
William P. Bahnfleth

ASHRAE IAQ 2016

Defining Indoor Air Quality

BY WILLIAM P. BAHNFLETH, PH.D., P.E., FELLOW/PRESIDENTIAL MEMBER ASHRAE

The first ASHRAE IAQ conference in 1986 was held "to review the latest research in indoor air pollution and provide missing current data for Standard 62" with the understanding that, "the indoor environment should minimize any impact on health and should be free of any impact on comfort, and control should minimize the use of energy."[1] Implicit in this statement is the belief that the performance measures needed to realize this goal could be defined in practical terms.

Thirty years later, 174 delegates from 21 countries met in Alexandria, Va., in September 2016 for the 18th ASHRAE IAQ conference, co-organized with the Air Infiltration and Ventilation Centre (AIVC) as its 37th annual meeting. The Indoor Air Quality Association (IAQA) and Indoor Environmental Quality Global Alliance (IEQ-GA) were partner organizations. Participants included members of the scientific community, representatives from government agencies, designers, and IAQ practitioners. Meetings of the ASHRAE Environmental Health Committee, IEQ-GA, the AIVC board of directors, and an ASHRAE residential stakeholder workshop were coordinated with the conference.

The conference theme, "Defining Indoor Air Quality: Policy, Standards, and Best Practices," reflected the recognition that definitions and measures of indoor environmental quality remain elusive. The geographically and professionally diverse participation in the conference created a unique opportunity to consider the current status of IAQ laws, consensus standards, and IAQ best practices, specifically those of high performance building designers. The program was further broadened by an emphasis on residential buildings and developing economies, both current strategic focuses of ASHRAE.

Invited keynote addresses served to highlight major issues addressed at the conference.

- Pawel Wargocki of Technical University of Denmark discussed the current state of science in his talk "On the Quest for Indices Defining Indoor Air Quality: What is a Reasonable Approach?" He reviewed the history of a wide range of metrics including ventilation rate, concentrations of CO_2 and total volatile organic compounds (TVOC), odor indices, and subjective assessment, i.e., perceived air quality.
- David Rowson, Director of the U.S. Environmental Protection Agency's Indoor Environments Division, spoke on "Public Health Priorities for Indoor Air Quality." He noted as emerging priorities the effect of climate change on IAQ, the relationship between energy use in buildings and IAQ, indoor exposure to particulate matter, and better metrics.
- David Jacobs, Chief Scientist of the National Center for Healthy Housing, provided a residential perspective in a presentation titled, "Bending the Healthcare Cost Curve: Indoor Air Quality and Healthy Housing." He argued that there is strong evidence that investments in home IAQ can reduce healthcare costs and that IAQ should be a factor in the valuation of real estate. Jacobs cited both the U.S. Surgeon General's call to action promoting healthy homes[2] and the World Health Organization's report on the environ-

William P. Bahnfleth, Ph.D., P.E., is professor of architectural engineering and director of the Indoor Environment Center at the Pennsylvania State University, University Park, Pa. He chaired the steering committee for IAQ 2016.

mental burden of disease associated with inadequate housing[3] as evidence of both a major problem and a significant opportunity.

- Chris Pyke, Chief Operating Officer of GRESB.com and Vice-President for Research of the U.S. Green Building Council, reported on a promising strategy for implementing improved IAQ design in a presentation entitled "From Project to Portfolio: Drivers and Barriers to Scaling up IAQ Performance from 1,000+ Property Companies and Funds around the World." His thesis, supported by experience, is that it is more effective to implement IAQ improvements across a large portfolio, thereby increasing the likelihood of a successful aggregate outcome, than on a building-by-building basis with a higher risk of an adverse outcome associated with each project.
- Howard Wolf, Standards Chairman of the Institute of Inspection, Cleaning, and Restoration Certification, spoke from the IAQ practitioner's perspective in his address "Reviving the 'Lost Step' in IH Remediation Protocols and Remediation Plans." Wolf underscored the need for better evidence-based standards for use by the remediation industry.

The program included 124 presentations. Session topics addressed current research, including IAQ monitoring and field measurement results, capture of contaminants from residential cooking, infiltration, and natural ventilation, among other topics. However, in keeping with the conference theme, much of the program was devoted to discussions about criteria for specifying good IAQ. These included a review of IAQ standards around the world, a panel discussion of the potential for development of a target pollutants list, the status of efforts to develop performance-based IAQ metrics, international urban IAQ, IAQ advocacy and policy development, practical strategies for achieving IAQ in high performance buildings, and an update on IEA Annex 68: Indoor Air Quality Design and Control in Low Energy Residential Buildings.

The session on the current status of global standards demonstrated that, although there are national/regional differences, minimum standards rely mainly on ventilation to achieve perceived air quality objectives, but with implicit and explicit health criteria. However, there is an interest in moving beyond this approach to criteria that more directly reflect the impact of IAQ on health. Subtask 1 of IEA Annex 68 deals with the development of a residential metric for chemical pollutants and includes an extensive review of previous approaches.

The panel discussion of target pollutants produced one of the liveliest discussions of the conference. Some panelists and audience members thought that it is important to identify specific contaminants that can be used to specify minimum health requirements. Others took the position that prescriptive approaches based on "red lists" of pollutants have not been successful and that the focus instead should be on occupants and their response to the environment rather than on the building.

A novel aspect of this IAQ conference was the use of audience voting at the opening and closing plenary sessions to provoke discussion and to get a sense of the consensus of the participants. Personal voting devices provided by co-organizer AIVC were distributed at the door of voting sessions. Audience members could respond to a number of multiple choice statements/questions, with results immediately projected on a video screen. Attendees were polled on questions including when, if ever, science-based metrics relating indoor contaminant exposures to performance would be available, how IAQ requirements should be specified (e.g., in terms of ventilation rates, exposures, or both), when outdoor air quality requirements should be included in designing ventilation and IAQ control systems, research needs to improve IAQ, and which indoor contaminants sources are of greatest concern. The first two questions were asked again at the closing plenary.

At the opening plenary, 45% of participants indicated that performance metrics based on existing science are possible today. When asked the same question at the end of the conference, only 13% agreed and over 30% said it would be at least 10 years before science is sufficient to achieve this objective. Over 80% of those voting initially indicated that both exposures and ventilation should be included in IAQ standards, with nearly 60% identifying exposures as having primary importance. In the final vote on this question, only 29% supported a ventilation/exposure approach, while exposure only and unspecified other approaches were selected by over half. While some thought that specific consideration of outdoor air quality was needed only where ambient air is known to be highly polluted, more than 60% supported mandatory review of outdoor air quality in all cases. From a list of eight research areas, performance-based IAQ metrics were clearly the

greatest perceived research need, followed by sensors/controls and the influence of occupant behavior. The most concerning contaminants, in the opinion of the participants, were primary and secondary material emissions, cooking, and outdoor air.

A discussion following the opening plenary allowed participants to explain and discuss the considerations behind their voting responses. Of particular interest was the comment that while there is a substantial body of scientific evidence to support implementation of performance criteria, there exists an acceptance barrier to doing so in the professional community. With respect to the reliance on ventilation vs. exposures in standards, the view was expressed that until more is known about indoor exposures and their effects on building occupants, prescriptive ventilation requirements are necessary as a safety net. Discussion of the importance of addressing outdoor air conditions in IAQ standards was strongly supported because of the evidence that ambient contaminants, especially particulate matter, are a problem worldwide. However, it was also stated that the focus of regulators should be on improving outdoor air quality rather than changing IAQ standards to adapt to outdoor pollution. It was suggested that the same evolution that has led to better outdoor air quality in developed countries through environmental regulations would also improve the outdoor air quality of developing countries.

Sessions on quantification of the effects of IAQ showed that while many methods have been proposed, consideration of significant indoor contaminants is incomplete and there is little consensus on the right approach. Metrics discussed included ventilation to meet occupant perception targets, target indoor pollutant lists, scoring systems focused on occupant well-being, and asset scores rating the building as a source of exposure. An example asset rating presented at the conference is the IAQ Score being developed by the U.S. Department of Energy's Building America Program and Lawrence Berkeley National Laboratory. It combines a Disability Adjusted Life Year approach to quantifying health impacts with an analysis of house features that influence moisture and odor issues to produce a rating on a scale of roughly 0–100.

IAQ 2016 succeeded in achieving its goal of bringing together a unique cross-section of the built environment and IAQ communities to discuss the critical issues associated with translating science into practice, complementing conferences more focused on the latest scientific developments. It was particularly valuable as a forum in which priorities for future work could be clarified through interactions of scientists, practitioners, government officials, and building owners. Undoubtedly, the conference clarified the need for more comprehensive, more reliable, health and productivity-based metrics. ASHRAE, AIVC, and others will continue to explore this issue in future programs and other activities. Selected conference papers with archival value are being prepared for publication in a special issue of Science and Technology for the Built Environment.

References

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