Healthy MATERIALS

Issue No. 2 Fall 1994

A Communiqué on Material Emission Testing and Standards Activities

Published by Canada Mortgage and Housing Corporation

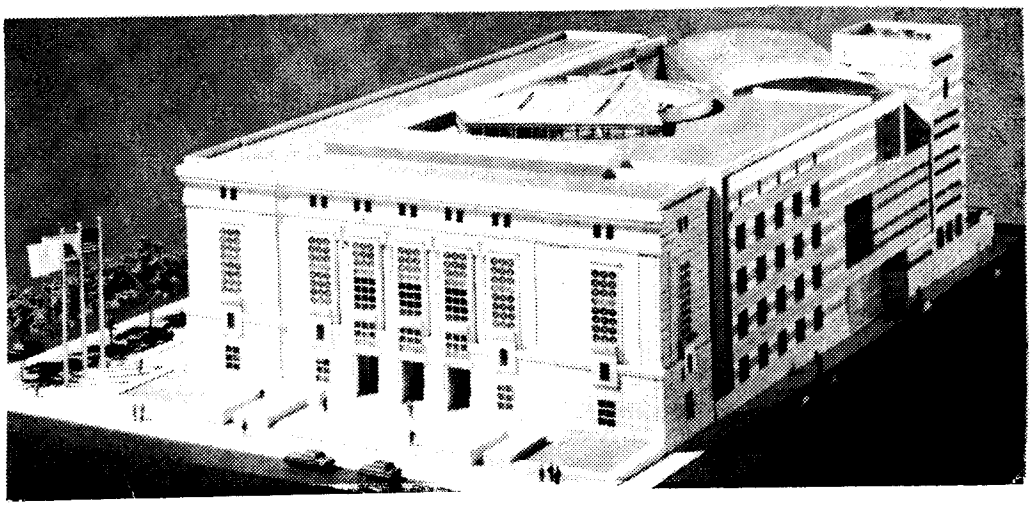
Symposium on sources and sinks a technical success

ASTM's recent symposium, "Methods for Characterizing Sources and Sinks," brought together more than 100 international experts to present their latest emissions research and to debate the critical issues affecting emissions testing.

The symposium was hosted by ASTM Committee D-22 on Sampling and Analysis of Air, Subcommittee D-22.05 on Indoor Air, and was held September 25-28 1994 in Washington D.C. By any measure, it was a great technical success.

Efforts are under way to rush the proceedings to print as a Special Technical Publication (STP) that continues in the line of previous excellent books documenting such ASTM meetings. All who missed the symposium should obtain a copy from ASTM as soon as it is published (summer or early fall 1995). *(continued on page 3)*

Inside...



The new San Francisco Main Library currently under construction — one of the first projects this size to incorporate a "healthy" approach.→ *(see page 29)*

Welcome to Issue No. 2!

The response to the first issue of ***Healthy Materials*** was very positive. We are delighted to see that the communiqué is meeting a need for information exchange in the emissions research field. We now have more than 650 subscribers in total, representing 21 countries. Approximately 45% are Canadian, 30% are American and 25% are from Europe and the Pacific Rim.

In this second issue, ***Healthy Materials*** continues its focus on emission testing and standards development with articles on the recent ASTM Symposium, current European activities, EPA's latex paint study and the National Particleboard Association's test house program.

Highlights are provided of the October meeting of the Task Force on Material Emissions. Canadian manufacturers and designers looking for material testing facilities will find the survey of Canadian test labs useful. The applications section features two American projects — the San Francisco Main Library and the Audubon office in New York.

Two detailed letters and a sampling of the more than 50 responses received to the first issue are also included.

We hope to hear from more of our readers in the future. ***Healthy Materials*** welcomes articles or information on emissions research, testing, standards development, demonstration projects and other related activities.

Terry Robinson, Co-Editor
Scanada Consultants Ltd.

Acronyms

The following is a list of the more common acronyms used in this issue of ***Healthy Materials***:

ASHRAE	American Society of Heating Refrigerating and Air-conditioning Engineers
ASTM	American Society for Testing and Materials
BEPAC	Building Environmental Performance Assessment Criteria
CMHC	Canada Mortgage and Housing Corporation
CHBA	Canadian Home Builders' Association
CGSB	Canadian General Standards Board
CPA	Canadian Particleboard Association
ECA	European Collaborative Action
EPA	Environmental Protection Agency (U.S.)
FLEC	Field and Laboratory Emission Cell
GC/MS	gas chromatography/mass spectroscopy
MDF	medium density fibreboard
MSDS	Material Safety Data Sheets
NPA	National Particleboard Association (U.S.)
NRC	National Research Council of Canada
NRCan	Natural Resources Canada
PSL	Priority Substances List
PWGSC	Public Works and Government Services Canada
RAL	German Institute for Quality Assurance and Certification
SVOC	semi-volatile organic compounds
TAGS	Test Atmosphere Generation System
TVOC	total volatile organic compounds
UBA	German Federal Environmental Agency
UF	urea formaldehyde
VOC	volatile organic compounds
WG	Working Group
4-PC	4-phenylcyclohexene

Aussi Disponible en Français

Healthy Materials est aussi disponible en français, sous le titre ***Matériaux sains***. Si vous voulez recevoir votre communiqué en français, s.v.p informez la Centre canadien de documentation sur l'habitation (CCDH).

ASTM Symposium (cont'd)

Attendees will surely be using it to refresh their memories of the events and discussions, as well as to dig deeper into the technical issues. Authors and reviewers are requested to expedite the return of documents so that this publication can beat the one year schedule that has been established so far.

The Symposium was held in five sessions plus a wrap-up discussion period: Overview (by Bruce Tichenor, the Chair); Design, Construction, Characterization and Operation of Test Facilities; Testing Protocols for Determining Emission Factors and Sink Adsorption/ Desorption Rates; Models for Predicting Source and Sink Behaviour; Interpretation and Application of Test Results; and, Understanding Indoor Sources and Sinks - Where Are We Now and Where Are We Going? (a summary of the previous four sessions, by Rapporteurs).

It will take the Special Technical Publication (STP) to do this symposium justice, but I will attempt to summarize some of my memories of the events in a few paragraphs.

It became obvious, and was the point of several presentations and discussions, that we must come to grips with the different needs of the many users of emission modelling, testing and analysis. While some of us must really understand the science of the processes involved, others require no more than a simple method to screen out the "bad actors." Other criteria can then be used for the final selection (for example, good coverage and hiding power may be the deciding factor between low-emission paints). While experts are trying to understand the details, users are having to make selections now. One manufacturer is already doing both material screening and component testing to produce low-emission office furniture.

What is measured, when and how often are important factors, but are dependent on whether the components of interest are odorous, toxic or mutagenic. What works for one class or set may not be best for all. For applied liquids, like paints and adhesives, it might be sufficient to measure the total amount of mutagens in the product to understand exposure and risk. Peak rates of release will always be important for odorous and toxic materials, however. Much was said about the possible synergistic and antagonistic effects of mixtures, but much more must be known in this area before our discussions produce more light than heat.

For the first time in these symposia, biological release rates and the effects on biological systems or indicating organisms was a featured area of research. We are crawling here where we might be walking elsewhere, but we are moving. There was considerable discussion on the use of the results from such tests, and on whether biological indication was more or less relevant than chemical measures. May the discussion continue on many fronts. We need the understanding that such dialogues will produce.

Many chamber types were discussed, plus their performance, advantages, limitations and future. For the first time a presentation challenged us to look more to microbalance measurements of individual materials as a method of obtaining basic data about materials that could be used as inputs to science-based models. Several speakers and commentators noted that experts in other fields already know techniques and science that can help us produce accurate science-based models of the emission and sink effects. The future looks bright. Costs will come down very significantly once we approach emissions evaluation from a science basis, but testing will still be required for some samples to show where new phenomena are involved.

Several of the presentations showed an improved understanding of the importance of local air flow phenomena for some materials and films, with chambers designed to produce repeatable and accurately-known boundary layer conditions. Determining local boundary layer velocity by laser doppler measurement was introduced. The possible impact of series resistances in the flow path from material to air was also introduced. Most models to date look only at parallel processes and will become more complex when series-parallel flows are introduced (say from thick materials with layering and applied coatings). With improvements in analysis techniques, plus better computers and software, the analysis should become simpler for the analyst and more comprehensible to the user.

Healthy Materials invites readers who attended this important symposium to give us their impressions for the next issue of the Communiqué. *JW*

TASK FORCE ON MATERIAL EMISSIONS

Working Groups identify directions for action

The Task Force on Material Emissions held its third meeting on October 13 in Ottawa, with a focus on the initial accomplishments of the seven Working Groups which were formed last winter.

Attendance was again strong, with 34 representatives from research agencies, test labs, industry associations, product manufacturers, consultants and environmental medicine.

CMHC's Jim White, the Task Force Chair, opened the meeting by summarizing a recent report on indoor air quality by the Toronto Medical Officer of Health (see pg 9), in order to create some context for the increasingly valuable work of the Task Force.

ASTM Symposium Highlighted

White continued with highlights of the recent ASTM Symposium, "Methods for Characterizing Indoor Sources and Sinks". Based on the Symposium presentations, White provided the Task Force with an overview of the types of emissions testing being undertaken, the key issues to be resolved for standardization of test methods, the current state of modelling, and the dilemma of preventing pollution versus reducing health risk. (For more details on the Symposium see pg 3)

Terry Robinson of Scanada Consultants Ltd updated the Task Force on the encouraging response to the first issue of ***Healthy Materials*** and the plans for the second issue.

Robinson also presented the results of the questionnaire sent to Task Force members and associates regarding research priorities.

Guest Presenter on European Activities

Hans Gustafsson of the Swedish National Testing and Research Institute made a well-received presentation on current European activities, with a particular focus on Scandinavia. Gustafsson summarized the four categories of materials leading to long-term emission problems in typical northern European buildings: polymers, paints, linseed oil products and materials decomposed by moisture.

Gustafsson emphasized the recent success of "FLEC" — the field and laboratory emission cell — developed in Scandinavia to simplify emissions testing. He described two labelling programs which are both using FLEC, the Swedish Flooring Trade Standard and the Danish Indoor Climate Labelling System of Building Materials.

Task Force participants were particularly interested in Gustafsson's collection of publications resulting from the work of the European Collaborative Action, "Indoor Air Quality and Its Impact on Man".

Working Groups Propose Directions

The Chairs from each of the seven newly formed Working Groups followed with brief presentations on the directions they have adopted.

John Burrows described the mandate of the **WG on Industry Response**, which includes identifying issues faced by manufacturers, documenting industry actions, determining the cost and technical implications of meeting proposed targets, and establishing a data base of manufacturers' test results. The WG already includes many of the major

material groups and will be soliciting input from other manufacturers not currently represented.

Environmental physician Dr. John Molot of the **WG on Health Data** presented an impressive backgrounder which summarizes what is known about the health effects of indoor pollutants, based on some 120 references. Molot defined sick building syndrome and multiple chemical sensitivity, noting current issues, such as the lack of an objective biological marker. Cacosmia — adverse reactions to odours — appears to be strongly linked.

The **WG on Test Methods** proposes to develop guidelines and standards for conducting material emission tests using small and room-sized chambers, in order to rank materials and better estimate their contribution to contaminant concentrations. Dr. Jianshun Zhang emphasized the WG's desire to work closely with the ASTM D22.05 Committee on Indoor Air and international research labs in improving existing guidelines, developing new guidelines for priority materials, and understanding the reasons for current differences in test results.

Home builders' and renovators' needs and activities will be the focus of the **WG on Builder Update**. John Broniek indicated that the WG will be following product development, labelling programs, codes and standards issues, material cost-effectiveness, liability issues and "healthy house" demonstrations.

Jim Robar presented the proposed mandate of the **WG on Communication Vehicles**, which will be encouraging partnerships among Task Force members on communication activities and promoting existing and future information products. The WG will be identifying priority audiences and key messages, preparing an inventory of current resources and reviewing proposed info products.

Dr. C. Y. (John) Shaw presented the terms of reference for the **WG on International Activities**. This WG aims to be a conduit for information exchange between Canada and other countries, with their scope encompassing guidelines, standards, labelling, new products, measurement and prediction methods, problem avoidance and remediation, and litigation trends.

Dr. Gemma Kerr commented that her **WG on Interpretation and Use of Data** is disturbed that so little attention has been paid to the needs of practitioners. The WG will be investigating how emissions data can be generated less expensively and in a format more useful in steering product selections. They also plan to evaluate the success of various labelling programs.

The Task Force also heard updates on current activities from several agencies.

Lower 4-PC Limits Recommended

Kerr described the carpet emissions research being undertaken by Public Works and Government Services Canada. VOC emission rates have been found to be lower by two orders of magnitude (from >100 to 2 mg/m^{2}h) when VOC-free glues are used with nylon carpet. A study of various types of recarpeting strategies on identical floors of a building has suggested a strong correlation between the concentration of 4-PC and occupant complaints. Kerr

Virginia Salares explains innovative wall system in CMHC's demonstration house for the hyper-sensitive.

therefore recommended that the Canadian Carpet Institute lower the levels of 4-PC in its labelling program.

Tom Hamlin and Tim Mayo of Natural Resources Canada presented "Clean Air-2000", a simple model which can be used by housing designers and builders to predict the impact of their material selections (see pg 11).

Dr. Jianshun Zhang provided an update on the National Research Council's emission research program. NRC has developed a small chamber test system, based on ASTM but with an internal chamber to provide control over velocity and turbulence. The importance of these parameters has been demonstrated for emissions from wood stain. Modelling shows good agreement with measured data for the first 15 hours. The next phase will involve long-term emissions from dry materials. The construction of a stainless steel, room-sized chamber has also been completed and commissioning and performance evaluation are currently underway. A variety of realistic air distribution systems have been incorporated. NRC will be collaborating with EPA's Research Triangle Park and Australia's Institute of Minerals, Energy and Construction in comparing test results and developing standards for large chambers.

Focus on Sinks and PSL-2

Rein Otson described Health Canada's new, larger version of the Test Atmosphere Generation System (TAGS), which will be used to examine the behaviour of airborne organics and to test sampling methods. The results of the 754-home VOC survey are being re-analyzed with respect to compounds identified in the second Priority Substances List (PSL-2). Otson noted that 24 of the 44 PSL compounds were found toxic to humans, with air being the primary route of exposure for the majority. Health Canada is examining predictive modelling approaches, focussing on sinks, with testing to be undertaken in Toronto homes. Otson requested emission data to augment Health Canada's databases, which have been converted to DBase4 format.

Ying Zhang outlined the research at Concordia University's Centre for Building Studies which is focussing on a better understanding of source emission mechanisms. Concordia has derived a physical model of source emissions and is now undertaking additional studies of the effect of environmental parameters.

Jay Kassirer of Cullbridge Marketing and Communications solicited input for the directory he is preparing on IAQ products and services (see pg 8).

Guide to be Released in 1995

Jim Robar updated the Task Force on CMHC's proposed publication "Building Materials for the Environmentally Hypersensitive", which has undergone an industry review and has been revised. The final version should be available in 1995.

Dr. Virginia Salares described several other CMHC initiatives related to the hypersensitive: a consumer video entitled "This Clean House", the characterization of six "sick" homes, a training program on home diagnostics, a draft guide on mechanical equipment and ongoing monitoring of the demonstration house for the hypersensitive. During the lunch break, Task Force members participated in tours of the demonstration house.

The Chair raised the possibility of joint funding of R&D projects through the Task Force, since it represents an ideal forum where industry, researchers and health professionals work together. Some members indicated that the mandate of the Task Force would need to be clearer to attract financial participation from their agencies.

The lack of known health effects data surfaced as an issue on a number of occasions, and there was some debate over the degree to which the Task Force should focus on health. Closing discussions identified the need for action on the part of the Working Groups. The WG chairs are to meet shortly to agree on priorities and coordinate their efforts.

It was agreed to hold the next meeting of the full Task Force in conjunction with the "IAQ, Ventilation and Energy Conservation in Buildings" Conference in Montreal in May. *TR*

For further information or copies of the Minutes:

Jim White, Chair, CMHC Research Division
700 Montreal Road, Ottawa, Ontario K1A 0P7
Tel: (613) 748-2309 Fax: (613) 748-2402

Terry Robinson, Secretariat
Scanada Consultants Ltd
436 MacLaren Street, Ottawa, Ontario K2P 0M8
Tel: (613) 236-7179 Fax: (613) 236-7202

NEWS AND ANNOUNCEMENTS

EPA completes first phase of latex paint study

by Bruce Tichenor, U.S. Environmental Protection Agency

The U.S. EPA's Air and Energy Engineering Research Laboratory, Indoor Air Branch, is currently evaluating emissions from interior latex paints at its facilities at Research Triangle Park, NC. In addition to the development of emission factors, the three part study will evaluate the applicability of recently developed mass transfer models for determining latex paint emissions. Ultimately, the effort should result in a test method proposal for ASTM.

Initial Assessment Characterizes VOC Emissions

Part 1 of the study, consisting of small chamber source characterization, has been completed. The purpose of this initial assessment was to determine the most appropriate techniques for conducting the overall latex paint assessment program. Activities included the selection of paint; compilation of information on paint composition based on product label and MSDS data; analysis of VOC and water content using ASTM methods; determination of major organic compounds; development of optimal sampling and analysis methods for organic paint emissions; evaluation of paint application methods; and selection of the substrate.

The paint selected for evaluation was a white interior flat latex wall paint produced by a major U.S. manufacturer. Based on ASTM methods for paint analysis, the paint has the following composition by weight: non-volatiles 57%, volatiles 43%, (water 40% and VOCs 3%). Analysis of the paint by liquid injection to a gas chromatograph (GC) gave a total VOC content of 45 mg/g with the following composition (in mg/g): ethylene glycol 24, Texanol® 13, butoxyethoxyethanol 5, propylene glycol 2 and diethylene glycol 1.

An evaluation of available methods resulted in the selection of the following sampling and analysis techniques: a) sampling on Tenax® TA sorbent; b) thermal desorption and concentration; and c) analysis by GC (with a DB™-Wax column) using a flame ionization detector.

Three application methods were evaluated: split applicator (a "standard" laboratory method), brush and roller. The roller method was selected for use in the remainder of the study.

Gypsum Chosen as Realistic Substrate

Emission rates from gypsum board and stainless steel were evaluated. While stainless steel is routinely used as a test substrate in emissions testing due to its non-adsorbent properties, gypsum board is a more realistic choice for latex paint. The evaluation showed that VOC emission rates from latex painted gypsum board are quite different from those occurring when stainless steel is used. Significant amounts of VOCs are absorbed by the gypsum board, reducing the short-term emissions to the indoor air.

Static and Dynamic Chamber Testing to Determine Emission Rates

Part 2 of the study will be completed in early 1995 and consists of static and dynamic chamber testing and IAQ modelling. Static chamber testing will determine equilibrium vapour pressures (concentration) of VOCs for use in mass transfer models. Dynamic chamber tests will begin with the development of an optimal test strategy which will consider factors such as the time between painting and placing the sample in a chamber, sampling times, air exchange rates, sample loading, surface velocities, and sink effects. This work will determine VOC emission rates and parameters, and will evaluate various source emission models, including mass transfer models.

Test House Studies to Validate Models

The third phase, to be completed in late 1995, involves test house validation studies to develop data for evaluating and validating source emission models, including mass transfer models. In addition, the studies should provide data for assessing the scale-up of small chamber source emissions data.

Mass Transfer Model May Lead to Simpler Test Method

EPA's assessment of latex paint is expected to result in emission rate data, validated source emission models and mass transfer models, test house data, and a draft ASTM "Standard Practice for Determining Emissions from Interior Latex Paints."

If a mass transfer model can be used to successfully predict emissions, a test method based on ASTM VOC content and equilibrium data from static headspace should be possible. The dynamic chamber test method could then be replaced by a simpler and cheaper technique.

For further information:
Dr. Bruce Tichenor, U.S. Environmental Protection Agency
Tel: (919) 541-2991 Fax: (919) 541-2157

Directory being prepared on the Canadian indoor environment industry

by Jay Kassirer, Cullbridge Marketing and Communications

An Ottawa-based firm is collecting information on companies in Canada that offer products and/or services which help create and maintain healthier indoor air environments for residential, commercial/institutional and industrial settings. This directory is being prepared for Industry Canada, Canada Mortgage and Housing Corporation and the Ontario Ministry of Environment and Energy's Green Industries Office.

Readers can assist in updating the directory by identifying Canadian companies and organizations that provide technologies and services which:

- monitor and assess the nature and pathways of indoor pollutants;
- prevent indoor pollution by minimizing or eliminating sources;
- control indoor pollution (eg. by ventilation and filtration) or clean up and restore indoor environments which have been degraded.

The potential benefits of participating include:

- a free listing in several directories to be distributed to health and housing agencies and to be made available, on request, to industry and the general public;
- visibility with government officers organizing related industry support programs;
- free, qualified publicity in target export markets, through commercial officers at Canadian consulates and Ontario commercial offices abroad.

Information should include company name, contact name, telephone and fax numbers, and can be sent to:

Jay Kassirer or Lily Weinstock
Cullbridge Marketing and Communications
809 Quinlan Road, Ottawa, Ontario K1G 1R8
Tel: (613) 733-6013 Fax: (613) 733-3306

Industry and EPA launch test house

A joint industry/government initiative in the U.S. will lead to an improved understanding of emissions from urea formaldehyde (UF) bonded wood products in housing.

After several years of discussions, a cooperative research and development agreement was signed on September 29 between EPA and the National Particleboard Association (NPA). Industry is the major funder of the project, with NPA contributing US $460,000. EPA is also providing funding. Geomet Technologies has been retained to undertake the study.

The overall objective is to evaluate the contribution of UF-bonded wood products to formaldehyde levels in new conventional and manufactured homes. The study will also analyze emission decay characteristics and will verify IAQ models.

The products being tested include particleboard underlay, hardwood plywood panelling, interior doors and kitchen cabinets. Unlike most previous testing programs, each product will be individually monitored from production through transportation and installation.

Test House Nearing Completion

The first phase of the project involves monitoring a test house, which is now under construction. Materials will be exchanged four times and testing will be carried out under

various loadings, source strengths and air exchange rates. The test house will be unfurnished and unoccupied.

Rich Margosian, NPA's co-investigator, hopes the work on the test house will be completed by February or March of 1995.

The next phase will involve similar testing on four manufactured homes. Each will have different characteristics and will function as a test chamber. The entire project is expected to take 12-20 months to complete.

Other industry groups involved are the National Kitchen Cabinet Manufacturers' Association, the Manufactured Housing Institute and the Hardwood Plywood and Veneer Association.

"We would like to see formaldehyde concentrations at the time of occupancy being at a level of 0.1 ppm or lower," predicts Margosian. He also hopes to see the testing and modelling procedures validated, and looks forward to having an unprecedented level of documentation on emissions from individual building components. *TR*

For further information:
Rich Margosian
National Particleboard Association, Gaithersburg MD
Tel: (301) 670-0604 Fax: (301) 840-1252

Toronto Health Dept. calls for action on IAQ

The City of Toronto's Department of Public Health has recently released a report which not only recognizes the importance of indoor air quality, but makes many far-reaching recommendations targeted to federal, provincial and municipal agencies. Several recommendations involve emissions from building materials.

"Indoor Air Quality: Issues and Concerns", authored by Dr. Perry Kendall, the Medical Officer of Health for Toronto, was released in September. The report nicely summarizes what is known about indoor air pollutant sources, IAQ guidelines and regulations, health effects and measures for improving IAQ.

Within the City's jurisdiction are 180 municipally-owned buildings, of which one third have undergone IAQ assessments in recent years. Schools are another focus. 15-20% of the schools in the Toronto Board of Education have been investigated for IAQ problems, while approximately half of the schools in the Metropolitan Separate School Board have been investigated.

The report recognizes the importance of source control as "often the most effective way of improving indoor air quality". The author cites various strategies, including the avoidance of certain materials, substitution of low-emission products and encapsulation, as well as the more conventional strategies of ventilation and filtration.

The report's recommendations are comprehensive and call for action by specific federal, provincial and municipal departments. Included in the recommendations are the following which deal specifically with material emissions:

- develop safety standards for off-gassing from building materials, furnishings and consumer products;
- work with industry to establish emission reduction targets, encourage voluntary reduction efforts and develop product labelling; and
- support research on VOC emissions and potential health effects.

Other recommendations related to emissions include:

- update current residential IAQ guidelines, with an emphasis on common VOCs, and develop IAQ standards for institutional and commercial buildings;
- establish an advisory committee to identify changes to the Ontario Building Code to ensure good IAQ;
- ensure funding for IAQ programs; and
- educate the public and building industry regarding IAQ, particularly in its relation to energy efficiency.

The City of Toronto's report and recommendations are quite significant in signalling the recognition by local health authorities of the need to address indoor pollutant sources to ensure healthy environments. *TR*

To order copies of the report ($10 plus handling & taxes):
City of Toronto, Department of Public Health
Tel: (416) 392-7410 Fax: (416) 392-1553

BEPAC places heavy weighting on source control

A newly available tool for assessing the environmental performance of office buildings recognizes the importance of controlling indoor emissions.

The Building Environmental Performance Assessment Criteria (BEPAC) gives credits for the following methods of controlling volatile emissions:

- non-textile floor coverings in common areas;
- fusion-bonded, needle-punched or other types of low emission carpet backings, or laying of carpet without adhesive or with dry adhesive;
- water-based paints or low-odour solvent-based paints meeting the requirements of Ecologo, Green Cross or Blue Angel programs;
- water-based, low-toxicity adhesives meeting Ecologo, Green Cross or Blue Angel requirements;
- building bakeout/flushout at >27°C and 1.5 ac/h for at least one week prior to occupancy.

Additional BEPAC criteria for indoor air quality include radon testing and remediation, moisture control, mineral fibre control, pollutant source isolation, minimum ventilation rates, ventilation intake and exhaust discharge locations, and ventilation system controls.

BEPAC addresses five major areas of environmental impact: ozone layer protection, energy, indoor environment, resource conservation and site/transportation.

BEPAC was developed by Ray Cole at the University of British Columbia, and is an extension of the Building Research Establishment Environmental Assessment Method (BREEAM) used in the U.K. BEPAC has been pilot tested on several buildings in British Columbia. Brian Charlton, the Minister responsible for Ontario's Management Board Secretariat, announced in late September that Ontario intends to have BEPAC assessments done on 800 provincially owned buildings as part of the province's Green Industries Strategy. *TR*

For further information:
Dr. Ray Cole,
University of British Columbia, Vancouver
Tel: (604) 822-2857 Fax: (604) 822-3808

Demonstration homes attract positive public response

Demonstration R-2000 homes in three provinces are emphasizing the use of low-emission components and finishes. This emphasis underscores the increasing shift in public demand toward healthier indoor environments.

Two "EnviroHomes" have been built in Edmonton, Alberta by Challenger Homes and in Saint John, New Brunswick by Wayne Moore Contracting. In addition to meeting R-2000 standards and incorporating many environmental features, the EnviroHomes alert the public to the advantages of cleaner indoor air.

The Edmonton EnviroHome uses Ecologo water-based paints, Medite II™ formaldehyde-free counter tops and water-based flooring adhesives. The Saint John EnviroHome features water-based finishes, solid wood or low formaldehyde cabinetry, and pre-finished hardwood flooring. The EnviroHome projects are sponsored by Canada Trust and the Canadian Home Builders' Association, with assistance from CMHC, NRCan's R-2000 Program and local sponsors. This initiative will be broadened in 1995.

In Nova Scotia, nine builders participated in the "R-2000 Showcase of Healthier Homes", involving 21 homes in Bedford and Dartmouth. Promotion to the public focused on material selection for a healthier environment.

Measures taken to reduce emissions included low-VOC interior paints, water-based floor finishes and adhesives, formaldehyde-free MDF board for shelves and trim, sealing of cabinetry edges and undersides of counter tops, and low-emission exterior plywood for subflooring. Carpeting was eliminated in 75% of the homes, and replaced with hardwood, softwood (hemlock) and ceramic tiles with low VOC grout. Sponsors included CMHC, NRCan, CHBA, Nova Scotia Dept. of Natural Resources, Nova Scotia Power, Clayton and Honeywell. *TR*

For further information:
R-2000 Program, Natural Resources Canada, Ottawa
Tel: (613) 947-2000 Fax: (613) 943-1590
John Broniek, Canadian Home Builders' Association, Ottawa
Tel: (613) 230-3060 Fax: (613) 232-8214

NRCan unveils builders' tool for material selection

Tim Mayo likes to introduce NRCan's work on material emissions by giving the example of the builder who called him from the top of a step ladder with two types of caulking in his hands, asking Tim which one had lower emissions. "The industry needs to know now. They can't wait for all the research to be completed," says Mayo.

NRCan staff receive numerous calls from builders for advice on low-emission materials, particularly for the Advanced Houses and R-2000 Programs. To address this immediate need, NRCan has developed a simple performance-based design tool — "Clean Air-2000" — to assist builders and housing designers in predicting indoor pollutant levels in new housing.

Tom Hamlin described NRCan's work at the October meeting of the Task Force on Material Emissions. Their approach began with the assembly of the best data available on emission rates, guideline concentration levels and actual pollutant levels in new Canadian homes. The user enters data on material types and quantities into an EXCEL spreadsheet, which then estimates pollutant concentrations after 30 days and after six months.

"Ventilation appears to control formaldehyde, but not TVOCs, which suggests that source control is essential", observed Hamlin. "Typical Canadian houses vary in source strength by two orders of magnitude."

Model Uses Labelling Program Limits

NRCan recognizes that their model is quite crude but represents a starting point upon which to base future refinements. Specific emission rates can be entered if known, but otherwise the upper limits from labelling programs are used, representing a conservative approach. Monitoring data suggests that actual emission rates from most products are lower than labelling program limits. Continuous ventilation rates equal to current National Building Code requirements (1/3 air changes/hour) are assumed.

Clean Air-2000 does not consider all types of chemical emissions, but does model a representative set, including TVOCs, formaldehyde and styrene. 4-PC, polycyclic aromatic hydrocarbons and chlorinated hydrocarbons could also be modeled if more immediate data were available. Sink effects are not considered.

Guideline levels were extracted from Canada's 1989 "Exposure Guidelines for Residential Indoor Air Quality" and from various international studies of lowest observed effect levels. Clean Air-2000 assumes that building materials are responsible for one half of the pollutant levels in a home, with occupants and their furnishings and activities being responsible for the other half.

The accompanying draft report, "A Proposed Procedure for Designing New Houses with Better Indoor Air Quality", was researched and written by NRCan's Madeleine Denis.

The report includes two case studies. The Ottawa "Innova House", one of NRCan's Advanced Houses, features low emission materials and had little difficulty in meeting guideline levels at the 30-day stage. A conventional house was also shown to meet the guidelines, but only after considerable modification.

Housing Implications

Based on the case studies, emission limits and default assumptions, the report makes a number of design recommendations, which have significant implications for conventional housing:

- eliminate solvent-based paints, sheet vinyl flooring and carpet underpads;
- limit carpet to 1/3 of the floor area;
- limit particleboard underlay/decking to 1/8 of the floor area;
- completely seal all particleboard and MDF cabinetry;
- ensure a high air change rate after application of paints and glues for 30 days prior to occupancy.

Mayo indicated that NRCan intends to make the report and spreadsheet available to builders this winter. *TR*

For further information:
Tom Hamlin or Tim Mayo,
CANMET, Natural Resources Canada, Ottawa
Tel: (613) 947-1959/996-3089 Fax: (613) 996-9416

EMISSION TEST FACILITIES

Survey of Canadian Laboratories

With interest in low-emission materials rising, building designers and owners are increasingly seeking data on emissions.

*To assist material specifiers, manufacturers and government agencies in identifying where emissions testing can be done in Canada, **Healthy Materials** surveyed a number of private and public lab facilities.*

Seven labs currently undertake various kinds of chamber tests and six have provided descriptions of their current activities. Health Canada has recently upgraded their test atmosphere generation system (TAGS) and will be providing an article for a future issue.

NRC · CNRC

National Research Council

by Dr. C. Y. (John) Shaw

The concern over indoor air quality has stimulated increasing interest in building materials and furnishings with low emission characteristics. To address this need, the Institute for Research Construction (IRC) at the National Research Council has launched a five-year project on material emissions and indoor air quality modelling. Two documents will be produced at the end of this project. They are a database containing the emission characteristics of commonly used building materials and furnishings, and a computer model for predicting the effects of contaminants generated by materials and furnishings on the overall contamination level in buildings.

Currently under construction is a full-size chamber for measuring the emission characteristics of large samples of building materials, components, furnishings and work stations under conditions similar to those in real buildings. It can also be used to test air cleaners. The stainless steel chamber is 5m by 4m by 2.75m high (55m^3). It has a dedicated HVAC system with an air purifier, HEPA air filters, and stainless steel ducts, coils and fans.

The HVAC system is capable of delivering up to 10 air changes per hour of conditioned air. The types and locations of the supply air diffusers and return air grilles inside the chamber can be changed to simulate different air flow conditions existing in actual buildings. The air temperature and relative humidity in the chamber can be controlled between 15° and 35°C and between 20 and 80%, respectively. An automated measurement system will be used to measure air temperatures, relative humidities, air velocities, and turbulence intensities at more that 30 locations inside the chamber. A dedicated gas chromatograph will be used to measure the contaminant conditions.

This chamber will significantly strengthen the abilities of IRC to measure material emission characteristics, and predict the effects of the contaminants generated by building materials and furnishings. This information can be used by designers and building owners to specify building materials based on their emission potentials. It will also enable us to help Canadian industry to meet future labelling requirements for domestic and international markets. In addition, the new chamber will form a natural complement to the Canadian Construction Materials Centre to provide an evaluation service of national and international stature.

For more information:
Dr. J.S. Zhang or Dr. C.Y. Shaw
National Research Council, Institute for Research in Construction, Ottawa
Tel: (613) 993-9538/993-9702 Fax: (613) 954-3733

ORTECH Corporation

by Peter Piersol

ORTECH is a technology-based consulting and testing organization located in Mississauga, Ontario with a total technical staff of approximately 200. Building material emissions testing is conducted as a joint service through the environmental, analytical and building sciences groups. In 1994 ORTECH's quality program received ISO 9002 registration status.

Facilities available to conduct materials emission tests include small dynamic chambers, headspace testing vessels, large flexible dynamic tedlar chambers and the related support equipment such as sampling equipment and trace organic analytical laboratories.

ORTECH presently has three small dynamic testing chambers; two of 55 litres and one of 1 m^3. These chambers have temperature, humidity and clean air flow rate control. The chambers are used to test small material units or portions of materials such as floor coverings, wall coverings, office furniture components, paints and surface coatings. Air exiting the chambers is sampled for VOCs on multi-adsorbent tubes with analysis by thermal desorption followed by gas chromatography/mass spectrometry (GS/MS). This technique is capable of detecting compounds at the nanogram level. Formaldehyde is sampled in a sodium bisulphate absorbing solution with colourimetric analysis. This formaldehyde technique is known as the chromatropic acid method and is capable of detecting formaldehyde at the microgram level.

Headspace vessels of various designs are used to do initial investigations of chemicals emitted from materials. Samples are placed in small containers of less than 100 ml and the headspace chemical analyzed by GC/MS. These headspace containers can be at room temperature or at elevated temperatures such as 40°C to enhance emissions.

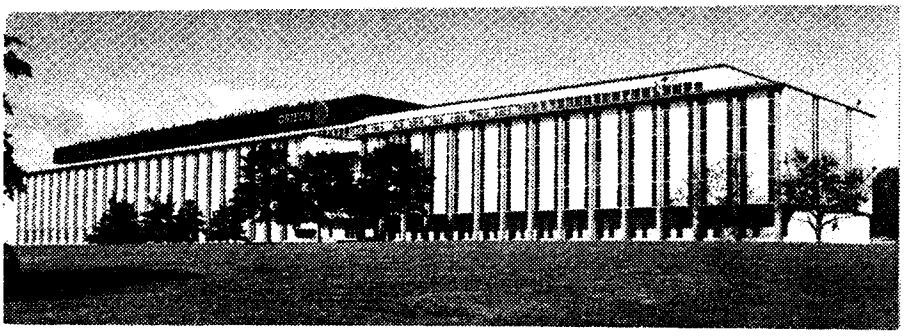
In order to test larger units such as chairs or other furniture components, flexible dynamic chambers have been constructed of tedlar which are placed in large "walk-in" environmental chambers for temperature control. The humidity and clean air flow rate control is similar to that of the smaller dynamic chambers.

ORTECH has been involved in emission testing of building materials for over ten years. Initial activities included studies of urea formaldehyde foam insulation (UFFI). Recently studies have investigated carpets, carpet undercushions, insulation, structural lumber, paints, flooring adhesives, office furniture, gypsum wallboard, fibreboard, vinyl flooring, wall coverings, cabinetry, floor cleaners and polishes, and cleaners and disinfectants.

A recent project involved the testing of approximately 35 building materials to address the concern that materials with recycled content have additional chemicals which could off-gas. This study found a wide range in emissions with no difference between those with recycled content and conventional materials.

Another study involved the testing of proposed building materials for a psychiatric hospital *(see **Healthy Materials** Issue 1, pg.4)*. This study is continuing with the investigation of VOC emissions from floor cleaners, floor polishes, institutional cleaners, soaps and disinfectants, and the development of a protocol to evaluate these building maintenance and caretaking products. Initial findings have determined that manufacturer information such as Material Safety Data Sheets (MSDSs) are inadequate to evaluate potential VOC emissions.

For further information:
Peter Piersol
ORTECH Corporation, Mississauga
Tel: (905) 822-4111 ext.545 Fax: (905) 823-1446

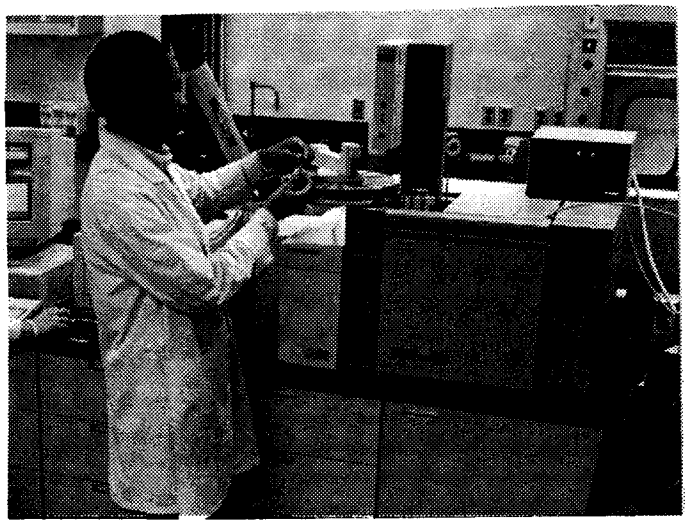


Forintek Canada Corporation

by Jack Shields

Forintek's new 65,000 square foot pilot plant and research laboratory near Quebec City opened officially on October 13. The new facility is a showcase of Canadian wood technology.

Forintek's eastern lab will continue to focus its R&D program on lumber, composite panels and building systems. The composite department has specially designed formaldehyde emission test laboratories and is continuing to act as the monitoring and inspection agency for the Canadian Particle Board Association's formaldehyde certification program.



A new program to study chemical emissions from wood products was initiated last year. A high resolution gas chromatograph/mass spectrometer has been purchased for this work and a new emission collection chamber has been constructed. Once characteristic emissions have been identified for various wood products, the effect of changes in processing conditions will be studied to determine the impact of emissions. In particular, parameters related to the processing of composite panel products such as adhesive type, adhesive content, wood species and pressing temperature will be examined.

Forintek will continue to play a strong role in codes and standards in the environmental field as it relates to wood products. Forintek's facilities are also available for industry and government agencies on a contractual arrangement.

For more information:
Jack Shields, Forintek Canada Corporation, Sainte-Foy, Quebec
Tel: (418) 659-2647 Fax: (418) 659-2922

BOVAR-CONCORD Environmental

by Laura Hurst

BOVAR-CONCORD Environmental currently has a sophisticated laboratory-based test chamber to assist clients in addressing indoor air quality concerns. The chamber is ideally suited for the precise measurement of emissions from building materials. The dynamics of air flow within the chamber have all been well established as have a wide variety of measurement methods and physical parameters.

The testing chamber is shown schematically in Figure 1. The sample exposure zone is 0.26 m^3 and is accessible from the exterior. The input air flow rates through the chamber can be varied to provide a range of contact times in the exposure zone. Typically, at a chamber flow rate of 100 L/min which corresponds to an air velocity in the contact zone of 0.05 m/sec, the exposure contact time is 0.26 minutes. However, it is possible to create testing conditions to mimic a variety of real life scenarios.

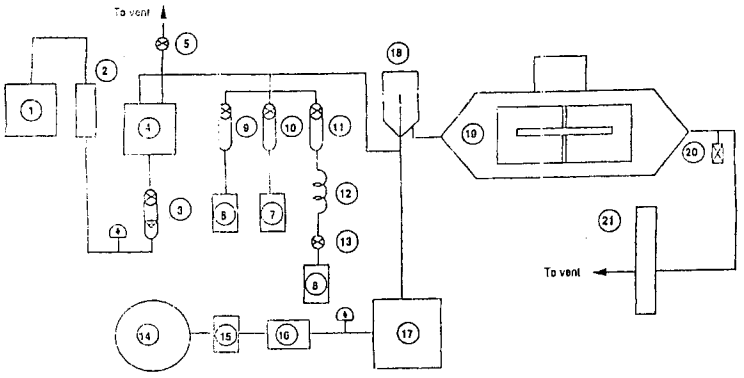
A vital component of any materials testing system is the ability to obtain reliable and reproducible measurements. The chamber has undergone extensive characterization of this parameter. Twelve active sampling lines and greater than thirty passive sampling ports can be used to monitor:

- the complete spectrum of organic compounds;
- ozone, sulphur dioxide and NO_x.

Sampling can also be performed on an automated basis continuously for greater than a 24 hour period.

An alternative and unique use of the chamber is the testing of materials for their ability to adsorb pollutants. Materials that are suspected of adsorbing particular compounds can be exposed to a variety of air pollutants under well defined conditions. Emission measurements can be taken at various

Fig. 1 Dynamic Vapour Generation System and Exposure Chamber



LEGEND

1. nitrogen supply
2. molecular sieve
3. flowmeter #1
4. AID standards Gen.
5. toggle valve
6. cylinder I
7. cylinder II
8. cylinder III
9. flowmeter #2
10. flowmeter #3
11. flowmeter #4
12. copper coil
13. neddla valve
14. compressed air
15. air prefiller
16. charcoal filter
17. Miller-Nelson RH & flow controller
18. mixing vessel
19. sampling chamber
20. air valve
21. charcoal filter

times, temperatures and relative humidities as determined by the needs of the particular situation.

From our past experience doing materials testing more directly, it is clear that this more elaborate chamber testing approach provides better quality data of greater practicability. We look forward to applying this instrumentation to advance the effort in reducing indoor air pollutants and creating a better work environment for all.

For further information:
Laura Hurst or Phil Fellin
BOVAR-CONCORD Environmental, Ottawa (with offices in Vancouver, Edmonton, Calgary and Toronto also)
Tel: (613) 745-4644 Fax: (613) 745-1290

Saskatchewan Research Council

by Alicje Cornelissen

The Saskatchewan Research Council (SRC) in Saskatoon operates a number of environmental chambers, on a fee-for-service basis, to determine building product emission rates. Chamber sizes range in volume from 33 litres (table top) to 23m^3 (room size). The chambers are all constructed with chemically inert components such as stainless steel. Testing parameters such as temperature, relative humidity and air exchange rates are controlled and monitored using calibrated instrumentation.

"Product offgassing tests at SRC go back to the early 1980s," notes Rob Dumont, a researcher at the Council. "Dave Eyre, now retired from the Council, was a rather lonely advocate at that time of emissions testing. He was able to convince some enlightened clients at NRCan to look at chemical offgassing from caulks and sealants. We now know that many of the solvents in caulks and sealants are rather nasty chemicals — toluene, xylene, etc., — and should be treated with care and high ventilation rates."

Since that early work, emission testing has also been done on composite wood products and sprayed-in-place polyurethane foam.

SRC's 23m^3 environmental chamber

Correct storage and conditioning of the samples are important prior to testing as are product loading ratios when conducting tests. Since test conditions are expected to represent typical residential construction practice, the type of specimen holder used in the chamber is based on the installation method used for the specific product in question.

VOC identification is determined by adsorption on solid sorbent tubes followed by thermal desorption and combined gas chromatography/mass spectrometry (CG/MS). The NIOSH Method 3500 is used to determine formaldehyde concentrations.

The large walk-in chamber has been used to determine the efficacy of various fast-drying coatings on full scale cupboard units in reducing formaldehyde emissions. The chamber has also been used for evaluating lead paint dust cleanup techniques. The smaller chambers have been used for formaldehyde measurements of various composite wood products and also for VOC identification of sprayed-in-place polyurethane insulations. VOC tests have also been performed on caulks and sealants.

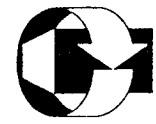
A very interesting project done last winter for the City of Saskatoon involved measuring the offgassing from a liquid-applied rubberized coating on an indoor running track. Levels of xylene in the building where the coating was used were as high as 40 mg/m^3. The VOCs at the track have been brought within an acceptable target level of 0.3 mg/m^3 (guideline proposed by the European Community) by hyper-ventilating the building.

Currently, testing is being performed on a wide range of building products used in residences. Building materials being tested include commonly used floor, wall and ceiling finishes. A new standard is being written as part of this project as there is a recognized need for well characterized test data on the emission rates of pollutants from building materials.

For further information:
Alicje Cornelissen, Director, Building Science Division,
Saskatchewan Research Council, Saskatoon
Tel: (306) 933-6139 Fax: (306) 933-6431

Healthy Materials would be pleased to publish information in future issues on the current activities of international labs. Please send us your news.

Centre des études sur le bâtiment



Centre for Building Studies

Concordia University

by Fariborz Haghighat

Material emissions testing in the Indoor Air Quality Laboratory at the Centre for Building Studies (CBS) of Concordia University in Montreal has been underway since early 1992. Two stainless steel environmental chambers have been manufactured for this purpose.

One chamber, built in accordance with ASTM D5116-90, is a small 50 L standard chamber. Presently, it is being employed to test the effects of temperature and relative humidity on the emissions from paints. To achieve this end, the small chamber is placed in one of two twin room-size chambers (inside dimensions approximately 2m x 2m x 2m) equipped with a heating/cooling control and data acquisition system. This set-up will maintain temperature and relative humidity at the desired testing values for the duration of the test run. Air samples, collected on sorbent tubes, are analyzed using a Hewlett Packard 5890 Gas Chromatograph (GC) equipped with both flame ionisation and electron capture detectors. Accompanying the GC is also a sorbent desorption system, AERO Trap Desorber.

The second chamber was specially designed at CBS to evaluate surface air movement effects on emissions from materials, by providing a uniform mean air flow and boundary layer over the sample area. Air velocity and turbulence fluctuation can be adjusted independently and intermittently. The experimental investigation of the effect of surface air movement on a wet material is presently underway.

Typical test results of emission rates from a constant source material, as a function of mean air velocity and turbulence fluctuation, are presented in Figures 1 and 2. These illustrate that as the air velocity increases, the material emission rate increases. In addition, the turbulence fluctuation influences the rate of increase in emissions. At a given turbulence fluctuation level, it seems that the emission rate is almost linear with air velocity. Based on fluid flow theory, higher velocities will reduce the thin laminar

boundary sublayer thickness, thereby increasing the mass transfer rate.

Fig. 2

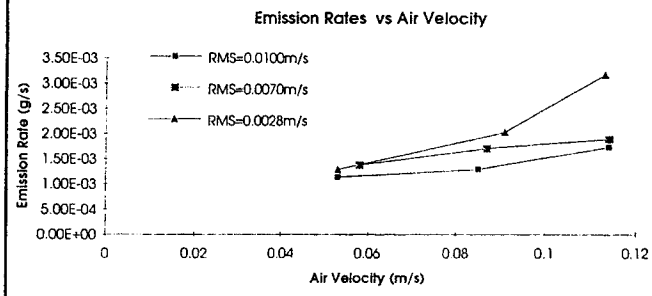
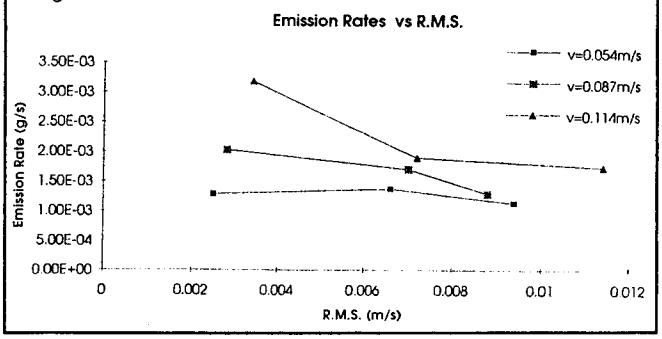


Fig.3



Typical test results from a constant source material, as a function of mean air velocity and turbulence fluctuation.

Note also that at a fixed velocity, the rate of material emission decreases with increasing turbulence fluctuation. This can be explained by the increased amount of mixing inside the chamber, as a result of the higher level of turbulence fluctuation. At different air velocities, the relationship between the emission rate and turbulence fluctuation is different. Therefore, more experimental study on this subject is underway. A physical model, which was developed at to estimate material emissions and which is based on fundamental fluid flow and mass transfer theories, will be validated using these results.

For further information:
Dr. Fariborz Haghighat
Concordia University, Centre for Building Studies, Montreal
Tel: (514) 848-3192 Fax: (514) 848-7965

THE LIGHTER SIDE OF EMISSIONS

So what smells like dead fish?

by Ken Ruest, Scanada Consultants Ltd

A recent odour investigation turned up an unusual source of emissions, while underscoring how difficult it can be to identify the cause of IAQ problems. In 1992, a homeowner moved into a new rowhouse unit and began to complain about a mysterious odour which appeared occasionally. The nauseating odour was characterized as smelling like rotten fish, wet drywall compound, heated electrical wires or rubber. After two years of investigations by the builder, the warranty program and mechanical consultants, the source of the odour remained elusive. The homeowner had become extremely frustrated and was threatening legal action.

The odour was noticeable in any season of the year, and was particularly strong in the main entrance vestibule and at the top of the basement stairway. These two areas were only separated from each other by the vestibule closet. In the vestibule, the odour was mostly noticed high above the floor while at the top of the basement stairway, it was noticeable at the main floor level. None of the other units in the development had this problem. The building materials were the same, except for hardwood floors and stairs in the troubled unit.

Each occurrence of the odour seemed to coincide with the arrival of occupants or guests and the opening of the garage door or front vestibule door. Pressures caused by the door movements were investigated to find where the odour could be entering. Waferboard subflooring, glues used with the hardwood floors, soil gases, overheating of electrical wiring, and even the possibility of a rotting animal carcass in the garage ceiling were all investigated... unsuccessfully.

Finally, while setting up yet another appointment, the owner became insistent that there was no use arriving before 8:00 pm since he felt the odour rarely occurred before then. That's when the light turned on for me! Sure enough, the elusive odour was traced to two decorative light fixtures in the front entrance and basement stairway. These two fixtures had been purchased by the homeowner outside the

country. Their light sockets were made of a moulded plastic which, when heated, released the offending odour. Unfortunately for the owner, the warranty program does not cover owner-installed equipment!

READERS' VIEWS

An Encouraging Response to the Communiqué

Approximately 50 readers sent us comments — all constructive — on the first issue of Healthy Materials. Space limitations prevent us from publishing all of them, but we have included a sample.

We believe that this publication will be a valuable addition to the current literature on indoor air quality. Although source control is usually the most effective means of reducing indoor air pollutants, little information is available to architects, builders, building owners and managers, and occupants on the best products and materials to use in buildings. The publication is useful as a forum for research and information exchange in this important and evolving field. We commend you for your efforts in providing this forum to those of us with an interest in indoor air quality. *Robert Axelrad, Director, Indoor Air Division, US EPA, Washington DC.*

I found the communique to be very helpful and I implemented a lot of it in my existing spec files - and will implement the knowledge on future specifications. *Derek Heslop, FSC Groves Hodgson Manasc Architects, Edmonton, Alta.*

Very good initiative since one of the pre-occupations of a facility manager is choosing healthy materials in order to increase the indoor air quality. *Gene Drapeau, Canadian Meteorological Centre, Montreal, Que.*

I really appreciate the focus on providing useful selection data for architects and owners... *Jay Whisenant, NTD Architects, San Diego CA*

Good work — more information is needed on this topic. We are especially interested in IAQ as it affects work places. *Peter Lukas, Canadian Centre for Occupational Health and Safety, Hamilton, Ont.*

Excellent first issue! My interest is in submarine atmospheres where materials emission is of the utmost importance... *Stephen Hill, Royal Military College, Kingston, Ont.*

Very informative. We are interested in healthy materials for persons with chemical sensitivities. *Louise Hall, Public Service Alliance of Canada, Ottawa, Ont.*

Great first issue! Super job. Continued good luck with it. *George Luciw, ASTM, Philadelphia, PA* ▪ I enjoyed the first copy and found it very useful. *Peter Dingle, Murdoch University, Australia* ▪ Great contribution! *Robert Olcerst, Brujos Scientific Inc., Baltimore MD* ▪ A very interesting issue. Congratulations! *R. Marutzky, Wilhelm-Klauditz Institut, Braunschweig, Germany* ▪ A well done newsletter. I find it quite informative. *Dan Clarke, Alberta Labour, Edmonton, Alta* ▪ Timely, useful publication — keep it up. *David Swankin, Swankin & Turner, Washington DC* ▪ First issue is just right. Short articles and a lot of information. *Stelios Papadopoulos, Occupational Physician, Athens, Greece* ▪ Useful information. *Mike Lowther, Ontario Ministry of Labour, Toronto, Ont* ▪ It's very interesting. Just go ahead! *R. Bohne-Matusall, Miljö-Chemie, Hamburg, Germany* ▪ Will follow after studying this most interesting and surprising edition. *Ben Bronsema, Ketel Consulting Engineers, Delft, Netherlands* ▪ The spring issue was excellent. *Dick Morris, National Association of Home Builders, Washington DC* ▪ Very interesting publication! *Panagiotis Siskos, University of Athens, Greece* ▪ Excellent, real leadership. *Jeff Feigin, Whycocomagh, Nova Scotia.*

Suggestions for Future Issues

Liked the first edition. Think that the audience for this publication could broaden if there were a few educational issues (e.g. how VOCs affect and impair health, how to mitigate IAQ problems, how the cost of homebuilding leads us to make less than favourable material choices). *Bill Kolida, BK Marketing, Vancouver, BC.*

First issue very interesting. Rather short on the European scene, but note expectation of articles in next issue to cover this. *Derrick Crump, Building Research Establishment, United Kingdom.*

[Include] Evaluation of alternatives to carpets and other problematic products. *Alex Wilson, Environmental Building News, Brattleboro VT*

Excellent publication. Please include any pertinent information of cleaning materials, especially institutional. *Jill Witherspoon, Toronto Board of Education, Toronto, Ont.*

Make it available electronically on Internet. Save paper, postage stamps, publishing costs. Make it faster, widely available, back issues easily referenced. *Brian Hayward, USA-CERL, Champaign IL*

How Much Does It Cost?

*Several readers have asked what a subscription to **Healthy Materials** costs. For the first 3 issues, all costs are being borne by Canada Mortgage and Housing Corporation and the communiqué is being distributed free of charge. From issue 4 onwards we will be charging approximately $40 Cdn a year, for 2 issues each subscription year. A form will be sent to you both before and with Issue 3. If we do not receive your paid subscription by 30 September, 1995, Issue 3 will be your last.*

*CMHC welcomes additional sponsors for **Healthy Materials**. Please contact Jim White if you can help defray publishing costs.*

Comments on PSL, Particleboard and Editorial Content

David Rousseau has sent a lengthy and thoughtful letter on two of the articles which appeared in the first issue. We've extracted the key paragraphs.

PSL Evaluations Misleading

[Ed. Note: See page 22 for an update on PSL reports.]

...The item on Health Canada's Priority Substances List seems a little out of place in a Healthy Materials publication. Furthermore I believe it is misrepresented in the byline next to the table. Toxicity evaluations of this kind are useful policy instruments, but I believe they do not, as suggested by the text, offer us useful "*toxicity evaluations... for human health, essentially in indoor air*".

For example, if you read down the column on the right, there are very few substances named in Group 2 which are listed as toxic, however most of them are known as neurotoxins or at least irritants. Two of the three which are listed as toxic are known carcinogens. Nearly all of the substances listed as non-toxic are considered toxic by industrial safety standards and have TLVs below 50 ppm, with at least one as low as 5 ppm If there were indoor air standards for these substances it is safe to assume that the recommended levels would be from 10 to 200 times lower than the TLVs.

The point is that the priority substances evaluation is an environmental impact assessment and body counting exercise, and there just aren't very many bodies in evidence where IAQ problems occur.

A substance doesn't have to be a carcinogen to present a health risk. In fact, the carcinogens are already well regulated, which leaves us with hundreds of other substances which are not listed as carcinogens, but are still important indoor air contaminants.

Concern with Industry's Attitude

The item on the particleboard program also raises concern. Absolutely every healthy building project or program has identified indoor manufactured wood products as a major source of indoor air contaminants. Again, the emissions of concern are irritants, not "toxic" in the usual sense of the word. There are mountains of research to substantiate this position, and so avoiding these products, or choosing the lower emission types is well justified.

Yet the position if the Canadian Particleboard Association is that "*the health impacts of formaldehyde remain controversial*" and that all Canadian mills are producing

board below the 0.3 ppm chamber test standard, therefore there must be no problem.

Terry Robirson offers three good points in the article about the shortcomings of particleboard testing and labelling, but the industry response is, again, "there's no problem".

The argument that boards cannot be labelled easily because of "*...the decorative nature of the panel products*" seems to me to be pure poppycock. The vast majority of the products of concern are core materials or underlayments which are covered in use. A label would be no problem. And those which have factory finishes either have a back side where they could be stamped, or they could be labelled with a washable removable label.

Regarding the variability of manufacturing argument, why not give the high, low and mean emission rates for a plant or process. The real problems are not technical, they are a lack of willingness to provide information (at best), and an intent to conceal information (at worst).

...It's time we recognized that healthy buildings are an important part of preventative health care, and that many important factors are not easily quantified or regulated. Arguments about who is right and who is wrong and which standards we should use will not get us very far, but useful information (and some of it will inevitably be anecdotal or "subjective") will allow the informed professional and consumer to make better decisions. Are manufacturers worried about this?

Need for Editorial Comment

...How about some more critical editorial commentary? I hope the purpose of the newsletter is to stimulate a healthy debate, not to repeat a lot of stale arguments from interest groups. I think a strong and critical editorial position is necessary for that healthy debate. In my opinion, this should be a "Healthy Materials" editorial perspective, erring on the side of caution and protecting the consumer first. Hal Levin does this very well I think.

David Rousseau
Archemy Consulting Ltd., Vancouver
Tel/fax: (604) 266-7721

Synergistic Exposures

In addition to the following extraction on Synergistic Exposures, Immo Tilgner has also written at length about his experiences with fungal contamination, particularly in cars. Readers wishing more information on this should contact him directly.

...Having been involved in air quality problems both at work and in private life, I would like to add a few comments regarding the reactions of environmentally hypersensitive people.

First and foremost I believe that within the total chemical soup in an indoor air environment there are chemicals that are synergistic. Testing the health effects of two chemicals in combination and also testing sequential exposure of any two chemicals may lead to a better understanding of the reaction of sensitive persons. For example, an exposure in a home and a different exposure in a workplace may trigger a response while a single exposure in either place may not trigger a response.

In my own experience is a student with an environmental hypersensitivity in a "New Car and New Building" combination. The offgassing in a new car did not trigger a response until the student was exposed to a brand new school. At that time the student became highly sensitized to the new car-new building combination. The student had only mild reactions when transported in an old car to the new buildings or when transported in the new car to older buildings. There were at least twenty other students at the new school so affected; students had to be placed into other schools.

The district was a new subdivision and of course some parents drove new cars because bus service was not available. The students were exposed to one chemical soup in the new home, to another in the new car, and still another in the new school building. I believe the synergy of certain chemicals may be responsible for the effects on certain people...

Immo Tilgner, Safety Engineer, Health Canada, Ottawa
Tel: (613) 957-8458 Fax: (613) 957-8563.

***Healthy Materials** welcomes readers' views on the above issues and on other topics relating to material emissions.*

Status of Emission Test Standards

This table updates the of list emission testing standards which are currently in place or are being drafted. We look forward to receiving information from readers on other standards. *JW*

NUMBER	NAME OF STANDARD	CONTACT/ TEL	STATUS
AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)			
D3614-90	GUIDE FOR LABORATORIES ENGAGED IN SAMPLING AND ANALYSIS OF ATMOSPHERES AND EMISSIONS		EXISTING
D3960-92	STANDARD PRACTICE FOR DETERMINING VOLATILE ORGANIC COMPOUND CONTENT OF PAINTS AND RELATED COATINGS		EXISTING
D5116-90	GUIDE FOR SMALL-SCALE ENVIRONMENTAL CHAMBER DETERMINATIONS OF ORGANIC EMISSIONS FROM INDOOR MATERIALS/PRODUCTS	BRUCE TICHENOR (919) 541-2991	BEING REVISED
E1330-90	STANDARD TEST METHOD FOR DETERMINING FORMALDEHYDE LEVELS FROM PRESSED WOOD PRODUCTS UNDER DEFINED TEST CONDITIONS USING A LARGE CHAMBER		BEING REVISED
Z2982Z	GUIDE FOR DETERMINATION OF EMISSIONS FROM SOLID MATERIALS IN ENVIRONMENTAL CHAMBERS	CARL MEYER (702) 366-9390	EARLY DRAFT
Z3866Z or D1356-93A	TERMINOLOGY RELATING TO SAMPLING AND ANALYSIS OF INDOOR AIR	HAL LEVIN (408) 425-3946	DRAFT
Z3869Z	STANDARD PRACTICE FOR DETERMINATION OF VOLATILE ORGANIC CHEMICAL EMISSIONS FROM CAULKS AND SEALANT PRODUCTS	DON FIGLEY (306) 374-8141	DRAFT
Z3870Z	STANDARD PRACTICE FOR DETERMINATION OF VOLATILE ORGANIC CHEMICAL EMISSION FACTORS FROM SPRAY-APPLIED RIGID POLYURETHANE CELLULAR PLASTIC THERMAL INSULATION	DON FIGLEY (306) 374-8141	DRAFT
Z3872Z	STANDARD PRACTICE FOR DETERMINATION OF VOLATILE ORGANIC CHEMICAL EMISSION RATES FROM PRESSED-WOOD BOARD PRODUCTS USING SMALL ENVIRON. CHAMBERS UNDER DEFINED TEST CONDITIONS	YOSHIO TSUCHIYA (613) 993-9777	DRAFT
Z4424Z	STANDARD PRACTICE FOR DETERMINATION OF VOC EMISSIONS FROM CARPET IN ENVIRONMENTAL CHAMBERS	JOHN GIRMAN (202) 233-9317	OUT FOR COMMENT
Z?	METHOD FOR DETERMINATION OF VOC EMISSIONS FROM ARCHITECTURAL COATINGS IN SMALL ENVIRONMENTAL TEST CHAMBERS	BRUCE TICHENOR (919) 541-2991	AWAITING RESULTS
Z?	GUIDE FOR DETERMINATION OF EMISSIONS FROM ADHESIVES IN ENVIRONMENTAL CHAMBERS		
Z?	METHOD TO DETERMINE THE RECOVERY EFFICIENCIES OF TEST CHAMBERS	BOB LEWIS (919) 541-3065	PROPOSED
Z?	PRACTICE FOR SCREENING AND SELECTING BUILDING MATERIALS AND PRODUCTS BASED ON EMISSIONS OF VOCS	HAL LEVIN (408) 425-3946	DRAFT?
Z4190Z	METHOD FOR DETERMINATION OF THE EQUILIBRIUM RELATIVE HUMIDITY OF POROUS INSULATION	DANIEL PRICE (404) 421 9555	DRAFT
Z4470Z	GUIDE FOR THE EVALUATING THE ABILITY OF INDOOR MATERIALS TO SUPPORT MICROBIAL GROWTH USING STATIC ENVIRONMENTAL CHAMBERS	PHILIP MOREY (610) 630-4657	DRAFT
CANADIAN GENERAL STANDARDS BOARD (CGSB)			
CAN/CGSB-51.23-92	SPRAY-APPLIED RIGID POLYURETHANE CELLULAR PLASTIC THERMAL INSULATION		EXISTING
COMMISSION OF THE EUROPEAN COMMUNITY (CEC)			
EUR 13593 1991	GUIDELINE FOR THE CHARACTERIZATION OF VOCs EMITTED FROM INDOOR MATERIALS & PRODUCTS USING SMALL TEST CHAMBERS	M. DE BORTOLI CEC JRC	EXISTING
EUR 12196 1989	FORMALDEHYDE EMISSION FROM WOOD BASED MATERIALS: GUIDELINE FOR THE ESTABLISHMENT OF STEADY STATE CONC'S IN TEST CHAMBERS	M. DE BORTOLI CEC JRC	EXISTING
NORDTEST METHODS (NT)			
NT BUILD 358	BUILDING MATERIALS: EMISSION OF VOLATILE COMPOUNDS, CHAMBER METHOD		EXISTING
	BUILDING MATERIALS: EMISSIONS OF VOLATILE COMPOUNDS, FIELD & LABORATORY EMISSION CELL		DRAFT

More Priority Substance Reports

The first issue of Healthy Materials listed the first 34 evaluation reports available on substances identified on Canada's Priority Substance List (PSL). The following table completes the list with nine additional evaluations. Substances were considered toxic in three categories, if they could affect the environment, the food chain that supports humans, or humans themselves. The evaluations were based on both inherent toxicity and predicted exposure to the environment, the food chain, or people. 'T' represents a toxic rating, 'N' a non-toxic result and 'I' indicates insufficient information to make a health-based evaluation. One substance on the original list, 1,1,1-Trichloroethane, was not evaluated since it was determined to be an ozone depleter and unacceptable on that basis alone. In total, 19 substances (or groups of substances) were deemed toxic to humans, 16 were classified non-toxic and 13 could not be classified because there was insufficient information available (health or exposure). *JW*

For further information:
Betty Meek, Health Canada
Tel: (613) 957-3129 Fax: (613) 954-2486

To order copies of the reports:
Marianne Joly, Publications Clerk
Health Canada, Room 104
Environmental Health Centre
Tunney's Pasture, Ottawa, Ontario K1A 0L2
Tel: (613) 957-3998 Fax: (613) 941-8632

Priority Substance List Toxicity Status

Substance Name	CASR #	Assessed as Toxic to		
		Envir	Food	Human
Group 1				
Polycyclic aromatic hydrocarbons		T	N	**T**
Waste crankcase oils		I	I	I
Group 2				
Cadmium & its compounds	7440-43-9	T	N	**T**
Chromium & its compounds, trivalent hexavelant	7440-47-3	I T	N N	N **T**
Bis(2-Ethylhexyl) phthalate	117-81-7	I	N	**T**
Inorganic fluorides		T	I	N
Nickel & its compounds	7440-02-0	T	N	**T**
1,1,2,2-Tetrachloroethane	79-34-5	I	N	I
Group 3				
Mineral Fibres (except refractory ceramics) Refractory ceramics		I I	N N	N **T**

Corrections to Issue No. 1

After thanking Hal Levin on page 3 for assisting with the distribution of ***Healthy Materials***, we then proceeded to give an incorrect phone number for him on pages 4 and 15! Our apologies! Hal's correct number is (408) 425-3946.

Apologies also go to Rein Otson of Health Canada, who was misquoted on page 16. The pollutant loading in Canadian homes should refer to "total vapour phase organic compounds" and not TVOCs.

EUROPEAN UPDATE

Healthy Materials thanks Hans Gustafsson of the Swedish National Testing and Research Institute, Dr. Geo Clausen of the Technical University of Denmark and Dr. Peder Wolkoff of the Danish National Institute for Occupational Health for providing information on current European activities. This update touches on many, but not all, of the emission-related activities currently taking place. Healthy Materials welcomes additional submissions of articles or news from our European subscribers.

Joule II develops data base on indoor air pollution sources

Joule II, an energy conservation R&D programme under the European Union's Directorate General XII for Science, Research and Development, is sponsoring two research projects on indoor air quality which are expanding the knowledge base on pollutant sources and loadings.

These projects have been initiated to address two concerns in Europe: the need to reconcile energy conservation and IAQ in heated buildings in northern Europe and the need to address possible problems associated with the explosive growth of air conditioning in southern Europe.

The first project is the European Audit Project to Optimize IAQ and Energy Consumption in Office Buildings. Ten countries have participated in the development of a common audit technique for IAQ investigations and assessment procedures for source control and ventilation.

The study has involved 54 office buildings in nine countries, contributing significantly to knowledge of pollution sources and loads in actual buildings. This project began in late 1992 and will be completed shortly.

The second project is the European Data Base for Indoor Air Pollution Sources in Buildings. This work began in March of this year and is scheduled to run for three years. Professor Eduardo de Oliviera Fernandes of Portugal is the Project Manger, and Dr. Geo Clausen and Professor Ole Fanger of Denmark are the Technical Coordinators.

This project involves the development of the following:

- standardized measuring methods — both chemical and sensory — for emissions;
- a model for predicting IAQ in real spaces;
- improved knowledge of the sorption characteristics of surfaces; and
- a data base of emission data for building materials, HVAC components and systems, and entire buildings.

The first part of the project methodology involves the characterization of indoor pollution sources, focussing on the following:

- Age: modelling changes in emission rate over time;
- Concentration: the effect of partial pressure differences on emission rates and the resulting impacts on ventilation effectiveness;
- Temperature and Humidity: modelling effects where actual environmental conditions differ from test conditions;
- Air Velocity: quantification of changes in the thickness of the boundary layer on the surface evaporation of chemicals;
- Exposure: sensory effects under different test conditions;
- Sorption: identification of a standard pollution sample for testing of sorption characteristics of materials.

The results of this work will be included in a steady-state model for predicting air quality in buildings. This will be followed by full-scale validation of the model.

A biannual newsletter is available on the project. Fifteen organizations are participating in the Joule II study. *TR*

For further information:
Dr. Geo Clausen
Laboratory of Heating and Air Conditioning
Technical University of Denmark, DK-2800 Lyngby, Denmark
Tel: +45 45 931222 Fax: +45 45 932166

European Collaborative Action takes comprehensive approach

"Indoor Air Quality and Its Impact on Man", an initiative within the European Collaborative Action (ECA) framework, was mentioned briefly in the first issue of ***Healthy Materials***. This initiative began in 1986, was originally known as "COST Project 613" and in 1991 became part of the European Community's Environment Program.

The focus has been on indoor pollution sources in buildings, exposure to pollutants and the impact on health and comfort.

The initiative is directed by a Steering Committee which consists of representatives of the 14 participating countries and the European Commission. Germany's Bernd Seifert chairs the Steering Committee, with Denmark's Lars Mølhave as the vice-chair. The Environment Institute of the Joint Research Centre at Ispra, Italy provides a scientific secretariat and administrative support.

This work has resulted in several reports on key pollutants. ECA has developed guidelines for chemical sampling, chamber measurements of formaldehyde and VOCS, IAQ investigations and ventilation. Based on these guidelines, extensive inter-laboratory comparisons of emissions testing have also been undertaken, involving both European and North American labs.

A new Working Group 10, "Evaluation of Building Materials and Products", was formed in 1993 with the aim of assessing and predicting the influence of building materials on IAQ and the resulting discomfort and health effects.

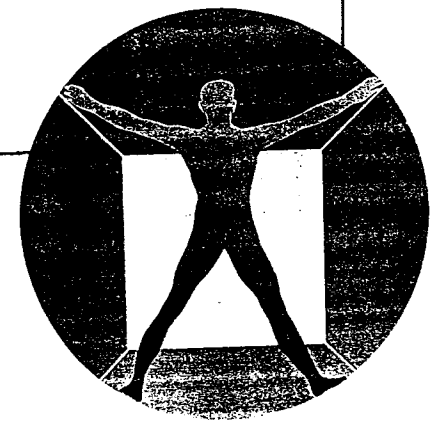
In 1995, WG 10 will publish a detailed procedure for the evaluation of VOCs from building materials. Draft chapters have been prepared by three subgroups — laboratory characterization of emissions, VOC exposures in buildings and toxicological evaluation — but are not yet available for release. The final report will document the key parameters influencing emissions testing, the approaches to emissions data interpretation, emission models and available emissions data. Also included will be a survey of climate chambers and test methods.

WG 10 is focussing its procedure on a single category of materials — flooring in apartments — as a first step. Materials being considered include carpet, linoleum, PVC and cork tiles, parquet and composite materials, as well as oils, varnishes and other finishes.

Another new working Group — WG 13 — is developing a definition of "TVOC" and guidelines on TVOC measurements and levels. *TR*

Available ECA publications on material emissions include the following:
Formaldehyde Emissions From Wood Based Materials: Guideline for the Establishment of Steady State Concentrations in Test Chambers (Report no.2)
Strategy for Sampling Chemical Substances in Indoor Air (Report no.6)
Indoor Air Pollution by Formaldehyde in European Countries (Report no.7)
Guideline for the Characterization of Volatile Organic Compounds Emitted From Indoor Materials and Products Using Small Test Chambers (Report no.8)
Determination of VOCs Emitted From Indoor Materials and Products: Interlaboratory Comparison of Small Chamber Measurements (Report no. 13)

Other related reports of interest to emissions researchers include:
Sick Building Syndrome (SBS) — A Practical Guide (Report no.4)
Effects of Indoor Air Pollution on Human Health (Report no.10)
Guidelines for Ventilation Requirements in Buildings (Report no.11)



For further information on European Collaborative Action, or to order publications:
Maurizio De Bortoli
Joint Research Centre, Environment Institute
T. P. 290, 21020 Ispra (Varese) Italy
Tel: +39 332 78 92 30 Fax: +39 332 78 58 67

Low emission products receive Blue Angel

Germany's Environmental Label program is probably the world's oldest environmental labelling system. Introduced in 1977, it is a voluntary program which aims to inform and motivate consumers and producers.

The designation "Blue Angel", while not the official name, has become the popular name for the Environmental Label, being derived from the figure in the centre of the United Nations environmental logo.

The program has focussed on alternatives to products most harmful to the environment. Environmental acceptability is based on many factors, including pollutant emissions, waste generation, recycling, noise and hazardous substances.

Program criteria assess specific aspects related to a product group and are updated every three years. At present, approximately 75 product groups have been established.

Decisions Made By Independent Jury

An independent Environmental Label Jury, in consultation with experts, determine criteria and methods of compliance, and make the final decision on applications. Compliance may consist of a binding declaration by the manufacturer or test results performed by neutral experts.

RAL — the German Institute for Quality Assurance and Certification — administers the program, receives applications and organizes expert hearings. UBA — the Federal Environmental Agency — reviews new applications and conducts testing.

Some of the product groups required to meet emission criteria include:

Low-pollutant Coatings (RAL-UZ 12a): The maximum content of VOCs, by weight, is specified for specific types of coatings. Certain hazardous materials are excluded. 97 manufacturers and 999 products have qualified.

Powder Coatings (RAL-UZ 12b): Similar requirements to Low-Pollutant Coatings.

Low-formaldehyde Products from Wooden Materials (RAL-UZ 38): For base materials, the maximum formaldehyde concentration is 0.1 ppm in standard chamber testing or 4.5 mg / 100 g of board (dry). For finished products, the maximum concentration is 0.05 ppm in standard chamber testing or a maximum emission rate of 2 mg/m^2h. Eleven manufacturers and 51 products have qualified.

Low-emission and Waste-reducing Copiers (RAL-UZ 62): Ozone concentrations must not exceed 0.04 mg/m^3 under test conditions. Liquid toners are not permitted due to their hydrocarbon emissions. Sixteen manufacturers and 41 products have qualified.

In addition, many categories include the requirement that materials must not contain any ingredients listed in Germany's Dangerous Substances Ordinance. Cleaning and maintenance products are also rated.

The total number of products bearing the Blue Angel label is now over 3,500. Over 120 foreign companies have succeeded in having their products receive the label.

Impact on Consumers

Surveys have indicated that the Blue Angel label is widely recognized by German consumers (almost 80%) and that they use the label to guide their choices. The market share of some low-emission products using the label has increased dramatically. For example, the market share of water-based lacquers has risen from 1% to 20% among the trades and 40% among do-it-yourselfers. *TR*

For further information:
Dr. Jürging, RAL Deutches Institut für Gütesicherung und Kennzeichnung e.V.
Siegburger Strasse 39, D-53757 Sankt Augustin, Germany
Tel: +49 224 116 050 Fax: + 49 224 116 0511

or Bornheimer Strasse 180, D-5300 Bonn 1, Germany
Tel: +49 228 726140

Emission test methods being standardized

The second meeting of the European Standardization Committee's (CEN) Working Group on "Emission of Chemical Substances From Building Materials" was held in Berlin on November 10-11. The Document "Survey of Emission Test Methods and Guidelines with Respect to Experimental Variables Influencing Emission in Test Chambers", was officially accepted.

At its first meeting in Stockholm, the Working Group defined the scope of its mandate, which is to draft standards for the characterization and determination of VOC emissions from building materials. This work will include defining the performance and operational procedures for test chambers, standardizing methods of VOC sampling and analysis, specifying how results should be reported and determining how materials should be sampled, prepared and pre-conditioned.

The results of the European Collaborative Action initiative are expected to be incorporated.

A background paper, "Pre-Normative Research and Standardization of Emission Test Methods", has been prepared for the WG by Hans Gustafsson of Sweden. This document summarizes current activities in emissions testing.

The Working Group consists of 24 members, representing 11 countries. Dr. Göran Stridh of the Örebro Medical Centre Hospital in Sweden is the convenor, with Dr. Josephine Bahr and Margareta Andersson, also of Sweden, serving as the secretariat.

Another Working Group, CEN/TC112/WG5 is developing standards for the determination of formaldehyde emissions from wood-based products. *TR*

For further information:
Dr. Josephine Bahr
Secretary CEN/TC264/WG7
National Board of Housing, Building and Planning
P.O. Box 534, S-37123 Karlskrona, Sweden
Tel: +46 455 53292 Fax: +46 455 53221

FLEC offers flexible alternative

To address the need within the building industry for small, portable, inexpensive equipment for checking emissions, Danish and Swedish researchers have developed the Field and Laboratory Emission Cell or "FLEC".

This device can be applied directly to the surface of a material — in a factory or in an actual building — to simplify testing. Materials can also be mounted within the cell, using the lower unit. FLEC is made of stainless steel and has perimeter air inlets to provide a constant air velocity. FLEC's flexible silicon rubber seal has been tested by EPA and found to be essentially leak-free when used as recommended.

Approximately 80 to 90 FLECs are now in use around the world, and FLEC is being specified in recent Scandinavian labelling programs. The cost is approximately US$4,000 for a basic unit. An additional $1,000 worth of flow equipment is also estimated to be required. *TR*

For more information:
Poul Erik Sørensen
Chematec, Dr. Sofies Vej 112, DK-4000 Roskilde, Denmark
Tel: +45 42 362880 Fax: +45 42 363330

Danish Labelling Program Launched

The "Danish Indoor Climate Labelling System of Building Materials", a new voluntary labelling program initiated in Denmark in the spring of 1994, ranks materials according to the length of time taken for emissions to fall below odour and irritant thresholds.

A comprehensive report prepared jointly by Dr. Peder Wolkoff of the National Institute of Occupational Health and Dr. Peter A. Nielsen of the Danish Building Research Institute provides the basis for the program.

The material evaluation focuses on odour and mucous irritation due to their prevalence in sick building syndrome cases. The maximum permissible concentration, C_m, of key

VOCs is defined as being 50% of known odour or irritation thresholds. The time in months, $t(C_m)$, for emissions to reach this level is determined from a visual inspection of emission profiles or from modeling. This number also provides some indication of the length of time during which special measures, such as increased ventilation, may be required when the material is installed. The testing is undertaken using FLEC under standardized room conditions at 0.5 air changes per hour.

A pilot study evaluated nine materials, including carpets, sealants and water-borne paints. The $t(C_m)$ results for significant VOCs ranged from 0.4 to 0.5 months for paints, 2.2 to 39 months for sealants, and 61 to 98 months for carpets. For thin films, such as paints, drying rates are highly dependent on air change rates and air velocities, and so such results are only used for ranking purposes. Several VOCs showed discontinuous decay rates during the first month, suggesting the need for long-term testing, particularly for carpets.

The Danish Confederation of Industries is preparing standard test protocols for various types of materials. The first labelled materials are expected to appear in early 1995. Private laboratories are being accredited to perform the analysis. A labelling board has been established to oversee financial, administrative and certification matters.

The system has received strong support from the National Agency for Housing and Building. Wolkoff believes that buildings built by some government departments in the near future may require conformity with the labelling system. *TR*

For further information or copies of the report "Indoor Climate Labelling of Building Materials: Chemical Emission Testing, Modeling and Indoor Relevant Odor Thresholds" (US$35):
Peder Wolkoff
National Institute of Occupational Health
Lersø Parkallé 105, DK-2100 Copenhagen, Denmark
Tel: +45 39 299711 Fax: +45 39 270107

Sweden tests all flooring products

For the past three years, Sweden has been implementing a voluntary, industry-led testing program for flooring materials. Since Sweden is a major supplier of the world's flooring market, this program also benefits importing countries.

A trade standard, "Measurement of Chemical Emissions from Flooring Materials", was drafted by the Swedish National Flooring Trade Association and the Swedish National Testing and Research Institute. This standard covers the selection and preparation of samples, emission measurements, analysis and reporting requirements.

The FLEC cell is specified for the testing, using the Nordtest Method NT Build 358. Measurements are taken at four weeks and at 26 weeks. Emissions often decrease by about two thirds during this time, but some materials, such as resilient flooring, may actually experience an increase due to diffusion barriers in the material.

An Emission Declaration is produced by each manufacturer for each product, indicating the emission factors for TVOCs at 4 and 26 weeks in $\mu g/m^2h$. Although there are no required limits, the "unofficial standard" appears to be 300 $\mu g/m^2h$ after four weeks, according to Hans Gustafsson of the Swedish National Testing and Research Institute.

A similar trade standard is being developed for flooring compounds and for paint and varnish. Concrete admixtures may be addressed in a future standard. *TR*

For further information:
Swedish National Flooring Trade Association
P.O. Box 4604
S-11691 Stockholm, Sweden
Tel: +46 8 644 0905 Fax: +46 8 643 9811

LOW-EMISSION APPLICATIONS

The first issue of ***Healthy Materials*** *focused on recent low-rise housing demonstrations in Canada. This second issue looks at larger buildings, particularly in the commercial sector, with articles on two milestone projects in the U.S. and two competitions currently underway in Canada.*

The National Audubon Society's new headquarters in New York

Audubon's new HQ "spoils" employees

Selecting low-emission materials was a major priority for the National Audubon Society in designing their new headquarters building in New York.

Leaving a modern office building in which occupants complained of poor air quality, the Society decided to renovate an historical building built in the late 1800s. Various measures were incorporated — higher outdoor air rates, filtration, low emission materials and enhanced lighting — to ensure an improved indoor environment. The renovation of the nine-storey, 100,000 square foot building was completed in 1993.

Finding Low-Emission Products Difficult

Jan Beyea, the Society's chief scientist and environmental consultant for the project, noted their initial difficulties in 29 finding low-emission products. "People didn't know what we were talking about. Now the situation is improving and there is a much better level of understanding." Eventually, manufacturers became interested and were very cooperative.

Since test data on the full range of VOCs was often unavailable, the Society used formaldehyde as an "indicator chemical". Beyea noted that noses were also useful for certain kinds of pollutants.

New subflooring was required throughout the building. Instead of interior grade plywood, Homasote™ — made from recycled newsprint with a low toxicity binder — was specified. Although not commonly used in commercial buildings, the material functioned well when screwed down properly.

Undyed wool carpeting was hard to obtain in North America and was eventually imported from Holland. Beyea feels that American manufacturers could have supplied such carpeting, but weren't able to provide emissions data. The carpet is tacked down, rather than using adhesives, and the underpad is made from natural jute.

Glidden's "Lifemaster 2000" zero-VOC paint was used for all walls and flat surfaces. This led to an odour-free environment at occupancy time. For furnishings, the use of pressed-wood products was avoided.

The Society also recognized the importance of "green management" and has selected non-toxic maintenance and cleaning products, only using stronger cleansers when necessary.

Productivity Benefits

"We took an overkill approach", says Beyea. "Eventually, simulation models will allow trade-offs in terms of the

overall pollutant loading of the building for a more cost-efficient approach".

After a year and a half of occupancy, employee satisfaction is high, claims Beyea. "You get spoiled. You become intolerant of the air quality in other buildings. The biggest change is that you're not tired at the end of the day." He says the Society has benefitted unexpectedly from productivity improvements.

The worst remaining sources of VOCs in the building are the photocopiers and printers. These were given a lower priority since they have shorter life spans than building materials and could be replaced in the future. *TR*

For further information:
Jan Beyea or Susan Devico, National Audubon Society, New York Tel: (212) 979-3073 Fax: (212) 353-0508.

A book has also been written on the project. "Audubon House: Building the Environmentally Responsible, Energy Efficient Office" is available for US $24.95 from John Wiley & Sons Inc., New York, Tel: (800) 879-4539 or in Canada at (416) 675-3580.

Healthy library under construction in San Francisco

Construction is well underway on the new San Francisco Main Library, a US $87 million, 387,000 square foot complex which utilizes numerous low emission materials.

Building designers are Pei Cobb Freed and Partners (New York) and Simon Martin-Vegue Winkelstein Moris (San Francisco), Associate Architects.

The architects proposed a "healthy" building approach, but this was not initially accepted by the client, the City and County of San Francisco. Project Manager Anthony Bernheim, who teaches a course on IAQ at the California College of Arts and Crafts, put on an IAQ workshop for the librarians' Health and Safety Committee during the project's design development. "Concern on the part of the library staff over the possible IAQ problems in a sealed, heavily used and extensively carpeted new building helped to convince the Library Commission," says Bernheim.

Budget Specified for IAQ

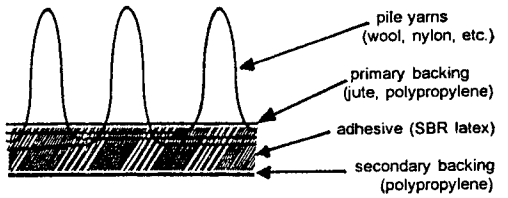
Of the total construction budget, 1.1% was allocated for indoor air quality measures, both low-emission materials and special ventilation systems. Hal Levin was retained as an IAQ consultant. Bernheim notes that the actual bids for the IAQ measures came in lower than expected. The designers began by reviewing emissions data, with chamber test data on VOC emissions being obtained for nine materials. MSDS data was also used.

Certain materials were eliminated from further consideration, such as particleboard, while others, such as carpet tile and certain adhesives, were found to be acceptable. A third category included materials which could become acceptable if modified, such as paint and carpet, and some manufacturers were able to change their product formulations to reduce emissions.

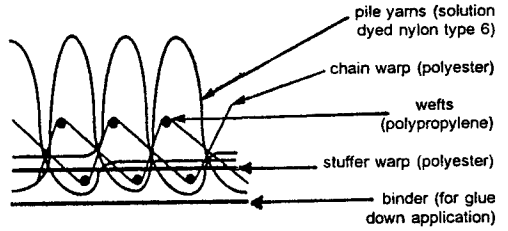
Latex-Free Carpet Developed

The largest single IAQ budget item was for alternative carpeting. To avoid 4-PC emissions, the designers worked with a manufacturer to develop a woven Wilton wool carpet (see figure 4) with no latex backing. In addition, carpets will be aired out for 48 hours prior to installation. Another manufacturer was able to supply test data for a solvent-free carpet adhesive.

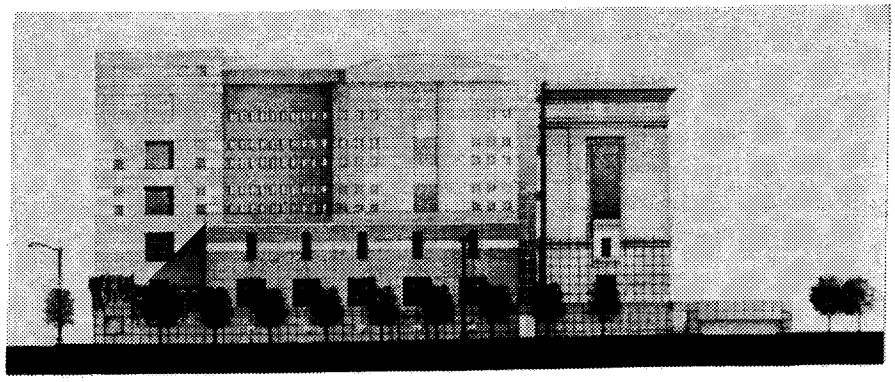
Fig. 4



A. Typical Tufted Carpet



B. Two Shot Three Frame Wilton



furniture systems. Construction is more than 60% complete, and the Library is scheduled to open in the spring of 1996.*TR*

For further information:
Anthony Bernheim
Simon Martin-Vegue Winkelstein Moris
Architects, San Francisco
Tel: (415) 546-0400 Fax: (415) 882-7098

Fiberglass ceiling panels are being encapsulated with a thin mylar coating of less than 1 mil. "This stops both formaldehyde emissions and fiber shedding, and has the added benefit of preventing supply air from being drawn back into the return air plenum," notes Bernheim.

MDF has been substituted for particleboard. Low-emission adhesives are being used with plastic laminates. Linoleum has been replaced with a cementitious flooring material.

Office systems furniture is being constructed without particleboard and will be allowed to offgas in a warehouse for one month before being installed.

Copy machine emissions were identified as a priority early in the design process. Dedicated exhaust systems were designed for copy rooms.

Paint Durability a Problem

In Bernheim's opinion, the design team was least successful with paints. "We are not satisfied with the durability of low-emission paints which are currently available. More research is needed." Some manufacturers agreed to substitute propylene glycol for ethylene glycol in their formulations.

Considerable effort has gone into designing an effective ventilation system for the Library. Detailed commissioning procedures for the HVAC system are another key part of the strategy for a healthy building. The design team also assisted the client in developing a maintenance plan which minimizes the use of solvents.

The building design, material specifications and material testing have been completed, with testing continuing on

IDEAS competitors design healthy apartments

CMHC is awaiting the 2nd stage submissions in the IDEAS design competition to see how designers are proposing to achieve superior indoor air quality in high-rise residential buildings.

The IDEAS (Integrated, Durable, Energy-efficient, Affordable Solutions) Challenge is sponsored by CMHC in collaboration with Natural Resources Canada (NRCan) and other sponsors.

Improved indoor air quality is one of a broad range of competition criteria, which also include durable building envelopes, energy efficiency, environmental impact and integrated ventilation systems.

"In the first stage, everyone proposed using low-off-gassing materials," notes CMHC's Jacques Rousseau. "But indoor air quality is very new for designers, and they are having a hard time designing it into their buildings."

Ed Lowans, an indoor environmental consultant, is being funded by the C-2000 Program to provide advice to all teams. Lowans says the teams are paying particular attention to flooring. Conventional carpet underlay will likely be replaced with polyethylene or felt pads. Wool carpets are being considered. Some groups are looking at the feasibility of hardwood floors on a rubber pad.

Lowans, who is chemically sensitive, is also concerned about offgassing from drywall due to the residual inks in recycled paper and possible contaminants from flue gas gypsum. He is therefore recommending a polyvinyl acetate (PVA) primer, since a latex primer may not adequately seal the drywall. Water-resistant drywall, which is made with paraffin, will be replaced with cementitious boards. Pre-mixed joint compound will be avoided due to the fungicide content.

Another area being examined is cabinetry. Pressed-wood products will likely be sealed on all six sides with laminates or acrylic sealers. Wood finishes will be water-based.

The 1st stage of the IDEAS competition drew 26 submissions, from which five finalists were selected last May. Since then, the finalists have been refining their designs and balancing innovation against financial constraints.

CMHC expects that all the stage 2 proposals will be submitted by the end of November. Stage 3 will involve the production of detailed drawings and specs. CMHC hopes that all projects are able to proceed to actual construction.

The finalists' proposals for apartment and condominium buildings range from 7 to 13 stories in height, with the sites located in Halifax, Montreal, Vaughan (a Toronto suburb), Sherwood Park (an Edmonton suburb) and Victoria. *TR*

For further information:

Sandra Marshall or Jacques Rousseau, CMHC, Ottawa
Tel: (613) 748-2660/2013 Fax: (613) 748-2402

Ed Lowans, Lowans & Stephen, Orangeville
Tel/fax: (519) 940-0964

C-2000 pilots incorporate healthier finishing materials

Two state-of-the-art low-rise office buildings by Bentall Development Inc. are being designed to minimize emissions from interior finishes.

The Bentall project is one of the pilot demonstrations of the C-2000 Advanced Commercial Buildings Program sponsored by Natural Resources Canada. The proposed office buildings consist of 75,000 square feet each and are part of the Crestwood Corporate Centre in Richmond BC, a suburb of Vancouver.

As part of C-2000's requirements to develop a strategy for improved indoor air quality, the Bentall team is proposing the following material selections:

- Floors: no sheet vinyl; cork or jute pad instead of synthetic undercushion; velcro strip attachment for carpets.
- Walls: no vinyl wallcoverings; sisal or paintable recyclable paper.
- Finishes: Ecologo paints; natural oil and wax wood finishes.

Guidelines are also being prepared for future tenants on their material selections.

Designers for the project are Bunting Coady Architects. The project team has just completed the design development stage and will soon be preparing detailed working drawings and specifications.

The C-2000 Program encourages the design and construction of demonstration office buildings which feature advanced energy and environmental performance. Several projects are currently under development.

For further information:
Nils Larsson, C-2000 Program, NRCan, Ottawa
Tel: (613) 943-2263 Fax: (613) 996-9416

COMING EVENTS

Calendar for 1995

Jan 28-Feb 1 **ASHRAE Winter Meeting**. Palmer House Hotel, Chicago IL. Contact: ASHRAE, 1791 Tullie Circle NE, Atlanta GA 30329, tel: (404) 636-8400, fax: (404) 321-5478.

May 9 (tentative) **Task Force on Material Emissions**, 4th Meeting. Montreal, Quebec. Hosted by Canada Mortgage and Housing Corporation. Contact: Chair: Jim White, CMHC, 700 Montreal Road, Ottawa, Ontario K1A 0P7, tel: (613) 748-2309, fax: (613) 748-2402; or Secretariat: Terry Robinson, Scanada Consultants Ltd, 436 MacLaren Street, Ottawa, Ontario K2P 0M8, tel: (613) 236-7179, fax: (613) 236-7202.

May 10-12 **Indoor Air Quality, Ventilation and Energy Conservation in Buildings**, 2nd International Conference. Montreal, Quebec. Organized by Concordia University's Centre for Building Studies, with sponsorship from various Canadian government agencies. Contact: Dr. Fariborz Haghighat, Centre for Building Studies, Concordia University, 1455 de Maisonneuve Blvd W, Montreal, Quebec H3G 1M8, tel: (514) 848-3200, fax: (514) 848-7965.

June 24-28 **ASHRAE Annual Meeting**. Marriott Hotel and Marina, San Diego CA. Contact: ASHRAE, 1791 Tullie Circle NE, Atlanta GA 30329, tel: (404) 636-8400, fax: (404) 321-5478.

Sept 11-14 **Healthy Buildings '95**. Milan, Italy. Contact: Professor Marco Maroni, Universita de Milano, Via S. Barnaba 8, 20122 Milano, Italy, tel: +39 2 5518 1723, fax: +39 2 5518 7172.

Calendar for 1996

July 17-19 **RoomVent '96**, 5th International Conference on Air Distribution in Rooms, (joined with International Symposium on Room Air Convection and Ventilation Effectiveness). Yokohama, Japan. Abstracts are due November 1, 1995. Contact: Professor S. Murakami, Institute of Industrial Science, University of Tokyo, 7-22-1 Roppongi, Minato-ku, Tokyo 106, Japan, fax: +81 3 3746 1449.

July 21-26 **Indoor Air '96**, The 7th International Conference on Indoor Air Quality and Climate. Co-organized by the International Academy of Indoor Air Sciences and the International Society of Indoor Air Quality and Climate. Nagoya, Japan. Contact: Dr. Koichi Ikeda, Institute of Public Health, 6-1, Shirokanedai 4-chome, Minato-ku, Tokyo 108, Japan, tel: +81 3 3441 7111 ext.275, fax: +81 3 3446 4723.

Attention: Conference and Meeting Organizers
If you are interested in publicizing your events in future issues of ***Healthy Materials***, please provide us with full information on the date, location and contact person.

Healthy Materials is published by Canada Mortgage and Housing Corporation, Canada's federal housing agency. It is distributed in French under the title ***Matériaux sains***. Its purpose is to facilitate collaboration and information exchange on material emission testing and standards development, in order to foster the coordinated development of test procedures and standards, encourage the availability of low-emission products and create an informed marketplace. ***Healthy Materials*** invites comments and articles from readers.

Co-Editors:
Jim White, Research Division, CMHC
700 Montreal Road, Ottawa, Ontario, Canada K1A 0P7
Tel: (613) 748-2309 Fax: (613) 748-2402

Terry Robinson, Scanada Consultants Ltd
436 MacLaren Street, Ottawa, Ontario, Canada K2P 0M8
Tel: (613) 236-7179 Fax: (613) 236-7202

Writers/Researchers: Terry Robinson, Jim White. Layout: Nicola Rutherford. Contributing writers for this issue: Bruce Tichenor, Ken Ruest, Peter Piersol, C.Y. Shaw, Jack Shields, Laura Hurst, Fariborz Haghighat, Alicje Cornelissen, Jay Kassirer.

Healthy Materials is published with the assistance of federal funds provided under Part IX of the National Housing Act, and is distributed free-of-charge to interested subscribers. To ensure continuity of delivery, please provide CMHC or Scanada with timely notice of any change of address.

Canada