Indoor Air BULLETIN™ Hal Levin, Editor

Technology, Research, and News for Indoor Environmental Quality

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# ASHRAE Standard 62 — The Next Generation

ASHRAE Standard 62, "Ventilation for Acceptable Indoor Air Quality," is probably the most important indoor air standard in the world. It goes far beyond simply specifying ventilation rates (although many use it just for that). As the basis for good design practice and building operation, it is invariably cited in lawsuits involving problem buildings and occupant health problems.

Now, even before the world has really figured out how to use the standard, a revision is in progress. Dr. Gene Tucker, an engineer at the US EPA's Office of Research and Development, presented a proposed revision outline to the members of the Standing Standard Project Committee (SSPC) 62, the ASHRAE committee responsible for the standard. The committee met at the ASHRAE meeting in Chicago on January 24. After a lengthy discussion, the outline, which incorporated comments previously received from committee members, was approved.

Dr. Tucker has been studying indoor air pollution sources and methods for IAQ control at EPA since 1984. He has presented several papers addressing indoor air pollution sources and IAQ control at major international conferences. His interests include source control, ventilation, and air cleaning. The outline of the proposed standard revision reflects Tucker's understanding of the importance of source control in achieving good IAQ.

## Source Control Emphasized

The revised standard (if it follows the outline) will emphasize the control of indoor air pollution sources. It will reward building designers and owners who implement source control strategies and penalize those who don't. It will do this by having tables for "minimum ventilation rates" and "additional ventilation rates."

The revised standard's table of minimum ventilation rates for commercial and institutional buildings will be similar to that found in Standard 62-1989. However, the proposed revision will also have "additional ventilation rates" that must be added to minimum ventilation rates if a designer does not consider sources in the design. These additional ventilation rates will be listed for sources with "potentially high emission rates of contaminants," according to Tucker. (In fact, this is no different from what is implied in the current standard's Indoor Air Quality Procedure.) These additional ventilation rates could significantly increase the total design minimum ventilation rates above those contained in the current standard.

## Emissions-based Ventilation Rates

According to the outline, maximum emission rates would be specified for listed source types such as floor coverings, wall coverings, organic solvents, furniture, office machines, smoking, and unvented space heaters. These specified emission rates would be the maximum allowable at minimum ventilation rates. The proposal would exempt "certified low-emission products" although there were no details provided.

New testing methods and programs must be developed and adopted for various types of materials and products for this provision to be implemented. An approach similar

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to the Carpet and Rug Institute's (CRI) for "green label" carpets might work. A different type of emissions testing program operated by Underwriters Laboratory measures ozone emissions from photocopiers. For architectural coatings where most of the VOCs contained in the bulk product evaporate (off-gas) as the product cures, the certification might be based on the total VOC content of the bulk product. A labeling program already exists in California and several other states that requires measurement of total VOCs in paints, adhesives, and other architectural coatings. We expect the EPA to help develop the standards and, probably, review the performance of laboratories doing the testing.

Tucker did not describe the details of the proposed basis for determining additional ventilation rates other than for purposes of explaining the approach. Default values for additional ventilation will be based on assumptions about the source strengths. The default values for additional ventilation could be quite high if committee members assume that the source strengths are high for the important pollution source products, materials, and activities in a space. Using these additional ventilation rate values will require more capacity in HVAC systems and more energy to operate them. However, source control can result in ventilation requirements that will be roughly equal to the values in the current standard. Thus, the standard, if adopted along the lines outlined above, will generate even more motivation for the designer to consider trade-offs between additional ventilation and management of sources. The standard will also generate more source emissions testing and source control measures by industry and their customers respectively.

## Important Differences Between the Standards

The outline contains some important differences compared to the existing standard. It has separate sections for commercial-institutional buildings and residential buildings. This is a response to many comments on the existing standard and the experience of several SSPC62 committee members with ASHRAE's Standard 90 on energy conservation. The outline also addresses buildings with and without mechanical ventilation systems, an expansion on the guidance provided in Standard 62-1989.

The outline includes new sections on "Documentation of Design and Operation Guidelines," and "Operating and Maintenance Procedures." There has been much discussion in ASHRAE about both these topics. Documentation is mentioned, even required, by the current version of the standard, but there is no guidance provided in terms of what is to be documented or what is to be done with it. Some guidance exists in ASHRAE's Guideline 1, Commissioning HVAC Systems, but even that guidance is sketchy at best. Operation and maintenance problems are constantly referred to as major contributors to IAQ problems at conferences and meetings on IAQ. It is not yet clear what the revised ventilation standard might say about the subject, but it is clear that there is a need to address the subject.

## Comments

Some of the SSPC62 members were concerned that the approach proposed by Tucker was too cumbersome for designers. In effect, Tucker has proposed that indoor air contaminant loads be considered when determining required ventilation rates. While the general methodology exists for doing this, most of the data necessary do not. However, there is a very rapid movement by many building industry components to initiate emissions testing programs of various sorts. The data will be far more abundant by the time the standard is revised and gets through the normal adoption procedure; realistically speaking, this will be no less than three years from now.

The approach Tucker has proposed is not new at all in terms of the way buildings are designed to handle thermal or structural loads. Constant and variable loads are calculated, estimated, predicted, or determined by whatever means is appropriate and feasible. Then the mechanical system or structural system is sized to handle these loads based on what we know about the performance of the systems. The same principle must be applied to pollution loads if air quality is to be truly acceptable by design. The proposed revision does just that.

## Stay Tuned

Next month we will present the proposed revision outline in detail and a comparison to the existing Standard 62 outline.

## For More Information

ASHRAE has two mechanisms for interested parties to stay informed of the committee's activities. One is to request that your name be placed on the "Interested Persons" list for SSPC62. Individuals on this list receive notices when a draft revision or addendum to the document is available for public review and notices of any special meetings of the project committee between society meetings. There is no charge for being on this list.

Another option is the Committee Information Mailing List (CIML) subscription. CIML subscribers get project committee rosters, meeting agenda and minutes, working and public review drafts, and other items which are circulated to the full committee membership. The general intent is to supply the basic materials which are distributed to the full committee during the development of the standard or guideline.

There is an annual fee for this subscription which runs from July 1 to June 30 each year. The fee is based on an

estimate of the amount of material involved. The fee for the July 1992 - June 1993 year is $80 for SSPC62.

If you are interested in subscribing, contact Sara Depen of the Standards staff at ASHRAE headquarters in Atlanta, 1791 Tullie Circle NE, Atlanta, GA 30329, 404-636-8400, ext. 503, or fax 404-321-5478.

*Ventilation*

# Ventilation for IAQ in Hot, Humid Climates

We've heard engineers and others say that the major cause of IAQ problems in the southeastern US is microbial contamination due to inadequate moisture control. The problems are not limited to moisture in fibrous linings in air distribution ducts. They also include high humidity throughout the space and, sometimes, inside the exterior walls.

In Florida, both outdoor humidities and temperatures are high nearly all year long. Outdoor air requires conditioning, both for temperature and humidity, to achieve comfortable, healthy indoor environments. When Floridians go from 5 to 15 cfm/person to implement ASHRAE Standard 62, it means conditioning a lot more outdoor air during most of the year.

Now we've been told that there are no package rooftop air handlers available that can meet ASHRAE Standard 62-1989 minimum outside air supply requirements *and* handle the latent loads experienced in Florida and other hot, humid climates. Can this be true? We asked a couple of people we thought should know.

## Carrier Corp. Says 'Can Do'

We first talked to Katherine Hammack, Sr. Product Manager of United Technologies Carrier in Farmington, Connecticut. She told us that there is a problem, but it isn't the equipment. "You're talking about people who want to close their eyes and grab something," Hammack said. "If you're talking about a standard, off-the-shelf unit, yes." However, she indicated that the loads can certainly be handled by adding cooling coils. She said that the Carrier units are designed to accept the additional cooling coils and that the cooling coils are stock items in the Carrier catalog.

But, not so fast. Hammack suggested we call a Carrier sales representative in Florida, and we did. Ron Kessner answered our call, and what he told us did not support Hammack's claims for Carrier's equipment. He said that the package units could not accommodate the extra coils and that they usually recommend split systems — separate chillers/condensers and air handlers. That way the chilled water (or other fluid) is brought to the air handler in the required quantity. Kessner said that with Florida's loads, no more than 40% outdoor air could be conditioned and delivered indoors by the package rooftop units under worst-case design conditions.

Frustrated by the conflicting answers, we called Denny Chamberland of Carrier's Syracuse office. He ran some sample design conditions through his computer for the 20-ton and 50-ton rooftop units at 10%, 20%, and 50% outside air. His computer runs showed that the issue is actually sizing the unit properly, but that there certainly is no truth to the notion that roof top package units can't do it. Of course, it makes a difference how many cfm one runs through the units. Obviously, a small volumetric air flow will be easier to handle than a large one. The real problem is sizing the units for the loads they must handle and the outside air delivery required of them. Too many designers simply use old rules of thumb for air-conditioning tonnage regardless of the actual interior loads or outside air requirements.

We have not checked with other manufacturers, but we understand that Trane is planning to come out with a more flexible standard product line. Obviously, no manufacturer who wants to stay competitive in the southeastern US (or other humid area) can afford to ignore this issue.

## Moisture in Walls

Moisture in the walls is a completely different issue. It tends to occur due to the fact that the inside is cooler and drier than the outside. Thus, moisture tends to migrate through the wall from the outside in. In a few unfortunate cases, it has created enormous mold problems after condensing behind the drywall or vinyl wall covering. Some large public buildings have been evacuated, lawsuits abound, and the world is taking note.

The hotel and motel industry is increasingly concerned about mold. In problem properties, molds have been found on the back side of vinyl wall coverings. The adhesive is an excellent nutrient, apparently, and the moisture entering from the outside cannot penetrate past the vinyl. The answer is locating the vapor toward the moisture source - outside, in Florida.

*News and Comment*

# Office Occupancy Rates Droop

The Building Owners and Managers Association (BOMA) has surveyed North American office markets and found that overall office occupancy rates in the US declined from 81.7% in 1991 to 80.9% in 1992. While the drop is not large, the trend is downward. The survey results, published in the *Year-End 1992 North American Office Market Review*, covers 46 cities and more than two billion square feet of office space in the US and Canada.

Occupancy rates were highest in certain west-coast cities from the San Francisco Bay Area northward all the way to Anchorage and in St. Louis, Kansas City, and Washington, DC. Rates were lowest in many Texas cities, several major midwest cities, and in New Orleans, St. Petersburg, Phoenix, Buffalo, and Hartford.

Countering the trend are predictions that there will be more than one million new office jobs created by 1997, according to BOMA. At the ASHRAE guideline of an estimated 140 square feet per person (sf/p) for office workers, that could create the demand for 140 million square feet of office space or 7% of the two billion square feet covered in the survey. This would still leave some 13% of the square footage vacant. Using the more generous per person square foot requirements based on the *1991 BOMA Experience Exchange Report* of 275 square feet per office worker in private sector buildings, the million new jobs would require 275 million, or 13.25% of the total two billion square feet reported by BOMA.

### The *BULLETIN* Comments

Empty office space means it's a buyers' market; potential tenants are in the driver's seat to name terms, and more are asking for assurance that IAQ will be acceptable. They want access to the mechanical equipment in case of the need for an IAQ investigation. They want landlords to absorb the costs of any such investigations. And, they want reasonable control of the ventilation system operating hours in their own space. Some aggressive tenants are asking for assurances of good IAQ, either by demonstration that ASHRAE ventilation standards are met, or through other means.

On the other side, landlords in buyers' markets are still looking to gain an edge over competitors by increasing services and amenities. IAQ is a hot marketing tool, particularly on the two coasts where IAQ consciousness is highest. But landlords in sellers' markets are naturally less likely to want to invest in equipment and commit to operating costs for improved IAQ.

No matter what the market, everyone loses when expectations related to IAQ are not explicit parts of the negotiations and the provisions of a lease. Housekeeping alone can be an important factor in IAQ, and the quality and frequency of dusting, vacuuming, and other cleaning operations should be addressed. Fees for additional hours of operation beyond "normal" operating hours are a major issue of contention for tenants with lots of night and weekend workers. These topics should also be addressed in the lease.

### *Reference:*

BOMA, *Year-End 1992 North American Office Market Review*, Washington, DC: Building Owners and Managers Association International. Copies are $40, $20 to BOMA members. To order, call 800-426-6292.

*Publications*

# Fiber Glass Exposure, Health Effects, and Guidelines

Much controversy has surrounded the use of fiber glass in buildings. Discussions have focused on fiber exposures to skin, eyes, and lungs and on the potential for indirect effects from microbial contamination of fibrous glass materials. It's been difficult to obtain up-to-date, unbiased information on fiber glass health hazards. However, a recent publication from the American Industrial Hygiene Association provides a fairly comprehensive discussion of fiber glass health hazards and describes work practices to minimize risks.

"Occupational Exposure, Toxic Properties, and Work Practice Guidelines for Fiber Glass" was published last year by AIHA and is available from AIHA at the address shown below. It describes the use and properties of fiber glass, provides a comprehensive international listing of exposure limits, discusses toxic properties, and provides guidance on workplace practices. It is well-referenced, easily read, and a valuable resource for concerned ***BULLETIN*** readers.

### Irritation

Fiber glass used in building thermal insulation, duct board, ceiling tiles, and ventilation system acoustic liners is clearly a skin irritant, usually causing itching attributed to embedding of fibers with diameters greater than 4 m. Allergic reactions reported in association with fiber glass exposure relate to the resin finishes used in some products. One of these is urea formaldehyde which comprises between 6 and 12% by weight of some of the building products mentioned above.

Workers exposed daily to fiber glass often develop "hardening" after a few days of work. They experience itching at first but then it ceases for as long as they maintain regular exposure. Once regular exposure ceases, irritation can occur again until re-hardening. Approximately a quarter of the general population is subject to dermatographism (the development of small, raised skin lesions after the skin is rubbed with a firm object). While some affected individuals can work with fiber glass without problems by adopting appropriately protective work practices, for others the degree of skin irritation may require a different job assignment.

Eye irritation and upper-respiratory tract irritation can also occur, although the latter usually only occurs after exposure to large quantities of fibers. These symptoms usually resolve when exposure ceases.

### Carcinogenic Potential

There are several on-going studies related to the potential carcinogenicity of fiber glass in industrial exposures, particularly in fiber glass manufacturing industries. These studies include animal inhalation, injection, instillation, and implantation as well as epidemiologic studies of fiber glass manufacturing plant workers. There is considerable controversy about the interpretation of results from these studies. Currently, the best thinking appears to indicate that there is very little if any cancer risk from inhalation exposure to fiber glass used in building materials at normal indoor concentrations. Various studies have produced conflicting results on the morbidity and mortality resulting from fiber glass exposure in the manufacturing setting. Confounding variables may explain the different outcomes from the various studies. These studies continue, and others interpret their results differently.

There does appear to be a potential cancer hazard inherent in exposure to ceramic fibers (very small fibers used in certain industrial applications). But these ceramic fibers are not found in typical building materials.

### Microbial Contamination

While the AIHA publication does not address microbial contamination issues, no discussion of fiber glass in these pages would be complete without it. There are several Florida buildings currently vacant due to serious microbial contamination; much of it is on fiber glass media. Readers can refer to the ***BULLETIN*** Vol. 1, No. 5, for our feature article on the subject.

Microbial growth is more likely when fiber glass products exposed to circulating air, or even inside walls, becomes soiled and moist. These conditions are almost ideal for microbial growth. Thus, fiber glass board ducts and fiber glass duct liners are especially susceptible to microbial infestation. While mold growth is most probable, bacterial growth is also very likely.

There are completed and on-going studies on the potential for microbial contamination of fiber glass building products. We plan to discuss the results in a future issue of the ***BULLETIN***.

### *To Obtain A Copy:*

Contact Publication Sales, AIHA, 2700 Prosperity Avenue, Suite 250, Fairfax, VA 22031, 703-849-8888, fax 703-207-3561. The cost is $22 per copy, $15 for AIHA members.

## *Letters*

# Hodgson on MCS

Building owners, operators, and tenants increasingly find themselves dealing with people with multiple chemical sensitivity (MCS). MCS is not uniformly defined by medical doctors examining individuals reporting MCS symptoms or by researchers investigating the syndrome. However, it is clearly a topic of importance to all those concerned with IAQ. Since medical science cannot resolve many of the mysteries, we are left to make our own judgments and act accordingly. The recent implementation of the Americans with Disabilities Act (ADA) has led many building owners and employers to consider people with MCS as well as other environmentally hypersensitive individuals more carefully.

To shed some light on MCS, Dr. Michael J. Hodgson, MD, MPH, has sent us his views of presentations on the subject at some recent meetings. In the process, Hodgson has articulated a fairly well-formed, if not definitive, set of ideas about MCS and, in some cases, some fairly strong criticism (implicit or explicit) of the views of his medical colleagues. He has also voiced strong criticisms of some current theories and practices. Such critical reviews are not only interesting but important in helping us grapple

with one of the most perplexing problems IAQ practitioners face today.

In his letter, Hodgson sets forth several possible notions about what MCS actually is. He tells us that we know far too little about the cause, and he gives some suggestions for improving medical management of MCS until we better understand its cause(s).

Some of his ideas about MCS are as follows:

- It is *not* based on "traditionally-defined immunological mechanisms."
- It may be related to "abnormal mucous membrane responses to irritants."
- A component of the syndrome may be psychiatric in nature, although one author suggests "that psychiatric disease is not a major component."
- Illness behavior - the way we respond to our illnesses - may play an important role. This points to the importance of the emotions.

Parts of Hodgson's letter may be of little interest or too technical for many of our readers. We have included it in its entirety because of the importance of the subject and our respect for Hodgson's views.

## About Michael Hodgson

Hodgson is Associate Professor at The School of Medicine, U. of Connecticut Health Center, Section of Occupational and Environmental Medicine. He is also perhaps the most active medical researcher looking at IAQ in the United States. He is a member of several committees of ASHRAE including its Environmental Health Committee, of which he is a former chair. His book, *Problem Buildings*, co-edited with James Cone, is one of the best anthologies in the indoor air field. (Cone and Hodgson, 1989.)

We think Hodgson's hypotheses about MCS are important and deserve serious consideration. His letter follows.

Dear Hal:

We have discussed multiple chemical sensitivities [MCS] over the last two years on a number of occasions, both in the U.S. and in Europe. I have promised to send you a summary of my thoughts after the recent meeting held by the American College of Allergy and Immunology (ACAI), convened by John Selner, MD, this year's president. The meeting occurred on the background of two national meetings, one held under the auspices of the National Academy of Sciences (NAS). The other was a meeting sponsored the Agency for Toxic Substances and Disease Registry, held together with the Association of Occupational and Environmental Clinics (AOEC) in Washington, D.C. Both meetings have generated formal published reports. The one was published as a supplemental issue to an NAS report (National Research Council,1992). The other was published as a special issue of the *Journal of Toxicology and Industrial Health* (1992). It is worth looking at those two reports, primarily for what they do not present. In my opinion, neither one provides very broad thoughtful summaries of the issue.

The NAS meeting was striking in it's disorganization and choice of panel chairs. Some participants argued that important, existing data were not mentioned or discussed, such as the work by Rebecca Bascom, MD. She herself, though present at the meeting, did not refer to her own work which she presented at the Yale University-Pierce Laboratory-EPA meeting in October 1991. It has apparently been accepted for publication at the *Journal of Pharmacology and Experimental Therapeutics*. Others were asked to be panel chairs and felt "set up." There was clearly a political agenda to the meeting, although most participants did not appear to understand what the agenda really was.[1]

The NAS summary volume has a very important contribution by Roy DeHart, with a wonderful quote at the beginning, "If you do not know where you are going, any road will get you there." This might serve as a *leitmotif* for much of the work. Dr. DeHart makes an important point, namely that unless we define what we're looking at, we can not compare our work with that of others who think they may be looking at the same thing. He argued strenuously for a universally accepted case definition. That case definition still does not exist; at least, most of the publications use their own; and, to the best of my knowledge, no groups have used anyone else's'. Although there was some overlap of participation at the two meetings, many participants did not attend both. As I perceived those two meetings, a number of issues arose.

- What is Multiple Chemical Sensitivities?
- Who gets it?
- How does it occur?
- Why does it occur?
- What can we do to prevent it?

I had raised some of those issues at the AOEC meeting, and Dr. Selner approached me about summarizing a workshop he was planning later. It is this workshop that will be the basis of the letter.

By way of background, John Selner, MD, and Herbert Staudenmeyer, Ph.D., have a practice in Allergy in Denver and have done so for twenty or so years. They have an environmental chamber in which they challenge individuals with low levels of both individual and mixtures of chemicals. They do this in attempt to test the effects of

specific agents and mixtures of agents on individuals in a clinical context. At the AOEC meeting, Dr. Selner suggested that at least some of these patients had a history of childhood sexual abuse. He felt this might be an important contributor to the way patients become ill.

The ACAI meeting consisted of a series of presentations followed by critiques.

Wayne Katon, MD, a psychiatrist at the University of Washington, started off the day and presented, in his summary, three separate pieces of work. First, he presented the "Boeing outbreak." In that investigation, about ninety of 450 shopworkers became ill after introduction of a new agent, a polyester resin. Exposures were poorly characterized; the primary information available suggests that " all exposure levels were below permissible exposure levels." As we will see later, this is simply inadequate for modern industrial hygiene. Of those ninety individuals, thirtyseven filed workers compensation claims. About twenty met a working definition of Multiple Chemical Sensitivities. Dr. Katon presented as exposure information simply that the results of all measured exposures were well below permissible exposure levels and suggested that the only predictor he found was preexisting psychiatric disease.

A second component of his talk addressed the current status of psychiatric research around anxiety and panic disorders and their relationship to agoraphobia[2]. In his view, anxiety and panic disorders are quite frequent and may progress to true agoraphobia in the setting of two well-defined pre-existing risk factors. These are childhood sexual abuse and a major psychiatric disorder. A third component of his presentation was a model of multiple chemical sensitivities. He suggested that some individuals have a trigger leading to an anxiety disorder with panic attacks. Some of these individuals will progress to agoraphobia. The same risk factors might be present as described above, namely, major psychiatric disease or childhood sexual abuse.

My concerns with Dr. Katon's views are simply that he does not address two major aspects of the early part of his disease model. The trigger, itself, is poorly defined. This may in fact be hyperventilation induced by mucous membrane irritation. We do know that a number of individuals with solvent neurotoxicity and with anxiety disorders, have underlying vestibular [inner ear] abnormalities. A physiologic basis for MCS may then include exaggerated irritant responses and vestibulopathy[4].

We know that animals will develop vestibulopathy in response to solvents. Some doctors think of vestibulopathy as a marker of solvent toxicity. On the other hand, vestibulopathy is associated with anxiety disorders and panic attacks. There are also people with underlying vestibulopathies from colds. Therefore, there is an issue here: vestibulopathy can be cause, effect, or associated phenomenon.

These vestibular abnormalities may in fact put them at risk for anxiety and panic disorders, rather than representing a consequence of anxiety or panic. In that case, the whole MCS model shifts slightly. It becomes: environmental exposure in individuals with an underlying physiologic abnormality leads to more severe disease. In addition, predictors of progression from panic to agoraphobia may in fact be solely the two Dr. Katon mentioned. On the other hand, they may include other factors, such as work stress or dysfunctional families. Finally, whether the Boeing outbreak was actually solvent neurotoxicity remains to be seen. Other measures that might have identified solvent neurotoxicity, such as color vision testing, auditory evoked potentials, or vestibular evaluations were not undertaken and the neuropsychological testing was, in my view, not adequate.

Dr. Rosenberg, from a neurotoxicology institute in Denver, presented a reductionist view of neurotoxicology. He focused on fundamental concepts and described them on a very basic level. An interesting aspect of his presentation was the simultaneous presentation of two separate audiovisual displays (a video tape on environmental hysteria running at the same time as he talked about his own slides). I found this quite distracting, and others in the audience may have failed to ask questions because of their distraction. Two major flaws in his presentation were misconceptions around basic toxicologic phenomena. His first contention was that, in fact, all neurotoxicology has predictable dose-response relationships, homogeneous in all populations. We know that this is simply not true. For example, cholinesterase deficiency[3] leaves the body unable to break down the neurotransmitter, acetylcholine. Some individuals have a hereditary deficiency in that enzyme. When they receive certain drugs as muscle relaxants during surgery, they may have very prolonged, much more severe loss of muscle tone. This leads to acetylcholine poisoning with hyperstimulation of the parasympathetic nervous system. In other words, individuals with that enzyme deficiency are at risk for central nervous abnormalities, brain dysfunction, drooling; bronchial secretions, wheezing, and bronchospasms; diarrhea, and other hypersecretions. Toluene diisocyanate is also known to have parasympathetic effects, i.e., it has some acetylcholine properties. TDI is a frequent cause of occupational asthma.

While the genetic defect of missing acetyl cholinesterase is rare, its occurrence is frequent and serious enough to require screening patients scheduled for certain kinds of surgery with muscle relaxation.

MCS is a rare enough syndrome that some such genetic heterogeneity may in fact be important. A second problem in Dr. Rosenberg's presentation was the belief that dose-response relationships are related only to the agent in question and not to other modifiers. We know quite well that both styrene and toluene metabolism are influenced by alcohol. That is, their central nervous system effects, too, are affected by alcohol. It is therefore no longer legitimate to consider a single "threshold" appropriate for all populations. At a given level (corresponding to exposure at the current Threshold Limit Value) of styrene or toluene exposure, alcohol will cause central nervous effects.

David Hartman, Ph.D., from Chicago presented a radical view of neuropsychology. His contention was that the sick building syndrome, multiple chemical sensitivities, and the syndrome of solvent neurotoxicity are all the same thing and are really manifestations of a personality disorders rather than neurotoxicologic effects. He also claimed that the sick building syndrome was really the same thing as the allergies to electromagnetic radiation described in the Nordic countries. He left before I had a chance to question him in greater detail about his beliefs.

Leslie Grammar, MD, Chief of Occupational Medicine at Northwestern, presented a view of immunologic occupational lung disease. Most of the presentation was quite good, and in fact a "state of the art" review of immunologic occupational lung disease, without great pertinence to multiple chemical sensitivities. A major concern in that presentation, though, was her contention that immunologic lung disease cannot be prevented. We do know that both animal models of isocyanate allergy and human epidemiologic surveys of asthma and isocyanate suggest that overexposures are a risk factor for sensitization. Many of us, therefore, believe that engineering controls, to prevent such accidental exposures, are in fact the way to prevent allergic lung disease.

Dr. DiFrieri, from the State University of New York at Stony Brook, presented an overview of agents associated with immunologic abnormalities in the environment on a "sub-clinical" level. This list was quite extensive; her review was thorough and exhausted (ing); and it was fascinating to recognize how many such associations have been defined. Nevertheless, it was a fairly uncritical review, and the actual pertinence of such "sub-clinical" abnormalities remains to be documented.

A summary of that section by Dr. Kalman, a well known immunologist, suggested that in fact the pertinence of all of these pieces of data for MCS remains to be seen. He called for a more rigorous approach.

Woodhall Stopford, MD, Director of the Occupational Medicine Residency at Duke, presented his "Lenore outbreak." This is an outbreak of neurotoxic disease in 32 incinerator workers. At least 25 of them have "white matter" disease[5] with autonomic nervous system dysfunction and vestibular abnormalities, together with neuropsychological impairments. In this presentation, his emphasis was on the fact that " all exposures were well below permissible exposure levels", and yet there was very severe neurological disease.

Herbert Staudenmeyer, Ph.D., a psychologist working with John Selner, MD, in Denver, presented their use of environmental chambers to create a common forum of illness beliefs between doctors and patients. In his view, a fundamental aspect of the syndrome of multiple chemical sensitivities is the belief by patients that their symptoms are, in fact, related to a series of agents. His view is that at least some of them are not, and that this belief must be tested scientifically. Dr. Staudenmeyer arranges for double blind challenges and, with statistical methods, demonstrates to patients that their beliefs are inaccurate. They then work on psychological aspects of becoming well, clearly recognizing that the organic aspects of the syndrome can not be treated in this way.

William Cain, Ph.D., presented a summary on irritant thresholds. You are aware of his work, and I will not repeat it here. [Readers: Note that the ***BULLETIN*** Vol. 1, No. 1, contained a summary of Dr. Cain's presentation at the conference on sources of indoor air contaminants held at Yale in October 1990. We are currently working on a feature article for the ***BULLETIN*** to present an update on Cain's very important work.]

## Summary

I had the opportunity to summarize Occupational and Environmental Medicine's view of the presentations. In my view, three major aspects of the syndrome remain to be clarified. First, the mechanisms are still not clear. It is reasonably certain (at least there is no evidence) that it is not based on traditionally defined immunological mechanisms. [Gel and Coombs 1 through 4 as described in standard texts of immunology]

At least a portion of these syndromes could be related to abnormal mucous membrane responses to irritants. This remains to be clearly documented, although Rebecca Bascom's work suggests this as a possibility. A separate hypothesis might be that of *metabolic toxicity*. Transport of agents through the olfactory route is ...[actually] a very hot topic in environmental health. A component of this syndrome may in fact be psychiatric, as clearly defined by Dr. Katon. Other scientific publications, such as those by Howard Kipen, MD, MPH, from the University of Medicine and Dentistry in New Jersey the Robert Wood Johnson Medical School, has suggested *that psychiatric disease is not a major component.* (Fiedler *et al.*, 1992).

This does not exclude the possibility that *illness behavior*, a phenomenon defined by David Mechanic, Ph.D., in the 1950's and 60's, is a major contributor. (Mechanic *et al.*, 1961) This must still be studied. Illness behavior is the way different people respond to the discomfort of medical symptoms. There are widely recognized sociologic predictors such as ethnicity and religion. Other authors have described illness behavior in the context of recovery from accidents. For example, at the same level of injury severity, culpability is a major predictor of clinical improvement. That is, if the injured patient caused the accident himself, they are likely to return to work much sooner than if the accident were caused by someone else, at times even inappropriately. If the injured worker warned their supervisors about a hazard, and was subsequently injured after the hazard was not fixed, [s]he is likely to return to work even later at the same level of injury. So, we clearly recognize that emotions modify our ability to function at a given level of disease severity.

A second major question is still the cause. Is there a toxicologic phenomenon underlying the problem? Is there some "sensitization" phenomenon on a immunologic basis? Could there be some behavioral sensitization phenomenon, such as suggested by Karen Bolla-Wilson in the *Journal of Occupational Medicine* (1991)? A final hypothesis was recently formulated by Claudia Miller, MD, MPH, who suggested that a phenomenon of "kindling" might be the underlying problem (Bell *et al.*, 1992). Kindling appears to refer to some sort of triggered process in the brain. No answer exists.

A third problem that remains is that of management. Until the true etiology and pathophysiology of the syndrome is worked out, etiologic management will remain elusive. On the one hand, the formation of a common belief system between doctor and patient is the fundamental basis of successful treatment. We might therefore focus on ways for documenting disease exposure relationships, whether in "N of 1" clinical trials, in exposure chambers, or some other way. This common belief could be tested in such a forum. Once doctors and patients agree on true causes, we may actually be able to work towards some solution.

You had asked whether you might use this letter. You should feel free to glean from this letter what you will. Yours is clearly not a peer review publication; these comments represent my own view; and I realize that anything that is written and mailed out is fair game for the world.

Michael Hodgson, MD, MPH

## Footnotes

1. MCS is not one thing. A variety of definitions exist in the literature. Cullen proposed one initially. Katon used one based on the response to four questions about personal perception of susceptibility. Kipen has variously used different ones at different times. At least three components may exist; mucous membrane responses, vestibulopathies, psychiatric or illness behavior components. These may interplay. Other physiologic mechanisms may also play a role, such as nasal transport, etc. Environmental illness appears to represent a broad range of responses, from gastrointestinal syndromes, to skin rashes, to MCS. Terr ("Clinical Ecology in the Work Place." *Journal of Occupational Medicine*. Volume 31, pp. 257-261) has clearly summarized the problems with environmental illness and clinical ecology.

2. Agoraphobia: a morbid fear of open or public places.

3. Cholinesterase: an enzyme that catalyzes the hydrolysis of acetylcholine to choline and an anion; called also *pseudocholinesterase*. Two forms of the enzyme are easily measured. Red blood cell esterase exists in red blood cells; pseudocholinesterase is synthesized in the liver and exists in free form in the blood plasma.

Cholinesterase deficiency: some individuals have a hereditary deficiency of the enzyme and are unable to break down certain chemicals, such as organophosphates, as rapidly as in normal individuals.

4. Vestibulopathy - a disorder of the inner ear. The inner ear keeps us balanced.

5. "White matter" disease - The brain consists of grey and of white matter. White matter is the myelin sheathing around nerve fibers. Its primary role is to speed conduction along the nerves. It can deteriorate in some diseases like multiple sclerosis and some forms of peripheral neuropathies.

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### For More Information:

Hodgson can be contacted at The School of Medicine, U. of Connecticut Health Center, Section of Occupational and Environmental Medicine MC-6105. 263 Farmington Avenue, Farmington, CT 06030-6105, 203-679-2893.

## *Letters*

# National Particleboard Association Responds to *BULLETIN* Article

In the last issue of the ***BULLETIN***, we reported on the recently revised OSHA rule on the labeling of products that emit formaldehyde above specified levels. We questioned the wisdom of reporting measurements as air concentrations (in parts per million - ppm) as is now done versus reporting them as emission factors (in $mg/hrm^2$)or emission rates (in mg/hr). Our concern is that reporting chamber concentrations can lead to misinterpretations of the tests and, possibly mistaken assumptions that test chamber concentrations will predict the concentrations in the actual use environment. Several leading authorities in the IAQ field agreed with our comments. We have raised this issue among others in the current balloting of the ASTM standard test method for formaldehyde emissions from composite wood products (E1333).

After receiving the following letter from William McCredie, Executive Vice President of the National Particleboard Association, we called him to initiate a dialogue amongst the key industry and research community members. McCredie responded somewhat indignantly and insisted that we misunderstood the OSHA rule as detailed in his letter below. In fact, our problem with the OSHA rule is that using the chamber concentration results from the standard test method is the only information available to most industry officials who must comply. Lacking the information on critical test parameters and the results in terms of emission factors or rates, no meaningful interpretation of the results is possible. The emissions tests are critical to implementation of the rule; however, currently available test results are potentially misleading.

Dear Mr. Levin:

We look forward to reading the ***Indoor Air BULLETIN*** and usually pick up some interesting items of information. However, in Vol. 2, No. 8 we came across two statements that give us great concern.

The most important is a misstatement that appears on page 15 in the article on *OSHA Requires Formaldehyde Labeling*. Under ***IAB*** Comments, you express difficulty with the units "ppm" for implementing the hazard communication requirements of the Occupational Exposure to Formaldehyde rule. Your difficulty certainly has resulted in seriously misleading your readers.

First, and most important, OSHA's language "capable of releasing formaldehyde at levels of 0.1 ppm" refers to a 0.1 ppm ambient concentration in the workplace to which a worker could be exposed. OSHA's use of the term "capable of releasing" is not a quantification of emissions from materials. OSHA is not referring to product emissions in either an emission level (ppm) or emission rate ($mg/m^2 \cdot hr$) manner. OSHA' s regulatory duties for employers are all based on the potential for exposure to a worker; including permissible exposure limits, action levels, and, duty trigger levels. For example, an employer has the duty to provide annual training to all employees exposed to formaldehyde levels at or above 0.1 ppm 8-hour time-weighted average (TWA).

The preamble explanation to OSHA's Occupational Exposure to Formaldehyde rule published in the Federal Register on May 27, 1992 (pg. 22290) provides ample evidence of OSHA's "potential exposure" meaning for the 0.1 ppm and 0.5 ppm trigger levels regarding Hazard Communication:

"To address this problem, OSHA proposed that, where the potential exposure is under 0.5 ppm, the label needs to indicate that formaldehyde may be present, ". (pg. 22297, middle column)

"The Agency felt that this 'low potential exposure' labeling for solid materials which may offgas formaldehyde struck a balance, ". (pg. 22297, middle column)

"Specifically, where it is determined through monitoring or the use of objective data that employee exposure will not exceed levels above 0.5 ppm, the hazard warning label shall include the following information:". (pg. 22297, right column)

"Formaldehyde-containing products incapable of causing exposures at or above 0.1 ppm or mixtures and solutions containing less than 0.1% formaldehyde will not be subject to any hazard communication requirements." (pg. 22297, right column)

"Finally, a considerable number of commenters asked for clarification on whether the levels that trigger the labeling and training provisions are intended to be based on instantaneous exposures, short term exposures, or 8-hour time-weighted averages. OSHA intends for these levels to mean 8-hour time-weighted averages." (pg. 22298, middle column)

In your last paragraph you imply that the wood products industry has led OSHA and HUD down the path of darkness on the question of how to quantify product emissions. In the field of industrial hygiene, and particularly in respect to OSHA exposure limits for airborne gases, the quantification unit is nearly always expressed in ppm. It is language our industry understands and uses everyday in our manufacturing plants for compliance with OSHA's Formaldehyde Standard, generic Hazard Communication Standard, and others. Chemical concentration (ppm) is also the basic unit for expression of exposure either in laboratory animal studies or in the exposure assessment portion of chemical risk assessments for humans carried out by regulatory agencies. We believe it is easier to communicate with our industry, other interested parties and the public if language used for product emissions is kept simple. We therefore, stay with ppm. We do not argue that emission rate information may not be useful in certain situations. As you noted, either product emission rate or concentration used for wood panel products can be translated into the other. [Reference: Lehmann, William F., "Effect of ventilation and loading rates in large chamber testing of formaldehyde emissions from composite panels," *Forest Products Journal*, April 1987.

Our second concern appears in the lead article on page 6, left column, under the subheading *Modern Building Materials:*

"The most well known and perhaps most widely used examples are particleboard, plywood, and other composite wood products based on urea formaldehyde resins. Fortunately, these resins are being replaced by more stable phenol-formaldehyde resins, and some manufacturers are developing and even marketing products that use no formaldehyde based resins at all."

Yes, UF particleboard certainly is a widely used example by writers that are quick to follow outdated data, old litany, and anecdotal information.

The facts support a much different story:

Since 1980, the US. industry has reduced average formaldehyde emissions by 75-90% from UF particleboard.

In 1984, the industry adopted a product emission standard of 0.30 ppm for all particleboard products.

In 1991, 97% of all U.S. particleboard was made in compliance with the 0.30 ppm standard the average emission level of this production was 0.18 ppm, well below the standard.

In 1992, the U.S. industry adopted a lower emission limit standard of 0.20 ppm for particleboard flooring products, comparable to the lowest emission UF particleboard made in Europe. Using EPA's VERSAR exposure model, a new home using the new UF particleboard flooring would have formaldehyde levels under 0.1 ppm in the first year of occupancy only slightly higher than if PF flooring products were used.

Your claim that UF resins "are being replaced by more stable phenol-formaldehyde resins" is just not true for particleboard. The number of plants offering PF or isocyanate bonded particleboard has decreased since 1980. The market share of PF/ISO particleboard had high points of 3.0% in 1981 and 1984; for the past few years, it has been under 2.0%. It is not clear what you mean by "more stable" in reference to PF resins.

There is one U.S. medium density fiberboard (MDF) plant that is currently making a board with other than a formaldehyde-based resin. But there have been one or two particleboard plants making a similar product during the past 15 years. The difference now is that market acceptance is a little higher due to the increased interest in IAQ.

We urge you to correct your misinterpretation of the OSHA Formaldehyde Labeling article as soon as possible. If we can be of assistance in this effort, please call.

Sincerely,
William H. McCredie
Executive Vice President

## The *BULLETIN* Responds

We stand by our comments in Vol. 2, No. 8. Mr. McCredie, like many others involved with pressed wood products, fails to distinguish between emission rates (or factors) and concentrations. Of course OSHA regulates on the basis of concentrations; that is the relevant parameter for calculating exposure. But to determine concentrations based on emissions tests, one needs to

know far more than the chamber concentrations during the test.

We called Mr. McCredie as soon as we received his letter. During the conversation we attempted to convey our concerns, not only about the issues addressed in the ***BULLETIN*** Vol. 2, No. 8 article and his letter, but also about the test method for formaldehyde emissions from composite wood products currently being balloted by ASTM. We view the method as seriously flawed in a number of important ways, and we have cast a negative vote on the ASTM ballot. We consulted several distinguished indoor air researchers, and they agreed with our reasons for the negative vote.

## OSHA's Position

When we failed to reach agreement with McCredie, he suggested we discuss our concerns with John Martonik of OSHA. We called Martonik, and we heard no disagreement with our comments. Martonik explained the history of OSHA's revision of the formaldehdye communication standard. In essence, Martonik explained, the revision was a compromise around differing concerns among a variety of affected parties including unions, particleboard manufacturers, textile manufacturers, garment manufacturers, and others. The focus of the revision was on the air concentrations that would trigger hazard communication requirements. We have not expressed an opinion on the appropriateness of the levels that have been set. Our major quarrel is with the means of determining what they are for a particular product and the impact the present practices have on those who must rely on the reported test results.

OSHA's rule is intended to protect workers and to require notification when specific exposure levels of concern might be reached. These exposures are related to the use of products containing formaldehyde: including, but not limited to, pressed-wood products and textiles. Determining the potential exposure levels is left to the employer who depends on the emissions test data from the manufacturer of the formaldehyde-containing product. However, no one can make such determinations without calculating the probable air concentrations based on source strength and ventilation data from the tests and from the use environment.

## PPM Don't Provide the Needed Data

The problem we expressed in the last ***BULLETIN*** is the use of formaldehyde concentrations (expressed in ppm) in connection with terms such as "emission standard" and "emission limit standard." McCredie himself seems to acknowledge that the composite wood products industry's use of concentrations to express the results of emissions tests does not provide an emission rate. He quotes the OSHA standard, saying that the concentration limit values that trigger the rule's provisions are not "quantification of emissions from materials."

That is precisely our point. Such data are essential for predicting exposure and determining the need for hazard communication under the OSHA rule. Without such data, no one can determine the need for hazard communication under the rule. Our concern is that the values obtained from measuring the concentration in the air during an emissions test are too easily misinterpreted as the concentration that will result from the use of the product being tested. This, of course, would only be the case if all the variables that affect emission rates were identical in the test chamber and in the environment where the product will be used.

The concentration to which people will be exposed, either in the industrial workplace or in any other environment, is ultimately the measurement value of interest. The unfortunate custom of the composite wood products industry of reporting formaldehyde emissions test results as airborne concentrations creates the potential for widespread misinterpretation and misuse of the data as a measure of the levels that will occur in the use environment.

Defenders of the current ppm-reporting practice have argued that it should be retained because it is widespread, it has been done so long, and it might confuse people to do otherwise. This argument simply isn't good enough. We know the limitations of the current method and we know a better way; we just have to overcome the industry's inertia.

## Calculating Exposure Levels

The concentration data reported from the emissions tests are only meaningful when they can help indicate the concentrations to which people will be exposed in actual environments. To calculate exposure concentrations from the "emissions levels" obtained in the standard tests, one must know several important things about the test conditions, the tested products, and the way the product will be used in a building as well as the environmental variables in that building.

The critical variables in both the chamber and the building where the product will be used are the product identification (thickness, dimensions, and type), the material loading factor (material quantity per unit of spatial volume), environmental conditions (temperature, humidity, air exchange rate, air mixing in the environment, and air flow at or near the material surface). Additional variables include product age and conditioning prior to the time of the measurement and product variability among sheets manufactured by the same organization.

Let's look at some emission rate calculations and the impact of changing some of the critical variables on the concentrations that would occur in a building. Even small changes in temperature or slightly larger changes in relative humidity or concentration have important impacts on emission rates. (See the ***BULLETIN*** Vol. 2, No. 2, page 8.)

To calculate the relationship between emission factor, concentration, loading, and ventilation, we use the following formulas:

$C = EF/(N/L)$ mg/m$^3$ = (mg/m$^2$•hr / [hr$^{-1}$/(m$^2$/m$^3$)]

or

$EF = C(N/L)$ mg/m$^2$•hr = (mg/m$^3$)[hr$^{-1}$/ (m$^2$/m$^3$)]

where

C is the concentration in mg/m$^3$
EF is the emission factor in mg/m$^2$hr
N is the chamber air exchange rate in hr$^{-1}$
L is the loading factor in m$^2$/m$^3$

Note that emission rates are the product of the emission factor times the quantity of the source present. For particleboard, the quantity, then, is expressed as area in m$^2$.

If we take the conditions used in one common application of the "standard" HUD chamber test to particleboard, we assume 0.5 ach, a 0.43 m$^2$/m$^3$ loading factor, and standard conditions of temperature and humidity. If the results of this test are a measured formaldehyde chamber concentration of 0.1 ppm, this translates into 0.123 mg/m$^3$. If we calculate the emission factor at the given conditions, we get an emission factor of 0.143 mg/m$^2$•hr.

If the ventilation rate were only 0.2 ach — as has been reported to be the case when large building ventilation systems are turned off in modern, energy-efficient offices and in reasonably well constructed, modern residences — the concentration might be only twice that measured at 0.5 ach. Matthews found that the higher the airborne concentration, the lower the emission factor, presumably because the elevation in airborne concentration will inhibit emissions. It does this by increasing the partial pressure of the formaldehyde in the air. In 1984, Thad Godish reported that a 50% reduction in the amount of plywood wall paneling or particleboard floor covering resulted in only a 29% reduction in the airborne formaldehyde concentration. This is further evidence of the suppression of emissions when airborne concentrations are higher.

Nonetheless, the airborne concentration would still be nearly 0.3 mg/m$^2$ in the air with a loading factor equal to that used in the chamber test. This translates to an emission rate of 0.349 mg/hr•m$^2$. If the ventilation rate were 1.0 ach, the air concentration would decrease, but by less than twofold: conservatively, probably about 0.06 ppm. This, of course, would vary greatly depending on the magnitude of the emission factor.

## *Letters*

# Mendell On SBS, Ions, and Particles

Mark Mendell works on IAQ issues at NIOSH in Cincinnati. His letter (printed below) addresses the potential impact of ion generators on SBS symptom reports discussed in recent issues of the ***BULLETIN***. He points out that David Wyon suggests his finding of lowered SBS symptom prevalence with negative ion generators (together with positive ion collection plates) is explained by the decreased occupant exposure to particulate matter rather than any more complicated effect of negative ions.

Mendell also points out that job dissatisfaction has been an "apparent contributor" to higher reported symptom prevalence in at least eight studies, although the relationship is not understood. In Mendell's own "California Healthy Buildings" pilot study, job stress showed a stronger dose-response relationship with each symptom than any other factor. Yet, he tells us, it is not clear whether job stress is a cause, an indication of greater susceptibility, a result of symptoms, or whether it simply leads to more symptom reporting even though the symptoms are not actually more prevalent.

Note that Mendell's letter was written as a private citizen and is "unofficial."

Dear Hal:

Once again, I find myself reading your newsletter and giving thanks that you decided to carve out your particular ecologic niche: to ask important questions in this confusing area of research, to seek out available information, and then to digest. critically synthesize, and communicate the information so effectively in the way that you do.

This time, I felt motivated to make a few comments on the current issue (Vol. 2, No. 8).

First, I agree with you that the Daniell *et al.* study on negative ion generators is organized around a phantom intervention, without shedding light on the question of

interest, and possibly misleading many readers in the process.

Related to the topic of ion generators, let me mention two things that David Wyon told me. One you probably know already: He believes that lowered particle levels are a more likely explanation for beneficial effects of negative ion generators in his study than are any more complicated mechanisms based on direct physiologic effects of negative ions. He also said, in response to a question about the function of positive collection plates, that he did not think it likely that the collection plates helped in lowering particle concentrations. Rather, he said, the collection plates were supplied simply to minimize soiling of surfaces near the ion generator, where a large number of charged particles would normally settle out. Most particle deposition, he thought, would occur regardless, and mostly on surfaces all over the office space either way.

Also, about the Daniell *et al.* report: you seem disturbed by Daniell's statement that "job dissatisfaction was an apparent contributor to symptom reporting, with a magnitude comparable to presumed effects of air quality." This is something which at least eight studies have found, I believe, but no one yet knows what the relationship means. In our California study, job stress showed a dose-response relationship with reporting of each symptom, stronger than any other factor assessed in the study. Yet we could not tell if job stress *causes* symptoms directly, *indicates greater susceptibility* to symptoms causing environmental exposures, *results* from symptoms, or simply *leads to more reporting* of symptoms which are not in fact more frequent.

Still, speaking in a multivariate sort of way, I think the evidence suggests that symptom reporting is *not* independent of indoor air quality, but that, holding indoor air quality factors constant, symptom reporting is also very strongly related to work stressors and other social/psychological factors. The problem of potential symptom overreporting by job-stressed workers could be minimized by the development and use of objective measures of health status. But in the usual cross-sectional studies (everything measured at the same time), one still could not tell which caused which; only a prospective follow-up study could unravel that. But no one said this would be easy.

Lastly, hoping that my first paragraph qualifies me in your eyes as a sensitive and discerning individual of impeccable taste, may I request that you consider a different set of textures for your bar graphs? The figure on page 5 made my eyes cross.

Keep up the good work.

Unofficially yours,
Mark J. Mendell

*Conference*

# Don't Miss Indoor Air '93 – Make Plans Now!

Professor Olli Seppänen, president of Indoor Air '93, told the ***BULLETIN*** that he has received over 900 abstracts for the conference, and now the authors' papers are arriving. On the basis of the abstracts that were received, Seppänen said, he expects a very successful and exciting conference. We reviewed the list of abstract titles and sessions, and we are certain the 6th International Conference on Indoor Air and Climate will be a valuable meeting.

We saw Professor Seppänen at the ASHRAE meeting in Chicago in late January. He told us that he is extremely optimistic about prospects for the conference. "The number and diversity of abstracts we received indicate that this will be an outstanding conference in the tradition of the five previous ones," he told us. We are sure he is right. The majority of important contributors to the indoor air field present their latest, most significant work at the triennial event, "Indoor Air 'xx." We have already spoken to several colleagues who are planning presentations, many of them of major, on-going studies that promise to enlighten us all.

A feature of the Helsinki meeting that we do not recall since Indoor Air '84 in Stockholm is the organization of several workshops. Titles for 16 of them are listed in the preliminary program, and they include leadership by some of the luminaries of the indoor air field. There will be a two-part workshop on "New Criteria for Ventilation;" part 1 is on health effects, part two is on sensory criteria. William Cain and Thomas Lindvall will chair the sessions. Other sessions include "Indoor Air Quality and Energy Efficiency," "Maintaining Clean HVAC Systems," and "Evaluating Building Materials."

As usual, there will be many simultaneous events, and attendees will have to make some hard choices. But the

distribution of the conference papers (with six-page length limits) to all registrants allows the enterprising attendee to look over the papers the night before (after the social events, of course) and make some informed choices. The volumes of papers from previous meetings are, themselves, incredibly rich resources of information on nearly every conceivable indoor air topic. (We still occasionally find valuable papers that we had not previously studied in the 1990 conference proceedings.)

### Extra Attractions

Seppänen told us: "We have also arranged for some very wonderful social events during the conference and some exciting tours afterwards." In fact, there are tours to Russia including a "Satellite Symposium" sponsored by The International Society for Indoor Air Quality and Climate (ISIAQ). ISIAQ will sponsor a symposium on "Moisture Problems, Thermal Comfort, and the Indoor Environment," in St. Petersburg, Russia, from July 9-12.

Other post-conference events include a one-day cruise to Tallinn, Estonia, or a four-day cruise to St. Petersburg. There is a trip to the Finnish lake district, an "Arctic safari," and a "midnight sun" flight.

### Conference Registration and Costs

Registration fees for the conference are shown in the table below: On February 17, the published exchange rate for Finnish marks (FIM) was approximately 5.86 to the US dollar. So, for example, the advance registration of FIM 2700 converts to $460.

### Registration Fees

| | By 4/1/93 | After 4/1/93 | On site |
|---|---|---|---|
| Delegates | FIM 2700 | FIM 3100 | FIM 3500 |
| Students | FIM 2300 | FIM 2700 | FIM 3100 |
| Accompanying persons | FIM 600 | FIM 800 | FIM 1000 |
| One day pass | | | FIM 1350 |

### Helsinki is Inexpensive

Many people think that travel to attend to the conference may be prohibitively expensive; Helsinki has that reputation. But the Finnish mark was devalued recently, and the prices for hotels are lower than in most US or other European cities for comparable quarters. We assume that other costs including food, local transportation, and souvenirs will be comparably affordable.

The Preliminary Program lists hotels ranging in price from 170 Finnish marks to 400 FIM, single occupancy. This converts to about $29 to $68 per night (at an exchange rate of 5.86 FIM to the US dollar). The listed first class hotels (Category A) start at 305 FIM ($52) single occupancy and 390 FIM ($67) double occupancy. Category B start at 275 FIM single occupancy, and category C from 170 FIM single occupancy. The youth hostel costs 90 FIM per bed. The official conference hotel costs 400 FIM single occupancy and 550 double occupancy.

If you stay in a medium-priced hotel(300 FIM/day) for five days and pay the advance conference registration fees, you can figure on a total of about $800 US to $1000 US plus air fare to attend the conference. If you bring a spouse or significant other, the cost might be $900 US to $1200 US. It's not cheap, but we promise you, it will be worth it.

### Weather

The preliminary program says; "In July, summer is at its best in Finland, with daily temperatures in the range of 20 to 25 °C (70 - 80 °F). There is a lot of sunshine, and daylight almost around the clock, but since nothing is more difficult than weather forecasting, be prepared for an occasional shower."

### *For More Information*

If you have not already received the Preliminary Program, you can obtain a copy by writing Indoor Air '93, Otakaari 4, P. O. Box 87, SF-02151 Espoo, Finland. Fax +358 0 451 3611. You can reach Professor Seppänen by phone at +358 0 451 3600.

## Calendar

### Domestic Events

March 29-31, 1992. **Indoor Air Pollution**, Sixth Annual Conference, Adam's Mark Hotel, Tulsa, Oklahoma. Sponsored by University of Tulsa. Contact: Division of Continuing Education, 600 South College Avenue, Tulsa, OK, 74104-3189, fax 918-631-2154.

April 1, 1993. **Liability and Compliance in Indoor Air Quality**, MidAtlantic Environmental Hygiene Resource Center, Philadelphia. Contact Sue Smith at the MEHRC, 3624 Market Street, Philadelphia, PA 19104, 215-387-2255, fax 215-382-0056. *Fee is $250. Continuing education units are available from ABIH.*

April 13-15, 1993, **Microbiological Sampling and Assessment of Indoor Environments**, MidAtlantic Environmental Hygiene Resource Center, Philadelphia. See listing for April 1 for contact information. *Fee is $775. Continuing Education credit is available from ABIH.*

April 21-23, 1993. **Indoor Environment '93**, Indoor Pollution Conference and Exhibition. Hyatt Regency On the Inner Harbor, Baltimore, Maryland. Sponsored by IAQ Publications, Inc. Contact Conference Director Lisa Markham, IAQ Publications, 4520 East-West Highway, Suite 610, Bethesda, MD 20814, 301-913-0115, fax 301-913-0119.

April 27-28. **ASTM Subcommittee D22.05 on Indoor Air**, Atlanta, GA. Contact George Luciw, Staff Manager, ASTM, 1906 Race Street, Philadelphia, PA 19103, 215-299-5571. *All ASTM meetings are open and there is no cost to attend. Only members may vote on standards actions. The meeting includes a variety of interesting agenda items including discussion of a standard test method for carpets, a draft guide for investigating Legionellosis outbreaks, discussion of environmental chamber measurements of formaldehyde from composite wood products, and other topics related to sampling and analysis of indoor air. ASTM membership costs $50 per year.*

May 3-7, 1993. **Air & Waste Management Association Annual Symposium**, "Measurement of Toxic and Related Air Pollutants," Omni Hotel and Convention Center, Raleigh, North Carolina. Contact Martha Swiss, A&WMA, P. O. Box 2861, Pittsburgh, PA 15230, 412-232-3444, fax 412-232-3450.

May 4-5, 1993. **Advanced Instrumentation and Sampling Methodology for IAQ Surveys**, MEHRC, Philadelphia. See contact information for April 1 listing above. *Fee is $575.*

May 6, 1993. **Microbial Procedures for Indoor Air Quality Investigations**, MEHRC, Philadelphia. Contact information above for April 1 listing. *Fee is $250.*

May 15-21, 1993. **American Industrial Hygiene Conference and Exposition**, New Orleans Convention Center, New Orleans, Louisiana. Contact: AIHA, 2700 Prosperity Avenue, Suite 250, Fairfax, VA 22031, 703-849-8888, fax 703-207-3561.

June 13-18, 1993. **New Summits for Environmental Solutions**, 86th Annual Meeting and Exhibition of the Air & Waste Management Association. Colorado Convention Center, Denver, Colorado. Contact: Marci Mazzei, A&WMA, PO Box 2861, Pittsburgh, PA 15230-9940, 412-232-3444, fax 412-232-3450. *Advanced registration $375/$460 for members/others respectively.*

June 26-30, 1993. **ASHRAE Annual Meeting**, Radisson Hotel, Denver, Colorado. Palmer House, Chicago, Illinois. Contact ASHRAE Meetings Department, 1791 Tullie Circle NE, Atlanta, GA 30329, 404-636-8400.

July 20-23, 1993. **Advanced Hands-on Indoor Air Quality/HVAC Diagnostics**, Harrison, Maine. The H.L. Turner Group Inc. Also offered August 17-20, September 28-October 1. Contact the H. L. Turner Group, Inc., RR #1, Box 535A, Harrison, Maine 04040, 603-228-1122. *Intended for those who already know something about IAQ. Faculty includes seven or eight of the most experienced researchers and consultants in the country. $1,250 tuition includes course material, breakfast and lunch, and a lobster bake. Continuing education credits available from American Board of Industrial Hygiene.*

October 10-13, 1993. **Understanding the Workplace of Tomorrow**, 14th Annual Conference and Exposition on Facility Management, International Facility Managers Association (IFMA). Denver Convention Center, Denver, Colorado. Contact IFMA Headquarters, 1 East Greenway Plaza, 11th Floor, Houston, TX 77046-0194. 800-359-4362.

November 7-10, 1993. **IAQ '93: Operating and Maintaining Buildings for Health, Comfort and Productivity**, Philadelphia, Pennsylvania. Sponsored by ASHRAE. Contact ASHRAE Meetings Department, 1791 Tullie Circle NE, Atlanta, GA 30329, 404-636-8400.

## International Events

July 4-8, 1993. **Sixth International Conference on Indoor Air Quality and Climate**, Indoor Air '93, Helsinki, Finland. For more information, contact the conference secretary at: Indoor Air '93, P.O. Box 87, SF-02151 Espoo, Finland, fax +358-0-451-3611.

October 27-28, 1993. **Volatile Organic Compounds, Royal College of Physicians**, London, England. Sponsored by Indoor Air International (IAI). Contact: Conference Secretariat, International VOC Conference, Unit 179, 2 Old Brompton Road, London SW7 3DQ, UK, +44 767 318 474, Fax +44 767 313 929.

November 1-3, 1993. **Clima 2000**, Queen Elizabeth Conference Centre, London, England. Contact: Anne Gibbins, CIBSE Headquarters, 222 Baltham High Road, London, SW 12 9BS, fax 44-1-6755449.

March 15 - 18, 1994. **Cold Climate HVAC '94 - International Conference on HVAC in Cold Climates**. City of Rovaniemi, Finland. Sponsored by FINVAC, Federation of Societies of Heating, Air Conditioning and Sanitary Engineers in Finland. Contact: FINVAC/Cold Climate HVAC '94, Mr. Ilpo Nousiainen, Sitratori 5, SF-00420 Helsinki, Finland, +358 0 563 3600, Fax +358 0 566 5093. *The official conference language is English.*

April 17-19, 1994. **International Symposium on Volatile Organic Compounds in the Environment**, Montreal, Quebec, Canada. Sponsored by ASTM Committee E-47 on Biological Effects and Environmental Fate. Contact: symposium chair Dr. Wuncheng Wang, U.S. Geological Survey, WRD, P. O Box 1230, Iowa City, IA 52244. Tel 319-337-4191, Fax 319-354-0510. *Prospective authors are requested to submit a title, a 250-300 word abstract, and an ASTM paper submittal form by April 16, 1993 to Dorothy Savini, Symposia Operations, ASTM, 1916 Race Street, Philadelphia, PA 19103.*

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