Indoor Air Quality Update™

A Guide to the Practical Control of Indoor Air Problems, from Cutter Information Corp.

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The Hot Issues in IAQ: Where Do We Go From Here?

On September 25th and 26th in Washington, D.C., *IAQU* will sponsor "IAQ Update '89." This will be a forum to discuss the most challenging issues facing researchers, consultants, policymakers, and others responsible for indoor air quality. Leading IAQ authorities will assemble on panels moderated by *IAQU* editor Hal Levin. The panelists will address topics including radon, asbestos, the new ASHRAE ventilation standard, safe building materials, sick building syndrome, and the accreditation of indoor air investigators.

The forum caught the attention of Congressman James Scheuer (D., New York) whose Natural Resources Subcommittee has scheduled a hearing on the IAQ Act of 1989, the "Mitchell-Kennedy Bill," for the day following the forum. By doing so, Rep. Scheuer will take advantage of the presence in town of the many experts and industry leaders who will be participating in the forum. It is also likely that news coverage of the forum will generate more interest in IAQ, the legislation, and the hearing itself.

Levin conceived the forum as an opportunity for critical dialogue on important issues which do not get discussed directly in most scientific and professional meetings and papers. In this month's *IAQU* we consider some of the topics and issues which will be discussed at the forum. If you cannot attend in person, we hope the following articles will inspire you to send us comments or questions for inclusion in the discussion and in a post-forum publication. If you wish to register for the forum or submit comments, please see the information at the end of this issue.

In This Issue

ASHRAE STANDARD 62-1989 IMPLEMENTATION

The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) has revised Standard 62-1981, "Ventilation for Acceptable Indoor Air Quality," the most important guidance document for indoor air. Its replacement, Standard 62-1989, will be available any day now. This is perhaps the most important event regarding IAQ to occur in several years. ASHRAE established a committee in 1983 to revise the prior standard. Now, more than five years later, the revised standard is about to be published.

The standard-writing committee's membership included engineers, architects, chemists, physiologists, product manufacturers, and industry representatives. While it is certainly far from perfect, the final product represents an informed consensus and is the best available guidance on ventilation control of indoor air quality.

We believe that *full implementation of the standard would eliminate up to 90% of all indoor air quality problems*. The standard addresses most of the problems that cause poor indoor air quality in buildings where complaint or illness rates are elevated. These problems include HVAC system designs, installations, or operations inadequate for the loads; load changes without corresponding modifications of the HVAC system; poor HVAC system maintenance practices; microbial contamination in HVAC systems; insufficient outside air supply; and poor supply air distribution.

However, there is far more to the standard's "full implementation" than just its publication by ASHRAE. In order for it to be fully implemented, engineers, architects, and HVAC equipment manufacturers must use it to guide their designs, buildings, and products; code-writing organizations and jurisdictions charged with code adoption must choose to include or reference it as a mandatory element; and, building officials and building operators must enforce and follow it.

Because of its significance, we made implementation of Standard 62-1989 the focus of our first session at the forum. Following are some of the issues and problems critical to implementing the standard and developing more comprehensive control of indoor air quality.

Limited Health Protection

Can Standard 62-1989 protect the public from harmful constituents in indoor air, or is it just a comfort standard as many of its critics have alleged?

The standard defines acceptable indoor air quality by two criteria. The first criterion is that no more than 20% of the occupants express dissatisfaction with the indoor air. The second criterion is that there are no known contaminants at harmful concentrations as determined by cognizant authorities. Unfortunately, the standard fails to include provisions for fulfilling the second criterion.

Other than in its definition of "acceptable indoor air quality," Standard 62-1989 does not minimize the risks associated with long-term chronic exposure to low levels of indoor air pollutants. It can't; there simply are too many gaps in the current level of knowledge. It is primarily a comfort standard, providing more acceptable (to the occupants) indoor air quality. Complete protection of public health indoors through an ASHRAE standard is not likely in the foreseeable future.

How New is the "New" Standard?

As this new standard goes into effect, what difference will it make? Will buildings be more comfortable, healthier, and safer?

The answer partly depends on the degree to which the standard is followed. This, in turn, depends in part on the engineering community's acceptance of the standard and in part on the rate and degree of its incorporation into mandatory codes and statutes. For most engineers, following the current standard simply means using the minimum outside air supply rates specified. Unfortunately, those trying to minimize equipment sizing and operational costs often dilute the prescribed rates by interpreting the standard contrary to its meaning or intent.

Can or should building owners be required to operate buildings according to the standard, or is it useful or practical only as a design standard? How should compliance with the standard be evaluated on an on-going basis? Can it be done in a practical and unobtrusive way?

Successfully implementing the standard also depends greatly on whether buildings will be required to operate according to the standards, or will just be required to meet design specifications. The foreword to the standard is unequivocal about this point: "It must be recognized, however, that the conditions specified in this standard must be achieved during the operation of buildings as well as in the design of the buildings if acceptable indoor air quality is to be achieved." If the standard is achieved in the design but the performance is not verified either upon completion or periodically after occupancy, the standard's purpose and promise will have been subverted.

Major changes in the standard:

There are two major changes in the new standard, according to John Janssen, chairman of the committee that developed it.

- The first major change is the increase in the minimum outdoor air flow rate in clean environments from 5 cfm/person to 15 cfm/person. A clean environment is one in which known sources of unusual contaminants or unusually strong sources of contaminants do not exist.
- The second major change is that the distinction in Standard 62-1981 between smoking-permitted and smoking-prohibited environments has been removed.

The old standard established a 5 cfm/p minimum in nonsmoking and a 20 cfm/p minimum in smoking-permitted areas. The new standard specifies a 15 cfm/p minimum for all spaces regardless of whether smoking occurs. The rationale is that people smoke less now than formerly, and that research has shown that 15 cfm/p is adequate to control environmental tobacco smoke to a level that will be found acceptable by at least 80% of the occupants.

Some critics of the standard argue that there has actually been a reduction in the protection afforded nonsmokers from ETS in the change from a 20 cfm/p minimum in smoking-permitted spaces to 15 cfm/p minimum in all spaces (whether or not smoking is permitted). However, outside air requirements for most occupied areas are 20 cfm/p or higher. Office spaces, dining rooms, and conference rooms must receive 20 cfm/p, bars and cocktail lounges must receive 30 cfm/p, and smoking lounges must receive 60 cfm/p. Nonetheless, it is still quite pos-

sible that significant concentrations of ETS can enter a nonsmoker's "breathing zone" since smoke plumes do not mix perfectly. They tend to remain relatively concentrated until travelling some distance from the source.

We see some other significant changes in the standard — changes which can do more to improve indoor air quality in the future than the minimum outside air supply requirements.

- One is the requirement that design documentation be prepared in conjunction with the design of HVAC systems.
- Another is the requirement that HVAC systems be easily accessible for inspection, cleaning and maintenance.

Outside Air Supply Minimum Requirements

Do the outside air supply requirements mean delivery of specified quantities to the breathing zone of each individual occupant, or only an average for the space served by each supply air register? Is the total the quantity for each room or area or an average for the entire building? How do designers interpret the requirements in Standard 62-1981 and what will they do with the new standard?

These are serious and fundamental questions about how to interpret one of the standard's most important requirements. The standard is not sufficiently clear to answer these questions. Some of the provisions for averaging (described below) and identifying spaces according to the specific use suggest that the requirements are for particular spaces rather than for the whole building.

However, the standard provides no further guidance as to whether the air must actually be distributed within the space according to the distribution of occupants. It does not clarify whether the required quantities of outside air must actually be delivered to the breathing zone of each occupant, to a breathing zone somewhere within the space, or just introduced somewhere into the space.

A related question concerns the following provision in the standard: outside air supply quantities may be reduced when multiple spaces are served by a common supply system. The purpose of this provision is to offer opportunities for energy conservation (read that "economy" if you like).

The standard allows for some averaging under a provision it borrowed from an Australian standard. This provision allows a reduction in the overall building total outside air to compensate for the ventilation requirements of the most demanding space. Where occupant density varies considerably in a building, this could result in significant differences among spaces. And, where room volumes vary significantly, differences could be rather large.

Shortfalls and excesses in outside air supply distributions can result from such an approach. But this is not the result of the "Australian" averaging procedure alone. It is the result of any approach which averages loads from different zones supplied by a common supply system. The problem has not been addressed by the standard. Averaging outdoor air requirements for all spaces served by a single system will result in these sorts of distortions of supply requirements unless we use some explicit approach to avoid them.

Variations on the types of systems used might result in some solutions. We could use induction systems with outside air and cooling coils (or, where required, heating coils) at the distribution terminal, or separate outside air supply and recirculation distribution networks. But where economizer cycles are employed for a significant part of the day or year, these approaches are less cost effective. Alternatively, we might use a variable outside air supply and constant volume space air distribution system or another system utilizing proportional control approaches.

Ventilation Effectiveness

How will ventilation effectiveness be measured? Can it be measured, and if so, when and by whom? What happens if it is less than what was specified?

How do we design for ventilation effectiveness? Will designers have to specify more than the minimums prescribed by the standard to compensate for ventilation effectiveness less than 100%?

What about very large spaces? Are outside air supply rates based on the number of occupants adequate? Shouldn't we consider a minimum outside air exchange rate for the space to remove stale air or contaminants emitted from sources not dependent upon occupants?

Ventilation effectiveness is a central part of the standard. Yet its quantification is relegated to an appendix in the standard. There is controversy in the indoor air research and consulting communities regarding the degree to which supply air actually reaches the occupants and how designers should deal with this consideration.

Poor air distribution within a space can adversely affect IAQ even though the outside air supply rate is at or above the required minimum. The standard says that the outside air supply rates in Table 2 are needed "for well-mixed conditions (ventilation effectiveness approaches 100%)." It defines ventilation effectiveness as the "fraction of outdoor air delivered to the space that reaches the occupied space."

This might be one of the more controversial provisions of the standard. It is not clear in the standard itself whether the outside air flow requirements pertain to each air handling unit, each space, or each individual occupant's immediate environment. There will be much controversy about how much and what kind of averaging is permitted by the standard.

Air exchange rates based solely on occupant density or number are inadequate because they ignore spatial volume. When volumes vary greatly from norms, for instance, in a very high ceiling space, a sparsely occupied space, or a very tiny space, per person outside air ventilation rates may provide insufficient air exchange or may result in unacceptable drafts.

The important question is whether required outside air must be delivered to each individual occupant's breathing zone. If not, where should it be delivered?

Several questions arise here.

- Should occupants receive some fraction based on the ventilation efficiency of the system?
- How and where will ventilation efficiency be measured? If the delivered outside air does not meet the design requirements, then who will be responsible to correct it?
- Will designers start to overdesign in order to protect themselves against liability?
- Will code officials question the inefficient use of energy and disapprove plan submittals for nonconformance to energy conservation requirements?

The engineer and architect are in a difficult position. We would expect them to protect themselves first, the owner and the occupants last. What else can they do?

Control of Unusual Sources or Contaminants

How can unusual or strong sources of contaminants be dealt with? Can and will ASHRAE provide guidelines? Is the standard's disclaimer with respect to the protection of occupant health an invitation for a parallel set of indoor air quality standards which do address health concerns comprehensively?

The standard requires the designer to consider any special or strong sources of indoor air contaminants, yet provides little to no guidance for assessing source strengths, calculating likely airborne concentrations, or controlling concentrations to acceptable levels. An appendix contains a collection of guidelines from various authoritative bodies, but engineers and architects are left on their own to interpret the information and apply it in their projects. This is certainly not a routine task.

The ventilation rate procedure that prescribes a given quantity of outside air for each occupant is blind to the strength or nature of contaminant sources. This is one of the shortcomings of the standard. However, there is an exception statement under the ventilation rate procedure which requires that unusual contaminants or sources be controlled at the source or the air quality procedure must be used. Under that procedure, no specified quantity of outside air is required. Instead, contaminant levels are prescribed for ten contaminants, and guidance is offered for many others.

The standard requires that the designer determine what levels are acceptable under the indoor air quality procedure. This, too, is a shortcoming of the standard. If neither the cognizant authorities nor ASHRAE are able to establish acceptable levels, it is highly unlikely that any professional engineer is going to pretend to know what acceptable levels ought to be. By not providing guidance on this question, ASHRAE undermines the utility and value of the standard.

Air Cleaning Requirements

Is air cleaning required whenever outside air quality violates National Ambient Air Quality Standards (NAAQS)? What kind of filtration or other air cleaning will be required when outdoor air contaminants exceed NAAQS levels?

The outside air supply minimum requirements clearly state that outside air must meet federal air quality standards. The standard calls for reduced outside air flows when filtration of contaminants exceeding federal air quality standards is impractical. 100% recirculation would then occur.

Ozone, carbon monoxide, and particulate matter are the contaminants most frequently exceeding federal standards in urban areas of the United States. Filtration can remove ozone and particulate matter. But practical

filtration for carbon monoxide (CO) is not currently available.

Many urban areas fail to meet federal standards for CO, especially during rush hour. So indoor air would be recirculated and indoor air levels of other contaminants will rise unless appropriate filtration is used.

When outside air supply is reduced to avoid using contaminated outdoor air, the standard and good engineering practice require filtration to remove contaminants known to be present in indoor air. Therefore, designers will be forced into the air quality procedure of the standard rather than simply supplying the required minimum quantities of outdoor air.

Thus, full implementation of the standard involves significant changes in current practice. Actually, the old standard, 62-1981, calls for cleaning outside air, but designers have not been complying with this requirement. The question now is will the new standard result in more complete compliance or will designers continue to ignore significant elements of the standard?

Design Documentation

Design documentation is a new requirement in the standard. However, it is not defined or described, and no direction or guidance is given for meeting the requirement. What does the requirement mean to practicing professionals? What does the standard require for design documentation? Will this requirement result in more responsibility for the design team? Who will receive the design documentation and what responsibilities will they have?

The design documentation requirement, if properly implemented, can result in far better communication between architect and engineer, between design team and building owner or operator, and between building management and building occupants. Architects, engineers, and facilities managers can focus contractual provisions on indoor air quality considerations. Interior designers and renovators will be able to determine the ability of the ventilation system to handle contemplated changes.

Unfortunately, ASHRAE has said practically nothing about what the design documentation should involve, who should prepare it, or what should be done with it. The standard only requires that the design documentation state design assumptions regarding ventilation rates and air distribution. There is no further guidance in the standard.

The only guidance we know of is in portions of papers presented at ASHRAE's 1989 winter meeting in Chicago by members of an ASHRAE committee preparing guidelines for HVAC system commissioning. See ***IAQU***, February 1989, for a summary of some of those papers and our own list of elements for design documentation. We incorporated relevant elements of those papers into that article and another one Levin presented last March at the American Society of Civil Engineers meeting in San Francisco.

What are the implications of documenting design assumptions when actual building conditions change? What will designers of tenant improvements do if the design assumptions for the base building do not provide adequate ventilation for the actual uses of the space? Who will be responsible?

The standard addresses this issue, indicating that building operators and designers of renovations should use the assumptions delineated in the design documentation. It says: "Design documentation shall clearly state which assumptions were used in the design so that the limits of the system in removing contaminants can be evaluated by others before the system is operated in a different mode, or before new sources are introduced into the space."

This is unambiguous; design documentation must adequately describe the system capability and must be available to building operators and designers before making changes. However, who will be responsible to maintain the documentation and make it available to these parties in the future? This is not spelled out in the standard. We suggest that the designers (architect, engineer, interior designers) of the original construction and of all modifications retain copies of all relevant documentation in their files; that the building owner maintain a copy; and, that the operating engineer or building management company maintain a copy. When changes are made, the design should be documented, all changes specifically identified, and the updated design documentation should pass through the same custodial process.

The remaining question is whether performance verification reports should be similarly maintained. If laws or codes require operation of the building in conformance with the design standards, then some sort of field measurements will be made. That information is also needed to complete the design documentation.

Accessibility of HVAC System Components

What is a readily accessible HVAC system? Does it include every branch duct, plenum, and acoustic liner? Is it simply a design requirement, or is there an implicit assumption that maintenance of HVAC systems should be improved to achieve acceptable indoor air quality?

Another key provision requires that HVAC systems be readily accessible for maintenance. Air-handling units and cooling coils must be easily accessible for inspection and preventive maintenance. Periodic in-situ cleaning of cooling coils and condensate pans should be provided for in the design. These features and several others are intended to reduce the potential for microbial contamination, which has been implicated in many cases of sick building syndrome or building-related illness. While it seems logical that these features be part of every HVAC system, in many cases they are not.

Impacts on Professionals, Businesses, and Industry

How will 62-1989 affect owners, architects, engineers, interior designers, contractors, building occupants, building managers, building operators, and litigants?

It could change the way many of these professional and business interests relate. Currently, the vagueness in ventilation requirements and practices is at the core of many lawsuits, disputes, and indoor air quality problems. A clear set of rules could reduce ambiguity about what is required, who is responsible, and how to accomplish it. We do not think Standard 62-1989 as written has done that. However, it has articulated some requirements that, if taken seriously, could generate a dialogue leading to substantial clarification and problem avoidance.

Will buildings be more costly to design, build, and operate?

The answer is "most likely." The question is how much, who will arbitrate costs, and will it be worth it? Some critics of the new standard have argued that it will raise the cost of construction and operation. A pair of researchers at the University of California Lawrence Berkeley Laboratory have run simulations on a number of buildings in ten U.S. and three Canadian cities to see what differences in costs might occur. They used DOE 2.1C for the simulations. Their results showed that in a "worst case" Washington, D.C. or Miami, Fla. building situation, capital and operational costs might increase about three to five percent. Some authorities have questioned these results, but no further analyses have been published.

Must the new standard be incorporated into codes in order to impact the design professions and building owners and operators?

Currently, most designers and their clients tend to follow only those standards which are mandatory. There has been a proliferation of regulations and regulatory authorities affecting design and construction fields; naturally, no one seeks out any regulations they do not have to follow. There are exceptions, of course. Some clients or designers who have had indoor air quality problems in previous buildings are more inclined to protect themselves. This is especially true if they have already been sued.

The Future of Standard 62

Where is ASHRAE going with ventilation standards? This one took five years to develop, and there is already a revision under way. Will the revisions be completed soon? What will be the most important issues and changes? What will the next standard be like and when will it come out?

Many of the issues raised above have been identified by others. Many people felt the standard should be published now with its imperfections rather than delay by trying to refine it further. In the debate over adoption by ASHRAE, they prevailed. Will they now move to establish a new revision committee to address some of the most glaring problems?

We have heard that a new committee may be formed with only minimal carry-over membership. Some of the issues discussed above will surely be recognized as requiring attention. We would be surprised if ASHRAE does not begin to respond soon.

Conclusion

There are still many unresolved issues concerning both the protection of public health in indoor environments and the implementation of the standard as written. The standard is primarily a "comfort" standard rather than a "health" standard. It makes a meek attempt to address health considerations. Its foreword proclaims that its purpose is "to specify minimum ventilation rates and indoor air quality which will be acceptable to human occupants and are intended to avoid adverse health effects."

But the standard itself gives little guidance related to health. It relies primarily on a handful of standards developed by others. Its

immediate usefulness is the provision of ventilation guidelines which are likely to eliminate most comfort-related indoor air quality complaints. By tripling the minimum quantity of outside air supplied to occupied spaces where smoking does not occur, the new standard is likely to reduce the airborne levels of most contaminants. However, a true health-protective standard has yet to be developed and will have to await an enormous increase in our understanding of the health effects of most indoor air contaminants.

Standard 62-1989 will be available from ASHRAE in mid-September. The cost is $42 for the general public and $28 for ASHRAE members. It is available from ASHRAE Publications, 1791 Tullie Circle, N.E., Atlanta, GA. 404/636-8400.

RADON: DOES THE RISK MERIT THE EXPENSE?

Radon is the "pollutant du jour" in indoor air. The scientific evidence is strong: the hazard posed by radon is considerable. Apparently, a large fraction of the population is exposed to significant levels of radon in their homes and other buildings. The popular media has published tremendous amounts of information concerning radon and its perils.

However, the scientific and policy questions about radon risk management are not without controversy. Some of the following questions identify important areas of uncertainty and disagreement.

Radon and Health: Do We Have All the Answers?

What is the verified health risk? What effects do changes in smoking prevalence rates have on projections of future health risks? What is the evidence that elevated radon levels in homes cause lung cancer in nonsmokers? Is there any epidemiologic evidence of radon risk at levels of four picocuries per liter of air (pCi/L) or even at 20 pCi/L?

Some epidemiological research has demonstrated the absence of excess lung cancer rates in areas where radon levels are elevated in nearly every home. Most lung cancers attributed to radon exposure are believed to occur in smokers. Some researchers have asserted that not a single case of lung cancer in a nonsmoker has been directly attributed to radon exposure. These facts would lead to a rather skeptical view of the need to mitigate radon, particularly where levels are less than 10 or 20 pCi/L.

Yet in many parts of the United States, a residential real estate transaction no longer occurs without considerable attention to radon. Individuals and families are worried. They spend time and money dealing with the radon problem. Can we hope for some resolution of these uncertainties in the foreseeable future? What needs to happen in order to develop a consensus opinion?

Federal Radon Policy

If EPA cannot regulate radon exposure, what can it regulate? What are the differences between protection of public health from radon versus protection from ambient air contaminants or VOC in indoor air?

What should government priorities be for answering unresolved technical questions about radon? What about the policy questions?

Some scientists, and most European governments, do not agree with the need for aggressive radon control at measured levels of four pCi/L of air. The Common Market countries have established safe levels approximately two and one-half times higher than EPA's.

While critics of EPA radon policy complain, EPA uses an approach which it has applied to regulate much smaller apparent risks. Should EPA develop a double standard: one for industrial emissions or contaminants, another for natural hazards? What sort of further evidence is needed for EPA to continue its aggressive radon program? Are there matters of fact that can be resolved through research, or are the issues strictly matters of opinion which must be resolved by policy-makers?

National Testing Program

Is a national testing program warranted in homes? Is the testing that is being done reliable? What hazard level warrants remediation? What risk level warrants the abandonment of a structure?

Is a national testing program warranted in schools? What is the risk for children exposed to four pCi/L in schools? If the exposure is for several hours a day, five days per week for up to 12 years, what is the increased risk? Does this merit a different action level than the residential environment?

In California, research has shown that radon levels are elevated in only a very small percentage of buildings. Should testing be done everywhere, or should the government identify high risk areas before all homes and public buildings are tested? How much will a reliable universal testing program cost? Is the problem urgent enough to warrant less-reliable universal testing?

Perhaps a compromise approach is warranted. This would mean universal testing in "hot" radon areas combined with a shift to long-term testing elsewhere. A pilot or survey program to establish where universal testing should take place could save a substantial amount of money and unnecessary concern.

Consumer Fraud and Consumer Protection

Are there unscrupulous or incompetent radon testing and abatement firms doing business? How do you identify competence? How do consumers? Are we doing enough to protect consumers from businesses that prey on their fears? If not, what can be done?

There are plenty of stories about rip-off consultants, door-to-door con men, and other consumer fraud. Can we effectively protect people from such scams? Should we? The panel on accreditation will face many of these same questions and issues.

Congressional Mandate for Background Levels

How realistic are goals for achieving outdoor (background) levels indoors? If they can be achieved, is the presumed risk reduction worth the cost? Should the same standard of acceptable risk be applied to other indoor air contaminants such as the constituents of environmental tobacco smoke or vapors from consumer products?

This goal is widely considered technically and economically unrealistic. First, we must determine whether the goal is worthwhile. If it is, we can then examine its feasibility and cost. With that information in hand, we can determine whether it is a reasonable goal.

Testing Sites

Can sites be tested effectively before buildings are designed and constructed? Are there parts of the country where all homes should be roughed-in or fully equipped with radon mitigation devices? Are there parts where it is unnecessary?

Some experts argue that all sites should be considered as potentially strong sources of radon and that mitigation measures should be "roughed in." When structures are completed, levels can be monitored and, if necessary, the control measures can be completed. Others argue that most sites are not "hot" and that special care is not warranted. However, good site measurement systems have not been developed. Can they be? Is the cost of "rough-in" mitigation measures warranted in "hot" areas only or elsewhere as well?

Point of Sale

What issues should be addressed at the point of sale to protect both the home buyer and the seller?

Both parties to the sale should work out a mutually acceptable agreement defining responsibility and action levels. Sufficiently accurate measurements for making definitive and potentially costly decisions must be made over a long period. Measurements should be taken for at least one winter and preferably for an entire year.

ASBESTOS ABATEMENT IN COMMERCIAL BUILDINGS

Asbestos abatement work in private, commercial buildings is a growing share of the asbestos abatement industry. As the industry refines its techniques and as liability-wary lenders, insurers, tenants, and investors consider their positions when buying, selling, refinancing, or leasing commercial office buildings, more abatement work is occurring. This is not necessarily the case with nonschool local and state government buildings, although some jurisdictions have been aggressive about ferreting out their asbestos-containing materials and addressing the hazards presented by them.

Engineering News Record (*ENR*), the highly respected construction industry weekly news magazine, has predicted that asbestos abatement contracts may reach $100 billion by the end of the decade. Drawing on EPA's research, as well as the extensive data base of its parent company, McGraw-Hill, *ENR* predicted that most abatement work will be done by a small number of large, well-equipped firms. Many of the start-up firms which entered the market during the past five years will be bought out or pushed out by the tough competition.

Nonetheless, there are many buildings where asbestos hazards are not being addressed and perhaps many others where they are being addressed improperly. Unions, particularly the Service Employees International Union (SEIU), are concerned that their members who work in such buildings are being exposed to significant hazards simply because assessment and management or abatement of asbestos-containing materials (ACM) is not a priority.

Individual homeowners and renters are concerned; some are expending considerable sums to assess and remove potential asbestos hazards.

There is still considerable discussion of the degree of hazard

presented by ACM. However, a dialogue is growing about extending regulations which now apply only to schools to cover other public-access buildings. The discussion includes many issues other than fundamental health questions. There are questions of workers' rights, equitable allocation of costs, effectiveness of operation and maintenance (O&M) programs, protection of abatement workers, and others. Some of these questions are addressed in the topics for the forum panel on asbestos abatement in commercial buildings.

Inspection Requirements and Workers Rights

Should inspection be required? Are there situations in which an asbestos inspection program is not advisable? Are any affected groups opposed to inspection, and why? What kind of notification should building maintenance workers or building occupants be given or entitled to?

These questions raise fundamental issues of workers' right-to-know and of responsibility for workers' or other building occupants' protection. How big a role should government play compared to private sector or market forces? Can liability avoidance and profit motives drive the private sector to behave in a manner satisfactorily protective of workers? The answer probably depends on one's perspective and interest in the issue. The positions of the key players, some of whom will be represented at the forum, are not identical.

SEIU has petitioned EPA to extend its asbestos-in-schools rules to require inspections in commercial buildings. EPA has not yet done so, and SEIU may go to court (as it has successfully done in the past) to force EPA to act.

A negotiated rule-making effort by SEIU, EPA, and other affected interests has been underway with facilitation by the Conservation Foundation, EPA Administrator William Reilly's former employer. At least one party to the negotiations has told ***IAQU*** that the negotiations have broken down, largely because the Conservation Foundation has not been effective. Our forum comes at a time when consensus is absent and progress is minimal. The discussion will probably be lively.

Abatement versus O&M

Is there an O&M program that really works? Are there any model O&M programs? Are large office building owners using O&M or removal?

Many large corporations are implementing comprehensive assessment, abatement, or O&M programs. Either they wish to avoid the liability involved with not doing so, they want to invest capital in their physical plants, or they are concerned about worker health and safety. In some instances, a shortage of capital might inhibit an otherwise worker-oriented employer from initiating a comprehensive, aggressive program. Some companies may have decided to take a wait-and-see position until more clarification is developed by the Health Effects Institute study on the health effects of exposure to asbestos in buildings.

Perhaps some of the large corporations with O&M programs could be persuaded to share the results of their experience with EPA and other interested parties. A model O&M program has not been put forward by EPA, even though it has endorsed O&M where immediate abatement of ACM is not indicated by an investigation and assessment.

Economic Trade-offs

What are the economic trade-offs of abatement when space becomes unoccupied versus establishing and operating an O&M program?

We have no data and have seen none to date. EPA should collect such data (protecting confidentiality) and publish an analysis with recommendations. Even the federal government's own experience through the General Service Administration's asbestos program would provide some data to guide private organizations and policy makers at EPA and in Congress.

Should abatement be required? Is a management program without abatement acceptable in the long run? Who should decide? Won't ACM have to come out at some point, even if it is at demolition time? Who benefits from taking it out now as opposed to later?

ACM has to be removed from a building at some point before demolition. Therefore, some abatement advocates and others argue that it might as well be removed sooner rather than later. Engineering economics does not support that argument. Deferring expensive action is economically advantageous if all other factors remain equal. The other factors include changes in the cost of abatement, the cost of money, and the organization's ownership of the property.

Of course, the market value of a building containing ACM will be discounted if asbestos is still in place. The intangible value of the liability associated with owning, operating, or occupying such a

building could be an important but elusive part of the equation.

Residential Abatement

Residential ACM abatements resulting from point-of-sale inspections seem to be increasing as a result of lenders' and insurers' requirements. Are we headed for a parallel and equally controversial set of activities in the residential building stock?

As a result of the attention given asbestos in schools and public buildings, homeowners and renters as well as those who lend or insure residential property have begun to consider asbestos hazards in residences. The administrative costs of reporting, monitoring, and otherwise properly conducting asbestos abatement at the residential scale can be large. No useful guidance has been developed by the federal government. Are there some reasonable actions that can be taken to avoid false alarms and unnecessary expenditures without creating a false sense of safety?

Is Current Regulation Adequate?

How can occupants and workers be best protected under current law and regulations? What new laws or regulations can increase their protection? Is the federal government likely to take a leadership role, or will states and cities continue to introduce and pass their own separate laws?

These are among the central issues in the current debate. Various sectors of industry want different things and answer these questions accordingly. Their disparate perspectives are understandable but not necessarily compatible. Can EPA play a role in resolving these issues harmoniously, or will Congress and the courts be the primary battlegrounds in the foreseeable future?

Improper Abatement: How Real?

Many abatement projects are done poorly, resulting in increased exposure to asbestos. Are there any studies to determine the extent of improper abatement? Is it still happening or is it a thing of the past? What can be done to reduce or eliminate improper handling of ACM abatement projects?

A small number of poorly conducted projects may have created an exaggerated sense of the amount of improper abatement. The media and those who oppose abatement may exaggerate the claims that poorly conducted abatement is widespread. We have seen no evidence to indicate the scope of the problem. If such survey information exists, it would be useful for those in possession of it to disseminate it.

Protecting Abatement Workers

How can we protect the very large number of individuals now involved in asbestos abatement activities? Are there large differences in the way abatement is done which result in the exposure of some but not others?

The quality of protective clothing, equipment, supervision, and care in an abatement project will determine the amount of worker exposure. The real issue is whether abatement contractors will provide the necessary quality without incentives in the form of regulations and inspections. Certainly liability considerations will motivate some firms to perform abatements as rigorously and cautiously as possible. The commitment or lack of commitment of a firm to a long-term duration in the field may affect management decisions regarding the need for such concern.

Theoretically, most abatement is likely to be completed within the next decade. Some firms may be planning ahead to develop new markets for their management skills, technical knowledge, and specialized equipment. Lead paint abatement utilizes many of the same resources as asbestos abatement.

In formulating policy, we should consider the future of both workers and firms. At the same time, we need consistent criteria for determining acceptable risks for workers now in asbestos abatement. Uneven enforcement of regulations and reporting requirements and gaps in the coverage of these requirements results in a lack of protection for some workers. The least protected are probably the most likely to need the protection; for example, those who work on very small projects or in areas where enforcement is lax. We must consider how to protect all workers.

A Final Resting Place

What is to be done to clarify and limit liability for disposed asbestos?

While most legally disposed asbestos is likely to remain in place for a very long time, liability may or may not remain so permanently placed. The courts are currently handling so many asbestos cases, some of them involving large numbers of plaintiffs or very large damage claims, that changes in the status quo are possible. Among the most troubling of the issues is legal liability for disposed asbestos.

Natural disasters or unforeseeable circumstances may result in the desire to relocate disposed asbes-

tos. Such eventualities will require clarification of responsibility and liability for the disposed asbestos. This is a very long-term problem indeed; and, it is not unique to asbestos. Other hazardous wastes will involve the same sorts of issues. These are fairly new problems for our society. The courts will make more decisions about this in the next decade than they have made in their entire history.

The very large cost of asbestos disposal is not unique. PCBs, dioxins, and other toxic substances all require expensive safety measures for their disposal. Technology and ingenuity should provide useful and less costly solutions.

ACCREDITATION OF INDOOR AIR INVESTIGATORS?

The general public and even responsible facility managers have difficulty assessing the credentials of potential IAQ investigators or remediation contractors. Door-to-door sales programs have been blossoming in the Reading Prong to promote radon monitoring and abatement. Newspaper and other advertisements are appearing for kits that test for a variety of indoor environmental hazards.

Asbestos laboratory accreditation and radon monitor proficiency testing only touch the tip of the proverbial iceberg. Evaluating the efficacy of a measurement device or the performance of a laboratory is simple compared to evaluating the qualifications of a professional offering to perform a broad range of IAQ-related services. Yet, without some assistance, how is the potential consumer in need of such services to determine whether an individual or firm is qualified, reliable, and fair?

These questions have been raised in a thought-provoking paper written by Dave Swankin, a Washington attorney, with much experience in IAQ issues. The paper was produced for EPA and is now being circulated for comments. This article represents our views on some of the questions raised in Swankin's paper.

The idea of accreditation seems obvious. Some body, public or private, should determine qualifications, develop and administer tests, and issue certificates. The accrediting authority might maintain a complaint hotline, implement continuing education requirements, administer periodic re-examinations, or establish other programs for the accredited individual or firm. There might be a referral service, professional development program, or other programs characteristic of professional licensing and consumer protection organizations.

However, there are many questions that should be answered before such a program is initiated or promoted. One of them is whether the affected professionals and industries will support such a program. Another involves the question of government involvement, especially if the accrediting program tends to limit competition and restrict consumer access to services. Oversight of the program and protection of an individual's right to do business and compete in an open market are also issues.

Is Accrediting Necessary?

Is an accreditation program necessary? What are the problems that such a program might address? Would the benefits be worth the costs?

We have heard reports of consumer rip-offs, testing devices that don't do what their promoters claim, consultants who can't find "the problem" when the next consultant can, and a number of classic small-time scams. We believe some sort of help is necessary, but it is not clear at this point whether an accreditation program will be useful. We need to know a whole lot more about how it would work, who would operate it, and what it might do.

Impact on IAQ Professionals

What would an accreditation program accomplish for the IAQ field — i.e., for employers and technicians — and for the public? Can such an accreditation program do anything to curb those who are competent but are intent on bilking the public?

An accreditation program might legitimize a field that is otherwise not very organized or cohesive. The process of developing the program might, however, have the opposite effect as tales of woe and unscrupulous or incompetent behavior are trotted out to support the need for the program. It might be able to ferret out some truly incompetent "professionals." A program would enhance the status of those with credentials and prevent a few incompetents from performing as much (or any) bad work. However, it might also erroneously bar a few competents from entering the field or continuing in it. Only a perfect set of tests can avoid erring in the selection process.

What Would the Program Look Like?

Would it accredit firms or individuals?

Either option may be appropriate. It may be possible to register firms without any direct qualifications other than the full-time participation of an accredited individual. In California, building contractors can be licensed either as individuals or as firms employing a qualifying individual other than the owner.

Registration would allow establishment of a complaint handling system that could include complaint investigation and resolution. Technical and business problems might be separated in terms of their processing. Valid complaints might lead to revocation of registration. Many consumer protection programs operate on this basis, notably automobile repair shops. On the other hand, barbers, beauticians, morticians, and many other professionals are licensed as individuals as are the so-called learned professions of medicine, dentistry, engineering, law, and others.

Who would operate it? State or federal governments, or private trade and professional associations? If nongovernmental, what sort of agency would be established to oversee various aspects of the program from review of qualifications through testing, scoring, and issuance of credentials?

What types of people would be on the policy board overseeing the program in order to obtain the confidence of the public and the industry?

Lawyers regulate themselves through bar associations. We rarely hear of lawyers being disbarred. The bar associations are state sanctioned, and, of course, most members of most state legislatures are attorneys themselves. This may simply be a case of the fox guarding the henhouse. Would IAQ investigators or remediation companies be any more likely to be unbiased protectors of the public interest?

Making Exams Fair and Effective

What procedures would be followed to see that the exams are fair, valid, and reliable? What types of examinations might be used in evaluating competence of IAQ technicians? Is competence the issue or is it fairness of business practices?

Any exam will be biased toward certain types of candidates for accreditation. Assumptions must be made about the type of qualifications required for admission to the exam. The qualifications themselves become an exam of sorts. In fact, the courts have found that application requirements for professional licensing are, in effect, a form of examination. Therefore, the decisions about examination qualifications must be made carefully.

Developing the exams themselves begins with definitions of competence and determinations of the nature of the exams. There is a massive movement toward interactive, computer-based examination systems for many professional licenses. At the same time, some examining bodies are switching to take-home essay exams which are then defended in front of a panel of examiners.

The process presents inherent problems for deciding who is qualified to determine what should be in the exam, who should write it, and who should evaluate the candidates' responses.

Exams can be developed to test nearly anything, so there might be a portion of the exam to determine candidates' business practices and values. This would be controversial, but much of the purpose of accreditation would be lost if there were no emphasis on business practices. Competence alone will not protect consumers.

Continuing Education

How can a certification agency provide assurances to the public that those who have been certified have kept up with the rapidly changing indoor air quality field and can apply state-of-the-art technology?

Continuing education is not universally considered effective at maintaining professional competence. In some professions it has led to expensive (and often pleasurable) junkets, tax-deductible at that. On the other hand, there are few other means to assure that a credential, once issued, continues to represent demonstrated competence in the field. Mandatory attendance at a special program might be wise. Testing upon program completion could help. But these sorts of requirements themselves spawn substantial sub-industries of organizations offering continuing education activities. The accrediting body then must determine what is acceptable, how much is required, and how often a requirement must be fulfilled over the life of the credential.

State or Federal Involvement

How might a voluntary accrediting program interface with existing state or federally mandated programs such as laboratory accreditation? How would it interface with state or federal mandatory programs for pollutant-

specific registration or certification?

Sooner or later, most voluntary programs start to pressure state and federal authorities for regulations and laws which will favor their members. This is in the nature of such organizations. Members seek the enhanced status that some sort of government sanction or endorsement brings. This could lead to a push for licensing or registration by the states or for certification by the federal government. We are still in the anti-regulatory environment which developed during the late 1970s and was institutionalized (or, perhaps more correctly, de-institutionalized) by the Reagan White House. But problems of the sort presented by asbestos, radon, and sick building syndrome generate new professional and business activity which eventually results in consumer complaints and other forces for some sort of protection.

Enforcement of Standards

How should the agency enforce any standards it might establish for accredited firms or individuals?

Many professional licensing, registration, and certification activities are essentially lifetime passes. Very few credentials are ever revoked, suspended, or otherwise acted on by the issuing body. Where discipline does occur, it is usually for business and not for professional abuse of the credential.

A virtual lack of enforcement breeds a sense of untouchability and even arrogance for the credentialee. This is precisely the opposite of the driving force for accreditation in the first place. However, no enforcement program will occur without the support of the accredited individuals themselves. It is important to build in an effective enforcement mechanism from the start, or the program will not be effective for long.

Can accreditation be done without squeezing out small operations? What anti-competitive risks might be associated with a certification program?

No such program can be established without risks of anti-competitive elements. Such programs inherently exclude some from membership in the pursuit of creating a higher standard. The challenge is to keep the process as open as possible and to establish minimum qualifications at the same time. Only constant watchfulness by those involved can avoid creating a standard so high that it unnecessarily excludes qualified individuals or so low that it really fails to afford the protections it seeks to provide.

MAKING BUILDING MATERIALS SAFE

IAQU has frequently focused on issues of "safe" or "clean" building materials and furnishings. We consider the selection of building materials and furnishings to be one of the most important ways to develop better indoor air quality. Designers, builders, owners, product manufacturers, and building operators can all play a role.

A significant fraction of the U.S. economy is involved in the manufacture, sale, and installation of building materials and furnishings. Yet very little guidance is currently available to those who wish to select and use cleaner, safer products.

In some cases, building materials and furnishings may not emit much of the total VOC in indoor air. Consumer products, appliances, equipment, pesticides, and other sources may dominate as VOC sources. In these cases, it may not be cost effective to focus on materials and furnishings emissions until the other sources are controlled commensurately.

What Is Safe?

What is a "safe" building material? Who is the material safe for — manufacturing workers, installers, building occupants, maintenance workers?

What is safe for most people may not be safe for others. Asthmatics and chemically sensitive individuals may not tolerate typical products. This may result in the development of special products or in the improvement of standard products. Both changes have already happened and will probably continue to happen.

Who Is Responsible?

Who is responsible for the impact of building products on indoor air quality? What have lawsuits to date determined? What are the positions of the manufacturers, architects, engineers, interior designers, suppliers, and contractors?

Can industry regulate itself? Should the government regulate building products contents or chemical emissions?

Building owners and designers cannot adequately test products before specifying them; this must be done by manufacturers. The producers have the greatest incentive to test, and the cost of testing would be more equitably distributed if done by manufacturers. However, designers and building owners must let manufacturers know what they are looking for. This is done in the specifications that are written for the products.

When designers specify, producers respond. The process is iterative, and products are slowly becoming less polluting.

Emissions Testing

Has the formaldehyde emission standard of HUD improved IAQ in mobile homes, manufactured housing, or elsewhere?

Can emissions test results help designers make better decisions? Or are emissions tests really useful only for research and possibly as a prelude to regulation? Won't emissions testing inevitably lead to a call for regulation of emissions?

Are the same tests suitable for researchers and for manufacturers?

What technical approaches can be applied to the characterization of emissions from new products by manufacturers? What sort of testing is appropriate for products whose emissions change (decrease) rapidly when they are new or initially exposed to the environment and slowly when they are "aged?" When should they be tested and what can be done to obtain comparable and useful results from emissions testing?

Should government set standards for testing or certifying materials emissions testing laboratories? Should government certify laboratories? Should government set standards for product emissions or content?

How much does product testing cost, and who should bear the cost?

We do not have any guidelines or consensus about which building material emissions should be characterized. We currently tend to look at the largest emissions quantitatively without regard to the health effects of the emitted compounds. We need to look at other criteria besides quantity in order to effectively advise designers and product manufacturers about how to select products or limit emissions. No one has put forward a proposal or model for health-based criteria to be used in designing emissions tests and evaluating their results.

Many diverse methods are in use, and they have wide-ranging applications and costs. Their results are also diverse in terms of usefulness, applicability, and reliability. Standards have been developed, for example, for particleboard and other composite wood products, but results from various tests do not always provide the information that designers or building owners might want.

Government might set standards or support their development by private groups, but the problem is a particularly difficult one for government because industries are sometimes very effective in limiting government oversight. However, government might play a role in the quality-control process or in the certification of testing methods or laboratories. The National Institute of Standards and Technology (NIST, formerly the National Bureau of Standards) plays an important role in many aspects of commercial laboratory work in various fields.

The Future

What does the future hold for building products? Are manufacturers doing any testing now? Are standards being implicitly developed? How are architects selecting products now? Are manufacturers changing their approach for marketing purposes or to limit liability?

A few manufacturers are testing their products already, and many have expressed interest in testing. Testing and the standardization of reporting could reduce manufacturers' potential liability. We have found building product manufacturers very cooperative with a few (although noteworthy) exceptions.

There seems to be a great awareness of the indoor air quality issue and a commitment to doing something about it. This commitment is evidenced by new marketing strategies, liability limitations, and product improvement. Testing will play a large role in this process in the foreseeable future.

A few architects have begun to consider emissions in selection, but liability is the driving force. Only a very few architects actually see safe products as a design feature which they can use to market their services and better serve their clients.

SICK BUILDING SYNDROME AND BUILDING-RELATED ILLNESS

Is SBS the medicalization of an engineering problem?

In one sense, the entire indoor air quality issue reflects a failure of the building community — designers, builders, building owners, and building operators. Indoor air should be of adequate quality without all of the specialized and focused attention we now pay it. However, in a different sense, indoor air quality problems reflect the nature of modern society. We have developed complex, interconnected environmental control and support systems that do not adapt quickly enough to rapidly changing conditions. In addition, chan-

ges in public expectations affect tolerance of marginal environmental conditions.

There are problem buildings, and there are people with disease. When we look at individuals with health problems we believe are related to indoor air quality, we may or may not match their symptoms and complaints with classic symptoms of SBS or BRI. Regardless of the diagnosis, they may still be suffering the effects of poor IAQ. We can't really determine whether most people's illnesses are truly caused by indoor air. The problem is too complex.

We can, however, understand the factors associated with elevated illness rates or complaints. Epidemiology identifies associations between exposures and symptoms to study sick building syndrome and building-related illness.

How can SBS be diagnosed? By professionals in medical, engineering, or industrial hygiene? Does an SBS diagnosis require an epidemiologic study?

Authorities in the field disagree on these questions. A universally accepted definition of SBS does not exist. Without such a definition, agreement is not possible. Each professional diagnoses SBS according to his or her own skills, knowledge, and biases; the diagnosis almost always reflects the discipline of the investigators. That does not mean that one is correct and the others incorrect. They simply see things differently and describe them differently.

Can there be just one case of SBS in a building? Can a person in a single-family residence have SBS?

Certainly the SBS symptoms can appear in just a few occupants, but the definition of SBS usually relates its diagnosis to a study of a larger building occupant population.

Will we ever know what causes SBS? What are the latest theories? What appear to be the most common causes? How is it most effectively prevented? Can we ever expect to eliminate all or nearly all SBS? If not, how much cannot be eliminated?

A large number of hypotheses exist regarding these questions, and many researchers have produced evidence that their particular view is correct. It is our view that there are many different potential causes of SBS in almost any building, and the occurrence of the symptoms depends on the peculiar mix of the environment and the occupant population.

Is it important to distinguish SBS and BRI? If so, what is the difference and why is it important? Are there acceptable levels of BRI?

There may be a spectrum of responses to poor indoor air from irritation to disease. Disease is what we can measure — a response which can be scientifically validated. A single dose of a toxin may lead to disease.

SBS can be demonstrated to be associated with occupancy of a particular building, but the cause(s) are not identified. When the cause of an illness is determined, it is considered BRI. BRI normally calls for removing the affected occupant from further exposure. Some forms of BRI are life threatening. Once diagnosed, it is important to identify and remove the cause to prevent further cases. With SBS, the suspected causes can be addressed, but there is no assurance that remedial action will reduce the incidence of complaints or illness.

What is happening with SBS and BRI lawsuits? Are there more of them? Who is winning more cases, plaintiffs or defendants? What factors make for a successful case? What factors make for a successful defense? Can SBS causes be proven in a lawsuit? Need they be? What can building owners, designers, builders, and operators do to protect themselves from such lawsuits?

The potential for litigation is the driving force behind a great deal of private-sector IAQ activity. We believe the activity itself is healthy, although the motivation may not be. Until there is a considerable clarification of liability, either through the courts or through legislation, it is likely that litigation will continue to grow around indoor air issues.

We wrote about litigation in the July 1989 issue of ***IAQU***. Briefly, we said that the number of lawsuits is increasing, that they are not going to trial, and that we are not learning much from them because the records are being sealed as part of the settlement agreements. SBS is difficult to prove, either in a legal or a medical sense. We can only attempt to obtain the strongest possible evidence, then use our judgment to decide whether the illness was caused by the building.

Those concerned about IAQ liability can retain "qualified" experts and follow their counsel. Many are doing so already. They certainly stand in a more defensible position than those who are not dealing with the question at all.

When many SBS lawsuits are settled rather than going to trial, how

can society benefit from all the effort and expertise that goes into the discovery phase of the lawsuits?

This important question troubles us greatly. We think that the amount spent on expert witness work relative to the amount spent by all federal and state governments for indoor air research is significant. Perhaps that is as it should be, but we would like to see more published findings of the extensive and expensive investigations, reports, and testimony of experts on indoor air.

Can or should standards be adopted to provide comfort for building occupants, or should standards only be adopted for health protection?

This issue stimulated a lively debate during the closing session of ASHRAE's IAQ '89 conference. A brief summary will appear in the proceedings of the conference due out in October. (Contact ASHRAE or watch these pages for further information.)

Our first panel and the article beginning this issue of ***IAQU*** deal with this question. We think it will receive considerably more attention in the coming years.

Would standards be most effective to control contaminant levels in air, source emissions, or ventilation rates?

This is the key question. We believe contaminant levels must be controlled in all areas. Clearly, if there were no contaminant sources, there would be no need for special ventilation. But no place exists without contaminant sources, and human occupants themselves are important sources of indoor air contaminants. We need some ventilation to remove occupant-generated contaminants; and the ventilation will also remove contaminants from other sources. What remains is to determine what other contaminants will be present, what are acceptable levels of other contaminants, and what is the most effective way to control them.

IAQ Update '89 Comments

Address your comments or questions for the Forum to ***IAQU*** Editor Hal Levin at Cutter Information Corp., 1100 Massachusetts Ave., Arlington, MA 02174; Fax: (617)648-8707. They must reach Cutter's offices by September 22 at the very latest.

To register, contact Kim Gay at (617)648-8700 immediately.

Conference Announcement and Call for Papers

"Indoor Air Quality and Ventilation in Warm Climates"

[From the conference announcement flyer:]
With problems of indoor air quality becoming increasingly apparent, it is essential to have a far more detailed and fundamental understanding of the occurrence of specific chemicals in indoor air, and of their mechanisms of interactions and modes of dispersion. These are heavily influence both by building design and construction materials as well as building ventilation and maintenance. Little attention has been paid to these problems in warm climates where building design can be substantially different from that in colder climates and where alternative systems are in use for cooling and ventilating. Occupational and domestic exposure to specific chemicals from a wide number of sources including cooking, cleaning, building materials and smoking all need careful evaluation as do such problems as "sick building syndrome" which has recently attracted considerable attention in many countries.

April 24-26, 1990. Sheraton Hotel, Rua Latino Coelho 1, 1097 Lisbon, Portugal; tel. 575757.

Conference registration and abstracts submittal (abstracts due September 30, 1989): Secretariat — International Indoor Air Quality & Ventilation Conference, British Occupational Hygiene Society, 1 St. Andrews Place, London NW1 4LB, United Kingdom.

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