas, and the xerophilic fungi were most active in non-water-usage areas. Sporulation was observed on sensor fungi in fungal detectors placed in rooms where the index exceeded 18 ru/week after one-month exposure. Sites where the index exceeded 18 ru/week were referred to as damp, where fungal contamination seems to be unavoidable. Evaluations of ventilation systems in bathrooms with extremely humid climates showed typical examples of a countermeasure to fungal contamination.

Practical Implications The purpose of this study is to establish a fungal index applicable in home environments with extremely high to relatively low relative humidity climates. The sensor fungus that showed the greatest response in a fungal detector (a device encapsulating spores of sensor fungi) served as not only a quantitative but also a qualitative indicator of the environment tested, indicating the type of fungi that would contaminate the site. A fungal index would be a good tool for detecting dampness that induces fungal contamination, which has adverse effects on human health. Evaluations of indoor climates would provide information useful to building owners, builders, designers, advisers, medical practitioners, and so on. Selection of the most suitable insulation systems in various buildings under different climates or evaluations of the drying process in water-damaged buildings could also be possible using fungal detectors and measurements of fungal indices.

N.-Y. Hsu, C.-C. Lee, J.-Y. Wang, Y.-C. Li, H.-W. Chang, C.-Y. Chen, C.-G. Bornehag, P.-C. Wu, J. Sundell and H.-J. Su - Predicted risk of childhood allergy, asthma, and reported symptoms using measured phthalate exposure in dust and urine

Abstract The associated risk of phthalate exposure, both parent compounds in the home and their metabolites in urine, to childhood allergic and respiratory morbidity, after adjusting for exposures of indoor pollutants, especially bioaerosols, was comprehensively assessed. Levels of five phthalates in settled dust from the homes of 101 children (3–9 years old) were measured, along with their corresponding urinary metabolites. Other environmental risk factors, including indoor CO_2, $PM_{2.5}$, formaldehyde, 1,3-β-D-glucan, endotoxin, allergen and fungal levels, were concomitantly examined. Subject's health status was verified by pediatricians, and parents recorded observed daily symptoms of their children for the week that the home investigation visit took place. Significantly increased level of benzylbutyl phthalate, in settled dust, was associated with test case subjects (allergic or asthmatic children). Higher levels of dibutyl phthalate and its metabolites, mono-n-butyl phthalate, and mono-2-ethylhexyl phthalate were found to be the potential risk factors for the health outcomes of interest. Similarly, indoor fungal exposure remained a significant risk factor, especially for reported respiratory symptoms. The relative contribution from exposure to phthalates and indoor biocontaminants in childhood allergic and respiratory morbidity is, for the first time, quantitatively assessed and characterized.

Practical Implications For asthmatic and allergic children living in subtropical and highly developed environments like homes in Taiwan, controlling environmental exposure of phthalates may be viewed as equally important as avoiding indoor microbial burdens, for the management of allergy-related diseases. It is also recognized that multidisciplinary efforts will be critical in realizing the true underlying mechanisms associated with these observations.

N. Ali, N. Van den Eede, A. C. Dirtu, H. Neels and A. Covaci - Assessment of human exposure to indoor organic contaminants via dust ingestion in Pakistan

Abstract Ingestion of indoor dust has been acknowledged as an important route of exposure to organic contaminants (OCs). We investigated the presence of polybrominated diphenyl ethers (PBDEs), novel brominated flame retardants (NBFRs), organophosphate flame retardants (OPFRs), polychlorinated biphenyls (PCBs), and organochlorine pesticides (OCPs) in indoor floor dust from rural homes (N = 31) and mosques (N = 12) in Gujrat, Pakistan. Low concentrations were observed for most contaminants. OPFRs were the principle contaminants, with tri-(2-butoxyethyl)-phosphate (TBEP) and tri-phenyl-phosphate (TPP) having medians of 66 and 109 ng/g, respectively. PBDEs were only minor constituents in the investigated samples, with BDE 209 (median 40 ng/g) being the most important congener. Levels and profile of ∑PBDEs, ∑NBFRs, ∑HCHs, ∑DDTs, and ∑PCBs revealed no difference ($P < 0.05$) between samples of dust from homes and mosques, indicating similar emission sources. Exposure scenarios using 5th percentile, median, mean, and 95th percentile levels were estimated for both adult and toddlers. Typical high-end, using median levels and high dust ingestion, exposure for adults were 0.02, 0.02, 0.03, <0.01, and 0.65 ng/kg bw/day and for toddlers 0.39, 0.45, 0.69, 0.01, and 15.2 ng/kg bw/day for ∑PBDEs, ∑NBFRs, ∑OCPs, ∑PCBs, and ∑OPFRs, respectively. To the authors' knowledge, this is the first study to document the presence of indoor OCs in Pakistani dust.

Practical Implications This is the first report on the analysis of various contaminants in indoor dust from Pakistan. Some of these chemicals are currently being used in different consumer products. The study will help to further an understanding of the levels of different organic contaminants (OCs) in Pakistani indoor environments and will enlighten the generally ignored area of environmental pollution in Pakistan. Furthermore, studies based on animal models have shown that some of the analyzed chemicals can cause different types of chronic toxicities. However, our results showed that the levels of estimated exposure via dust ingestion for all chemicals were several orders of magnitude lower than their reference dose (RfD) values or than those reported in studies from Belgium, China, Singapore, and the UK (Ali et al., 2011a; Harrad et al., 2008; Tan et al., 2007a,b; Van den Eede et al., 2011a; Wang et al., 2010).

S. Semple, C. Garden, M. Coggins, K. S. Galea, P. Whelan, H. Cowie, A. Sánchez-Jiménez, P. S. Thorne, J. F. Hurley and J. G. Ayres - Contribution of solid fuel, gas combustion, or tobacco smoke to indoor air pollutant concentrations in Irish and Scottish homes

Abstract There are limited data describing pollutant levels inside homes that burn solid fuel within developed country settings with most studies describing test conditions or the effect of interventions. This study recruited homes in Ireland and Scotland where open combustion processes take place. Open combustion was classified as coal, peat, or wood fuel burning, use of a gas cooker or stove, or where there is at least one resident smoker. Twenty-four-hour data on airborne concentrations of particulate matter <2.5 μm in size ($PM_{2.5}$), carbon monoxide (CO), endotoxin in inhalable dust and carbon dioxide (CO_2), together with 2–3 week averaged concentrations of nitrogen dioxide (NO_2) were collected in 100 houses during the winter and spring of 2009–2010. The geometric mean of the 24-h time-weighted-average (TWA) $PM_{2.5}$ concentration was highest in homes with resident smokers (99 $\mu g/m^3$– much higher than the WHO 24-h guidance value of 25 $\mu g/m^3$). Lower geometric mean 24-h TWA levels were found in homes that burned coal (7 $\mu g/m^3$) or wood (6 $\mu g/m^3$) and in homes with gas cookers (7 $\mu g/m^3$). In peat-burning homes, the average 24-h $PM_{2.5}$ level recorded was 11 $\mu g/m^3$. Airborne endotoxin, CO, CO_2, and NO_2 concentrations were generally within indoor air quality guidance levels.

Practical Implications Little is known about indoor air quality (IAQ) in homes that burn solid or fossil-derived fuels in economically developed countries. Recent legislative changes have moved to improve IAQ at work and in enclosed public places, but there remains a real need to begin the process of quantifying the health burden that arises from indoor air pollution within domestic environments. This study demonstrates that homes in Scotland and Ireland that burn solid fuels or gas for heating and cooking have concentrations of air pollutants generally within guideline levels. Homes where combustion of cigarettes takes place have much poorer air quality.

B. C. Singer, W. W. Delp, P. N. Price and M. G. Apte - Performance of installed cooking exhaust devices

Abstract The performance metrics of airflow, sound, and combustion product capture efficiency (CE) were measured for a convenience sample of 15 cooking exhaust devices, as installed in residences. Results were analyzed to quantify the impact of various device- and installation-dependent parameters on CE. Measured maximum airflows were 70% or lower than values noted on product literature for 10 of the devices. Above-the-cooktop devices with flat-bottom surfaces (no capture hood) – including exhaust fan/microwave combination appliances – were found to have much lower CE at similar flow rates, compared to devices with capture hoods. For almost all exhaust devices and especially for rear-mounted downdraft exhaust and microwaves, CE was substantially higher for back compared with front burner use. Flow rate, and the extent to which the exhaust device extends over the burners that are in use, also had a large effect on CE. A flow rate of 95 liters per second (200 cubic feet per minute) was necessary, but not sufficient, to attain capture efficiency in excess of 75% for the front burners. A-weighted sound levels in kitchens exceeded 56 dB† when operating at the highest fan setting for all 14 devices evaluated for sound performance.

Practical Implications Natural gas cooking burners and many cooking activities emit pollutants that can reach hazardous levels in homes. Venting range hoods and other cooking exhaust fans are thought to provide adequate protection when used. This study demonstrates that airflows of installed devices are often below advertised values and that less than half of the pollutants emitted by gas cooking burners are removed during many operational conditions. For many devices, achieving capture efficiencies that approach or exceed 75% requires operation at settings that produce prohibitive noise levels. While users can improve performance by preferentially using back burners, results suggest the need for improvements in hood designs to achieve high pollutant capture efficiencies at acceptable noise levels.

S. Batterman, L. Du, G. Mentz, B. Mukherjee, E. Parker, C. Godwin, J.-Y. Chin, A. O'Toole, T. Robins, Z. Rowe and T. Lewis - Particulate matter concentrations in residences: an intervention study evaluating stand-alone filters and air conditioners

Abstract This study, a randomized controlled trial, evaluated the effectiveness of free-standing air filters and window air conditioners (ACs) in 126 low-income households of children with asthma. Households were randomized into a control group, a group receiving a free-standing HEPA filter placed in the child's sleeping area, and a group receiving the filter and a window-mounted AC. Indoor air quality (IAQ) was monitored for week-long periods over three to four seasons. High concentrations of particulate matter (PM) and carbon dioxide were frequently seen. When IAQ was monitored, filters reduced PM levels in the child's bedroom by an average of 50%. Filter use varied greatly among households and declined over time, for example, during weeks when pollutants were monitored, filter use was initially high, averaging 84 ± 27%, but dropped to 63 ± 33% in subsequent seasons. In months when households were not visited, use averaged only 34 ± 30%. Filter effectiveness did not vary in homes with central or room ACs. The study shows that measurements over multiple seasons are needed to characterize air quality and filter performance. The effectiveness of interventions using free-standing air filters depends on occupant behavior, and strategies to ensure filter use should be an integral part of interventions.

Practical Implications Environmental tobacco smoke (ETS) increased particulate matter (PM) levels by about 14 μg/m^3 and was often detected using ETS-specific tracers despite restrictions on smoking in the house as reported on questionnaires administered to caregivers. PM concentrations depended on season, filter usage, relative humidity, air exchange ratios, number of children, outdoor PM levels, sweeping/dusting, and presence of a central air conditioner (AC). Free-standing air filters can be an effective intervention that provides substantial reductions in PM concentrations if the filters are used. However, filter use was variable across the study population and declined over the study duration, and thus strategies are needed to encourage and maintain use of filters. The variability in filter use suggests that exposure misclassification is a potential problem in intervention studies using filters. The installation of a room AC in the bedroom, intended to limit air exchange ratios, along with an air filter, did not lower PM levels more than the filter alone.

B. R. M. Kingma, L. Schellen, A. J. H. Frijns and W. D. van Marken Lichtenbelt - Thermal sensation: a mathematical model based on neurophysiology

Abstract Thermal sensation has a large influence on thermal comfort, which is an important parameter for building performance. Understanding of thermal sensation may benefit from incorporating the physiology of thermal reception. The main issue is that humans do not sense temperature directly; the information is coded into neural discharge rates. This manuscript describes the development of a mathematical model of thermal sensation based on the neurophysiology of thermal reception. Experimental data from two independent studies were used to develop and validate the model. In both studies, skin and core temperature were measured. Thermal sensation votes were asked on the seven-point ASHRAE thermal sensation scale. For the development dataset, young adult males (N = 12, 0.04Clo) were exposed to transient conditions; T_{air} 30-20-35-30°C. For validation, young adult males (N = 8, 1.0Clo) were exposed to transient conditions; T_{air}: 17-25-17°C. The neurophysiological model significantly predicted thermal sensation for the development dataset (r^2 = 0.89, P < 0.001). Only information from warm-sensitive skin and core thermoreceptors was required. Validation revealed that the model predicted thermal sensation within acceptable range (root mean squared residual = 0.38). The neurophysiological model captured the dynamics of thermal sensation. Therefore, the neurophysiological model of thermal sensation can be of great value in the design of high-performance buildings.

Practical Implications The presented method, based on neurophysiology, can be highly beneficial for predicting thermal sensation under complex environments with respect to transient environments.

About ISIAQ

With more than 800 members from more than 45 countries, ISIAQ is an international, independent, multidisciplinary, scientific, non-profit organization whose purpose is to support the creation of healthy, comfortable and productive indoor environments. We strongly believe this is achievable by advancing the science and technology of indoor air quality and climate as it relates to indoor environmental design, construction, operation and maintenance, air quality measurement and health sciences.

As a Society, our major role is to facilitate international and interdisciplinary communication and information exchange by publishing and fostering publication on indoor air quality and climate. We organize, sponsor and support initiatives such as meetings, conferences, and seminars on indoor air quality and climate; and we develop, adapt and maintain guidelines for the improvement of indoor air quality and climate.

ISIAQ's journal, *Indoor Air*, published six times per year, is the most respected and widely-cited source of scientific information relevant to building scientists and professionals. Our two major international conferences -- the Indoor Air 'xx and the Healthy Buildings 'xx conference series -- set the standard for high quality scientific information and its application to making healthy buildings. We also cooperate with government and other agencies and societies with interests in the indoor environment and climate.

To find out more about us, visit our website: http://isiaq.org

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Corporate Memberships are available

If your organization is involved in indoor air science, policy, or practice, a corporate membership in ISIAQ will place you in the limelight with the international indoor air community.

- ISIAQ reaches more than 45 countries around the world.
- ISIAQ's conferences, considered the most important in the field, have been attended by more than 4,000 individuals.
- The official Society journal, *Indoor Air*, is respected by scientists and policy-makers as the most reliable way to keep up with the latest scientific findings in the field.

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