Fiberglass Summary:
History, Effects and Hazards

Owens Corning Fiberglas ®, FiberGlass, Glass Fiber and Glass Wool: A Carcinogen That's Everywhere - The Asbestos of the 21st Century

Rachel's Environment and Health Weekly

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News and resources for environmental justice.

An industrial process for making glass fibers was first patented in Russia in 1840. [1] At the Columbian Exposition in Chicago in 1893, Edward Libbey, an American, exhibited lamp shades, a dress, and other articles woven from glass fibers. In 1915, the Allied Forces blockaded Germany and created an asbestos shortage which resulted in full-scale U.S. production of fiberglass as an asbestos substitute.

Asbestos is a naturally-occurring fibrous material that can be woven into cloth, does not burn readily, has excellent properties for thermal insulation, and therefore came into common commercial use during this century. [2,pgs.390-392] Fiberglass has many of the same characteristics as asbestos.

In 1938, the Owens Corning Fiberglass Company was formed, and three years later, in 1941, evidence of pulmonary disease was reported by Walter J. Siebert, who investigated the health of workers with the cooperation of Owens Corning.[1] That same year another investigator reported finding "no hazard to the lungs" of workers exposed to glass fibers in the air. Scientific disagreement of this sort has characterized the study of fiber glass ever since; meanwhile fiberglass production has increased steadily.

In 1941, the U.S. Patent Office issued patents for 353 glass wool products. Glass wool, fiberglass, fiberglas, fibrous glass, and glass fibers are all names for the same thing: man made thin, needle-shaped rods of glass.

Fiber glass is now used for thermal insulation of industrial buildings and homes, as acoustic insulation, for fireproofing, as a reinforcing material in plastics, cement, and textiles, in automotive components, in gaskets and seals, in filters for air and fluids, and for many other miscellaneous uses. More than 30,000 commercial products now contain fiber glass.

As asbestos has been phased out because of health concerns, fiberglass production in the U.S. has been rising. In 1975, U.S. production of fiberglass was 247.88 million kilograms (545.3 million pounds); by 1984 it had risen to 632.88 million kilograms (1392.3 million pounds).[1] If that rate of growth (10.4% per year) held steady, then production of fiberglass in the U.S. in 1995 would be 436 million pounds.

Fiber glass is now causing serious health concerns among U.S. officials and health researchers. Dr. Mearl F. Stanton of the National Cancer Institute found that glass fibers less than 3 microns in diameter and greater than 20 microns in length are "potent carcinogens" in rats; and, he said in 1974, "it is unlikely that different mechanisms are operative in man."

A micron is a millionth of a meter (and a meter is about three feet). Since that time, studies have continued to appear, showing that fibers of this size not only cause cancer in laboratory animals, but also cause changes in the activity and chemical composition of cells, leading to changes in the genetic structure in the cellular immune system. Although these cell changes may be more common (and possibly more important) than cancer, it is the cancer-causing potential of glass fibers that has attracted most attention.

In 1970, Dr. Stanton announced that "it is certain that in the pleura of the rat, fibrous glass of small diameter is a potent carcinogen." The pleura is the outer casing of the lungs; cancer of the pleura in humans is called mesothelioma and it is caused by asbestos fibers. Stanton continued his research and showed that when glass fibers are manufactured as small as asbestos fibers, glass causes cancer in laboratory animals just as asbestos does. [4] Asbestos is a potent human carcinogen, which will have killed an estimated 300,000 American workers by the end of this century. [5]

The finding that fiberglass causes diseases similar to asbestos was chilling news in the early 1970s, and an additional 25 years of research has not made the problem seem less serious. Workers in fiber glass manufacturing plants are exposed to concentrations of fibers far lower than the concentrations to which asbestos workers were exposed, yet several industry-sponsored epidemiological studies of fiber glass workers in the U.S., Canada, and Europe have reported statistically significant elevations in lung cancers. [6]

The International Agency for Research on Cancer (IARC), of the World Health Organization, listed fiberglass as a "probable [human] carcinogen" in 1987. In 1990, the members of the U.S. National Toxicology Program (NTP)-representatives of 10 federal health agencies-concluded unanimously that fiber glass "may reasonably be anticipated to be a carcinogen" in humans. NTP members were preparing to list fiberglass that way in the Seventh Annual (1992) Report on Carcinogens, the NTP's annual listing of cancer-causing substances, which is mandated by public law 95-622. But industry intervened politically.

Four major manufacturers of fiberglass insulation campaigned for three years to prevent their product from being labeled a carcinogen by NTP. They managed to delay the publication of the NTP's Seventh Annual Report on Carcinogens for more than two years, but on June 24, 1994, the Secretary of

Health and Human Services (HHS), Donna E. Shalala, signed the Report and sent it to Congress, thus making it official policy of the U.S. government that fiberglass is "reasonably anticipated to be a carcinogen." In the U.S., fiber glass must now be labeled a carcinogen.

Announcing this decision, government officials tried to play down its significance. Bill Grigg, a spokesperson for the U.S. Public Health Service (a subdivision of Health and Human Services) told the Washington Post, "There are no human data I'm aware of that would indicate there's any problem that would involve any consumer or worker." [7] To make such a statement, Mr. Grigg had to ignore at least six epidemiological studies showing statistically-significant elevations in lung cancers among production workers in fiber glass factories.[6] Indeed, according to researchers fiber glass is a more potent carcinogen than asbestos.[8]

Fiber glass is now measurable everywhere in the air. The air in cities, rural areas,[1] and remote mountain tops [4] now contains measurable concentrations of fiber glass.

If the dose-response curve is a straight line (that is to say, if half as much fiber glass causes half as much cancer) and if there is no threshold dose (no dose below which the cancer hazard disappears), then exposing the Earth's 5.7 billion human inhabitants to low concentrations of fiberglass will inevitably take its toll by causing excess cancers in some portion of the population.

According to OSHA researchers, an 8-hour exposure to 0.043 glass fibers per cubic centimeter of air is sufficient to cause lung cancer in one-in-every-thousand exposed workers during a 45-year working lifetime.[8] In rural areas, the concentration of fiberglass in outdoor air is reported to be 0.00004 fibers per cubic centimeter, about 1000 times below the amount thought to endanger one-in-every-thousand fiberglass workers.[1]

But people in rural areas breathe the air 24 hours a day, not 8 hours. Furthermore, a human lifetime is 70 years, not the 45 years assumed for a "work lifetime." Moreover, one-in-a-thousand is not adequate protection for the general public; U.S. Environmental Protection Agency uses one-in-100,000 or one-in-a-million as a standard for public exposures. (And in urban air, there's 10 to 40 times as much fiber glass as in rural air.) Therefore, the amount of fiber glass in the outdoor air in the U.S. and Europe (and presumably elsewhere) already seems higher than prudent public health policies would permit. Assuming a straight-line dose-response curve and no threshold, there is ample reason to be concerned about the human health hazards posed by fiberglass in the general environment.

It has been 25 years since researchers at the National Cancer Institute concluded that fiberglass is a potent carcinogen in experimental animals. During that time, additional research has confirmed those findings again and again.[8] During the same period, the amount of fiberglass manufactured has increased rapidly year after year. Ninety percent of American homes now contain fiberglass insulation. All of this fiberglass will eventually be released into the environment unless special (and very expensive) precautions are taken to prevent its release.

The likelihood of Americans taking such precautions is nil. Billions of pounds of fiber glass now in buildings will eventually be dumped into landfills, from which it will leak out slowly as time passes. Elevated concentrations of fiberglass are already measurable in the air above landfills today.[4]

In 1991, Patty's Industrial Hygiene and Toxicology, a standard reference book on workplace safety and health, says about fiberglass: "...it is prudent for industrial hygienists to treat these materials with the same precautions as asbestos." [1] How do we treat asbestos? In the U.S., all new uses of asbestos have been banned. A ban of fiberglass is long overdue.

[1] This article was researched and authored by Rachel's Environment and Health Weekly, June 1, 1995 edition and published by the Environmental Research Foundation which provided the research and substance of this article.

Footnotes:

- [1] Jaswant Singh and Michael A. Coffman, "Man-Made Mineral Fibers," in George D. Clayton and Florence E. Clayton, editors, Patty's Industrial Hygiene and Toxicology Fourth Edition, Volume 1, Part B (New York: John Wiley & Sons, 1991),pgs. 289-327.
- [2] Michael A. Coffman and Jaswant Singh, "Asbestos Management in Buildings," in George D. Clayton and Florence E. Clayton, editors, Patty's Industrial Hygiene and Toxicology Fourth Edition, Volume 1, Part B (New York: John Wiley & Sons, 1991), pgs. 387-420.
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- [3] The Annual List of carcinogens is drawn up by an inner agency Working Group for the Annual Reports on Carcinogens, which includes representatives from the Agency for Toxic Substances and Disease Registry (ATSDR); the Centers for Disease Control (CDC); the National Institute for Occupational Safety and Health (NIOSH); the Consumer Product Safety Commission (CPSC); the U.S. Environmental Protection Agency (EPA); the Food and Drug Administration (FDA); the National Cancer Institute (NCI); the National Institute o f Environmental Health Sciences (NIEHS); the National Library of Medicine (NLM); and the Occupational Safety and Health Administration (OSHA).
- [4] Reported in Katherine and Peter Montague, "Fiber Glass," Environment Vol. 16 (September 1974), pgs. 6-9.
- [5] Philip J. Landrigan, "Commentary: Environmental Disease-A Preventable Epidemic," American Journal of Public Health Vol. 82 (July 1992), pg. 941.
- [6] See Peter F. Infante and others, "Fibrous Glass and Cancer," American Journal of Industrial Medicine Vol. 26 (1994), pgs. 559-584, which reviews the following studies, among others: L. Simonato and others, "The International Agency for Research on Cancer Historical Cohort of MMMF Production Workers in Seven European Countries Extension of the Follow-Up," Annals of Occupational Hygiene Vol. 31, No. 4B (1987), pgs. 603-623; Philip E. Enterline and others, "Mortality Update of a Cohort of U.S. Man Made Mineral Fibre Workers," Annals of Occupational Hygiene Vol. 31, No. 4B (1987), pgs. 625-656; Harry S. Shannon and Others, "Mortality Experience of Ontario Glass Fibre Workers-Extended Follow-UP," Annals of Occupational Hygiene Vol.31, No. 4B (1987), pgs. 657-662; and John R. Goldsmith, "Comparative Epidemiology of Men Exposed to Asbestos and Man-Made Mineral Fibers," American Journal of Industrial Medicine Vol. 10 (1986), pgs. 543-552; G.M. Marsh and Others, "Mortality Among a Cohort of US Man-Made Mineral Fiber Workers : 1985 Follow-Up," Journal of Occupational Medicine Vol. 32 (1990), pgs. 594-604; P. Boffetta and others, "Lung Cancer Mortality Among Workers in the European Production of Man-Made Mineral

Fibers-A Poisson Regression Analysis," Scandinavian Journal of Work, Environment, and Health Vol. 18 (1992), pgs. 279-286.

- [7] Frank Swoboda and Maryann Haggerty, "U.S. Suspects Fiberglass as Carcinogen, Calls Insulation Safe," Washington Post July 2, 1994, pg. C1.
- [8] Peter F. Infante and others, "Fibrous Glass and Cancer," American Journal of Industrial Medicine Vol. 26 (1994), pgs. 559-584 lawyers san jose, san francisco attorneys, personal injury, personal injury lawyers palo alto, brain injury, toxics, chemicals, cancer, brain cancer, santa clara, stanford, mountain view."

Richard Alexander is a specialist in personal injury litigation with 30 years in-depth experience. Emphasizing working relationships with clients has led to an exceptional record of success. He has served as a member of the Board of Governors of The State Bar of California, President of the Santa Clara County Bar Association and the Board of Governors of Consumer Attorneys of California. He is a founding member of the National Association of Consumer Advocates, and heads Alexander Hawes, LLP.

Alexander Hawes, LLP is a California law firm that specializes in personal injury,wrongful death, and financial losses caused by negligence, defective products,toxic chemicals, corporate misconduct or insurance fraud on behalf of consumers, small investors, injured workers and small businesses. In addition to individual cases the firm prosecutes class actions for large groups of individuals who have suffered financial loss as a result of corporate fraud, defective consumer products, and environmental pollution. The firm holds Martindale-Hubbell's highest rating and is recognized in the List of Preeminent Law Firms in the U. S.

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IARC reclassification of man-made vitreous fibers

This fall, a special committee commissioned by the International Agency for Research on Cancer (IARC) completed a re-evaluation of the cancer hazard of synthetic mineral fibers, such as fiberglass. The panel concluded that the cancer risk from fiberglass is "not classifiable." This reverses an action taken in 1988, in which IARC concluded that fiberglass was a "possible" human carcinogen.

This subtle nuance in language meant a lot to the fiberglass industry, which has spent millions of dollars Euro-schmoozing over the past decade. We expect the industry to launch a full-court press to get the United States Department of Health and Human Services to reverse its 1994 finding that fiberglass is a "probable" human carcinogen. We can only hope the U.S. process will be more transparent than the secretive IARC special committee.

An early Owens Corning corporation press release boasted of the role one of its main scientific flacks played in the IARC re-evaluation. That release has since been removed from the web.

- **IARC Press Release** (reproduced here since their site *still* uses frames) This press release is unedited.
- **FIN response and questions for IARC** based on press release. These were sent on Nov. 29, 2001 (reached Europe on 11/30). IARC has not responded to these questions. We sent them a reminder for Christmas. We will let you know if and when they respond.
- **Looking beyond IARC and cancer**

IARC press release on reclassification of man-made vitreous fibers

IARC MONOGRAPHS PROGRAMME RE-EVALUATES CARCINOGENIC RISKS FROM AIRBORNE MAN-MADE VITREOUS FIBRES

A scientific working group of 19 experts from 11 countries convened by the Monographs Programme of the International Agency for Research on Cancer (IARC) has concluded its re-evaluation of the carcinogenic risk of airborne man-made vitreous fibres.

Man-made vitreous fibres in the form of wools are widely used in thermal and acoustical insulation and in other manufactured products in Europe and North America.

These products, including glass wool, rock (stone) wool, and slag wool, have been in use for decades and have been extensively studied to establish whether fibres that are released during manufacture, use, or removal of these products present a risk of cancer when inhaled.

Epidemiologic studies published during the 15 years since the previous IARC Monographs review of these fibres in 1988 provide no evidence of increased risks of lung cancer or of mesothelioma (cancer of the lining of the body cavities) from occupational exposures during manufacture of these materials, and inadequate evidence overall of any cancer risk.

Beside this, much industrial effort has gone into development of newer materials that have similar insulation properties to the older products, but which disappear from body tissues much more rapidly. The reason for this effort is that asbestos, a known human carcinogen which causes both mesothelioma and lung cancer and had been used as insulating material for several decades, is extremely slow to decompose and disappear from body tissues in which it has been deposited.

This characteristic, known as high biopersistence, is correlated with the high carcinogenic potency of asbestos fibres. Some of these newer materials have now been tested for carcinogenicity and most are found to be non-carcinogenic, or to cause tumours in experimental animals only under very restricted conditions of exposure.

The Monographs working group concluded that only the more biopersistent materials remain classified by IARC as possible human carcinogens (Group 2B). These include refractory ceramic fibres, which are used industrially as insulation in high-temperature environments such as blast furnaces, and certain special-purpose glass wools not used as insulating materials. In contrast, the more commonly used vitreous fibre wools including insulation glass wool, rock (stone) wool and slag wool are now considered not classifiable as to carcinogenicity to humans (Group 3). Continuous glass filaments, which are used principally to reinforce plastics, are also considered not classifiable as to carcinogenicity to humans.

For further details of the Monographs evaluation, consulthttp://monographs.iarc.fr, under "Agents most recently evaluated," or inquire by e-mail to grosse@iarc.fr.

For further details of current research at IARC on man-made vitreous fibres, inquire by e-mail to boffetta@iarc.fr.
For more general information, contact Dr Nicolas Gaudin, Chief, Communications (gaudin@iarc.fr).

FIN's questions for IARC
Dear Dr. Grosse:

Thank you for your reply. I do concur that IARC's charge is to investigate cancer, and I do appreciate the opportunity to ask some specific questions about the re-evaluation. They are as follows:

1. Who are the 19 experts from 11 countries on the re-evaluation panel, and what are their affiliations? If these persons are associated with a particular corporation, please provide the name of the corporation and their specific title within that organization.

2. Your press release specifically states that mineral fiber products "have been extensively studied to establish whether fibres that are released during manufacture, use, or removal of these products present a risk of cancer when inhaled." Although it has been established that installation and removal operations create airborne fiber counts far in excess of what has been recorded in a manufacturing situation, I know of no studies concerning the health or mortality of persons involved in installation or removal of MMVF insulation. Please cite the scientific basis for this statement in the IARC press release.

3. What new, independent scientific research has been offered to support the statement in the IARC press release that "Epidemiologic studies published during the 15 years since the previous IARC Monographs review of these fibres in 1988 provide no evidence of increased risks of lung cancer or of mesothelioma..."? Please provide full citations. If the study is available on the internet, please provide a URL. If the study was funded by the MMVF industry, please explain how IARC ensures that the study is free from bias.

4. If the studies mentioned above provide "no evidence" of increased cancer risk, how is that interpreted to cause IARC to lower the risk rating? Is a lack of evidence now considered evidence to the contrary? What has occurred to invalidate the original scientific reasoning behind the 1988 IARC classification?

5. Hamsters forced to breathe fine fiberglass in a Swiss laboratory did experience mesothelioma only six months into a two year study, according to documents released to the US Environmental Protection Agency. This study, funded by the MMVF industry, was apparently canceled shortly thereafter. At least, I have never been able to locate the final documentation. Was this study reviewed by IARC? If not, why not? Is canceling a study which is not yielding favorable results considered reasonable by IARC? (Citation: McConnell, Ernest E: Overview of the Pathology Results (Through 6 Months) of the NAIMA-supported Chronic Inhalation Study of Amosite, MMVF 10a Glass Insulation Wool and MMVF 33, a special Purpose Glass Fiber, in Hamsters. EPA document # 8EHQ-0296-13595; and letter from Ken Mentzer and supporting documents, doc. #8EHQ-0496-13595.)

6. A study at the Institute of Occupational Medicine in Edinburgh, Scotland, also produced mesotheliomas and other cancer tumors when inhaled by rats. The author of this study was James Jarvis. Was it considered? If not, why not? (Sorry, no full citation here, but I would love to locate the study if you know how.)

That's all for now. I look forward to your response. I was not able to access the full monograph on your web site. The link from the press release is either broken or there is a problem with the server.

Thank you.

Sincerely,

Robert Horowitz
Fiberglass Information Network (FIN)
Note: As of 4/24/02, IARC has not responded to our questions.

Looking beyond IARC and cancer

IARC has examined the cancer risks in the manufacturing environment and determined that they don't know whether there is a risk. That does not mean the risk does not exist. That does not mean there is no risk for installers or demolition teams. That does not mean that homeowners who are exposed to fiberglass due to a faulty installation will not get sick.

IARC is very much an "ivory tower" institution, with an arcane and impenetrable bureaucracy. We can't tell whether they have been unduly influenced by the fiberglass industry, because we don't know who IARC talks to, and we don't know who was on the special committee. Furthermore, neither FIN nor the general public was invited to give either written or verbal testimony.

IARC only considers cancer. Most of the people who contact FIN are not suffering from cancer. They are suffering from asthma- and allergy-like symptoms which have been linked, anecdotally or better, to exposure to fiberglass. The most severe cases are debilitating and do not go away once the fiberglass is removed.
Cancer rates of fiberglass workers are marginally higher than the general public according to the major epidemiological studies. The interpretation of these studies is open to debate, as is the way the studies have been structured.
The rat inhalation studies favored by industry are no better than the implantation studies the industry eschews. Rats and hamsters can only breathe through their nose, and have evolved an effective particle filtration system over the years. Humans breathe through the mouth and the nose. Our more powerful breathing apparatus is capable of sucking in more, larger, fibers deeper into our lungs.

IARC should commission research on the following:

- If fiberglass breaks down into the lungs, what does it break down into, and is that toxic to some organ other than lungs? This applies not only to the glass, but also to the highly toxic phenol-formaldehyde resins used as binding agents on most fiberglass.
- When old, filthy fiberglass enters the lungs, does that not provide a way for mold, feces and other potential disease-causing agents to penetrate very deeply into the lungs? What are the health ramifications of demolition work where fiberglass is present?

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Cancer War is Threatened by Environmental Protection Agency (EPA) Proposals

Chicago, August 16, 1996.— Cancer Prevention Coalition, Chicago

EPA's recent Proposed Guidelines for evaluating cancer risk threaten to roll back the agency's limited regulation of carcinogenic pesticides and industrial chemicals. These proposals trivialize the significance of animal carcinogenicity tests, and require that their results be validated by evidence of similar mechanisms of actions of carcinogens in animals and humans. Further, they place unrealistic emphasis on epidemiology as the major mechanisms for identifying carcinogenic risks.

These and other criticisms are detailed in the attached August 16, 1996, letter to EPA. This letter has been endorsed by 25 leading scientists, and by 50 environmental and public interest groups representing a constituency of some 10 million citizens.

Failure of the cancer establishment to provide EPA with guidance on the scientific invalidity of these proposals is consistent with its track record of indifference to cancer prevention.

August 16, 1996
Technical Information Staff (8623)
NCEA-WA/OSG
U.S. Environmental Protection Agency
=0 A401 M Street, S.W.
Washington, D.C. 20460

We express grave concerns over EPA's April 23 proposed Guidelines for evaluating the cancer risk of pesticides and other industrial chemicals. These new guidelines claim to "modernize the science of cancer risk assessment" by: relying on microbiological, genetic and mechanistic "weight of evidence"; prioritizing epidemiological over experimental evidence of carcinogenicity; and downgrading carcinogenic effects induced in animals at "only excessively high doses never seen in the environment" (EPA Press Release).

Furthermore, EPA proposes that these carcinogenic effects be qualified by criteria such as whether the induced tumors are "benign" or malignant and whether or not they metastasize. EPA also proposes that threshold or nonlinear dose-response extrapolation "is appropriate when there is no evidence of linearity."

EPA's proposals invite regulatory gridlock. They seek to replace the single criterion of experimental evidence on carcinogenicity by a complex of multiple lines of evidence of arguable merit and relevance, and thus open the Agency's floodgates to interminable special interests challenge. They also seek to shift decision-making away from scientist toward "risk managers."

Furthermore, the proposals are scientifically flawed:
There is a consensus in the scientific literature on the validity of qualitative extrapolation of experimental carcinogenicity data to human risk, irrespective of ancillary "weight of evidence." All the 23 recognized human carcinogens are also carcinogenic in experimental animals, and for many of these carcinogens, the animal data preceded epidemiological confirmation (Rall, D., Ann. NYAS, 534:78-83, 1988); for 18/23 of these carcinogens, one or more sites in humans were predicted experimentally.

Carcinogenicity testing is inherently insensitive as: a statistical function of the very small number of animals tested in relation to the many million humans at presumptive risk; the short life span of experimental animals relative to the long duration of human exposure; and the possibility that humans are more sensitive to particular carcinogens than animals. In an attempt to reduce such gross insensitivity, National Toxicology Program bioassays are routinely conducted at maximally tolerated doses (MTD) and MTD/4. For those few carcinogens, dimethylnitrosamine, vinyl chloride and acetylaminofluorene, whose testing has been extended downwards below MTD/4, carcinogenic effects have persisted at the lowest levels tested; contrary to EPA, such levels are "seen in the environment."

The remarkable advances in our understanding of the molecular mechanisms of carcinogenesis over the last few decades are fully consistent with linear dose-response extrapolation. However, in the absence of affirmative evidence of linearity, EPA's
Guidelines permit non-linear extrapolation and the establishment of allegedly safe or threshold exposure levels.

EPA's emphasis on the role of mechanistic and genetic data invites special interest challenge to experimental evidence of carcinogenicity. Illustrative is industry's insistence that methylene chloride is not carcinogenic as it allegedly induces cancer in only mice, and not rats or humans, and since it is more actively metabolized via a glutathione pathway in mice than in rats and humans; in fact, methylene chloride is also carcinogenic in rats (IARC, 41:43-85, 1986). Zeneca Pharmaceuticals also urges such downgrading: "We now have an excellent database for that kind of (mechanistic) evaluation."

This strategy is also aggressively supported by industry's academic consultants and organizations such as Harvard's Center for Risk Analysis which is seeking to downgrade the carcinogenicity of formaldehyde and chloroform on the basis of "new biological evidence." Similar challenges are also being directed to a wide range of other carcinogens, including nitrilotiracetic acid, EBDC fungicides, ethyl acrylate, and others inducing mouse liver tumors. Finally, it should be stressed that insistence on "mechanistic data" ignores the fact that we still do not know the mechanism of action of any single carcinogen.

EPA's Guidelines are myopically and unrealistically fixated on risk assessment for individual carcinogens, rather than on aggregate risks posed by a multiplicity of industrial carcinogenic contaminants in air, water, food and other consumer products and the workplace,, with multiple routes of exposure.

EPA's emphasis on the "greater weight of human data - (as) generally preferable over animal data", is misplaced and unrealistic. Epidemiological studies are generally unavailable for industrial chemicals in commercial use (Tomatis, L., Ann. NYAS, 535:31-38, 1988). Furthermore, such relatively few studies are commonly confounded by inadequate exposure data, sample size and follow-up, besides other limitations.

EPA Guidelines make no attempt to assess the increased cancer risks of children and pregnant women. "It is understood that - certain sensitive human subpopulations may be left without risk assessments"; this admission is contrary to EPA's Press Release.

Of particular concern, EPA's proposals fail to encourage industry's active participation in risk assessment. For example, industry should be requested to routinely develop microbiological and genetic data as possible early warning signals for the wide range of chemicals in use which are still untested for carcinogenicity. For those carcinogens detected at relatively high dose levels, MTD and MTD/4, industry should be invited to conduct appropriate dose-response tests at levels extending down to environmental levels. Industry should further be invited to conduct valid epidemiological studies, with detailed exposure data, n workers exposed both to chemicals as yet untested for carcinogenicity and to chemicals found to be carcinogenic in routine animal tests. Scientific and policy considerations apart, the highly technical and complex Guideline narrative effectively precludes participation by the general public and minority communities alike, thus failing to reflect principles of environmental justice.

Of related concern is the absence of any reference to scientific and lay representation of citizen, public interest and labor groups in EPA's Scientific Advisory Board.

Finally, EPA's proposals would erode its currently limited regulation of carcinogens. They would also result in a further increase of avoidable carcinogenic exposures. At a time of escalating cancer rates, EPA should more appropriately direct its policies to preventing risks of cancer by toxic use reduction strategies, rather than by attempting to manage them.

<u>SUBMITTED AND ENDORSED BY</u>:

1. Scientists:

- Samuel S. Epstein, M.D., Chairman of the Cancer Prevention Coalition; and Professor of Environmental Medicine, School of Public Health, University of Illinois at Chicago Medical Center
- Barry Castelman, Ph.D., Environmental Consultant, Baltimore
- Eve Clute, Director, Institute of Body Therapeutics, Lihaina Maui, HI
- Dr. Thomas Higginbotham, Colorado Springs, CO
- Susan Ivey, M.D. MHSA, University of California, Berkeley
- Dr. Marvin S. Legator, Professor of Community Health, University of Texas - Galveston Medical Branch
- Dr. Brian Leibovitz, Editor-in-Chief, Journal of Optimal Nutrition, Davis, CA
- Dr. Edward Lichter, Professor of Medicine, University of Illinois - Chicago, Illinois
- Dr. William Lijinksy, Ph. D., Member of the Board of Directors, Cancer Prevention Coalition; and Former Director of Chemical Carcinogenesis Program, Frederick Cancer Research Center, Maryland
- Dr. Thomas Mancuso, Emeritus Professor Occupational Medicine, University of Pittsburgh, PA
- Franklin Mirer, Ph.D., Director Health and Safety, United Auto Workers, MI
- Dr. Vincente Navarro, Professor of Health Policy, John Hopkins University (MD)
- Herbert Needleman, M.D., University of Pittsburg Medical Center
- John Olney, Professor of Medicine, Washington University School of Medicine, St. Louis, MO
- Dr. Peter Orris, Division of Occupational Medicine, Cook County Hospital, Chicago
- Michael Plewa, Professor of Genetics, University of Illinois - Champaign
- Kenneth Rosenman M.D., Professor of Medicine, Michigan State University
- Janette Sherman, M.D., Alexandria, VA
- Dr. Sandra Steingraber, Boston, MA
- G. Marie Swanson, Ph.D., M.P.H., Director and Professor of Family Practise and Medicine, Michigan State University, MI
- Dr. Joel Swartz, Charles Drew Medical University, Los Angeles, CA
- George Wald, Nobel Laureate, Harvard University
- Charles F. Wurster, Emeritus Professor of Environmental Studies, State University of New York
- Dr. Quentin Young, President American Public Health Association, Chicago, Illinois
- Dr. Arthur C. Zahalsky, Professor of Immunology, Immunox, Inc, Edwardsville, IL
- Grace Ziem, M.D., Baltimore, MD

2. Individuals:

- H. Bishop Dansby Esq., Harrisburg, VA
- Gay lord Nelson, General Counsel , Wilderness Society
- Delores Pino, J.D., Chicago, IL
- Ceil Sinnex, Editor, Gynecologic Cancer Prevention News
- Leonard W. Schroeter, Association of Trial Lawyers of American, Seattle, WA

- Les Reid, Sierra Club, Pine Mountain, CA
- David Steinman, Investigative Reporter, CA
- Martin Teitel, PhD., Executive Director, C.S. Fund, Freestone, CA
- Anthony Mazzochi, Oil, Chemical and Atomic Workers Union

3. Groups:
- Action Now, CA
- Alaska Clean Air Coalition
- American's for a Safe Future, CA
- Arrest the Incinerator Remediation, Lock Haven, PA
- Boston Women's Health Book collective, MA
- Breast Implant Information Exchange, CA
- Center for Constitutional Rights
- Center for Media and Democracy, Madison
- Chesapeake Bay Foundation, MD
- Chicago Recycling Coalition, IL
- Christian Women Against Cancer, MD
- Citizen Action, DC
- Citizens Against Cancer, MI
- Citizens for Alternatives to Chemical Contamination, MI
- Citizens for a Better Environment, IL
- Coalition for Consumer Rights, IL
- Cold Mountain, Cold Rivers, MT
- Communities for a Better Environment, CA
- Compost Patch Inc.
- Conscious Choice Magazine
- Defenders of Wildlife
- Earthsave International, CA
- Edmonds Institute, WA
- Environmental Action Foundation, MD
- Environmental Health Coalition, CA
- Environmental Health Watch, OH
- Environmental Research Foundation, MD
- Enviro-Health Concerns, KS
- Exeter Citizens for Clean Air
- Farmer - Consumer Alliance, VA
- Feminists for a Compassionate Society, TX
- Food and Water, VT
- Foundation on Economic Trends, DC
- Good Neighbor Project for Sustainable Industries, MA
- Grassroots Coalition for Environmental and Economic Justice, MD
- Grassroots Environmental Organization, NJ
- Greenpeace

- Illinois Pesticide Education Network
- Illinois Stewardship Alliance
- Institute for Agriculture and Trade Policy
- International Alliance for Sustainable Agriculture, MN
- International Center for Technology Assessment, DC
- Lake Superior Greens
- Legal Environmental Assistance Foundation, AL, FL & GA
- Massachusetts Campaign to Clean Up Hazardous Waste, MA
- Missouri Coalition for the Environment
- Montana Coalition for Health, Environmental and Economic Rights
- Montana Environmental Information Center
- National Hispanic Leadership Institute on Cancer, CA
- National Women's Health Network, DC
- New York City Green Party
- New York Coalition for Alternatives to Pesticides
- New York Environmental Law Project
- Northwest Coalition for Alternatives to Pesticides, OR
- North Carolina Fair Share
- Nutrition for Optimal Health Association, Chicago
- Oil, Chemical and Atomic Workers Union, CO
- Parents Community Council
- Peace Farm, TX
- Pennsylvania Environmental Network
- People Against Cancer, IA
- People for Community Recovery, IL
- Pesticide Action Network North America, CA
- Philadelphia Occupation Safety and health Group, PA
- Pittsburgh Against Toxic Incineration
- Project Impact Inc.
- Pure Food Campaign
- Rachel Carson Trust
- Radiation and Public Health Project, NY
- Safer Pest Control Project, IL
- Southeast Alliance for Environmental Justice, CA
- Southeast Environmental Task Force, IL
- Sierra Club - Lone Star Chapter, TX
- Toxic Links Coalition, CA
- Tri-State Environmental Council
- United Auto Workers, MI
- Victims of Fiberglass
- Women's Cancer Resource Center, CA
- Women's Cancer Resource Center, MN
- Women's Environmental Development Organization, NY

- Women Care, CA
- Women's Community Cancer Project, Boston

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FIBER GLASS: A CARCINOGEN THAT'S EVERYWHERE
http://www.ejnet.org/rachel/rehw444.htm
RACHEL'S ENVIRONMENT & HEALTH WEEKLY #444
---June 1, 1995---
News and resources for environmental justice.

An industrial process for making glass fibers was first patented in Russia in 1840. [1] At the Columbian Exposition in Chicago in 1893, Edward Libbey, an American, exhibited lamp shades, a dress, and other articles woven from glass fibers. In 1915, the Allied Forces blockaded Germany, creating an asbestos shortage which resulted in commercial production of fiberglass in the U.S., as an asbestos substitute. Asbestos is a naturally-occurring fibrous material that can be woven into cloth, does not burn readily, has excellent properties for thermal insulation, and therefore came into commercial use during this century. [2] Fiberglass has many of the same characteristics as asbestos.

In 1938, the Owens Corning Fiberglas Company was formed, and three years later, in 1941, evidence of pulmonary [lung] disease was reported by Walter J. Siebert, who investigated the health of workers in cooperation with Owens Corning. [1] That same year another investigator reported finding "no hazard to the lungs" of workers exposed to glass fibers in the air. Scientific disagreement of this sort has characterized the study of fiber glass ever since; meanwhile fiberglass production has increased steadily.

That same year (1941), the U.S. Patent Office issued patents for 353 glass wool products. Glass wool, fiberglass, fiberglas, fibrous glass, and glass fibers are all names for the same thing: thin, needle-shaped rods of glass, which nature does not make but humans do.

Fiberglass is now used for thermal insulation of industrial buildings and homes, as acoustic insulation, as fireproofing, as a reinforcing material in plastics, cement, and textiles, in automotive components, in gaskets and seals, in filters for air and fluids, and for many other miscellaneous uses. More than 30,000 commercial products now contain fiberglass.

As asbestos has been phased out because of health concerns, fiberglass production in the U.S. has been rising. In 1975, U.S. production of fiberglass was 247.88 million kilograms (545.3 million pounds). By 1984 it had risen to 632.88 million kilograms (1392.3 million pounds). [1] If that rate of growth (10.4% per year) held steady, then production of fiberglass in the U.S. in 1995 would be 4365 million pounds.

Fiberglass is now causing serious health concerns among U.S. officials and health researchers. As we reported in RHWN #74, in a series of papers published from 1969 to 1977, Dr. Mearl F. Stanton of the National Cancer Institute found that glass fibers less than 3 micrometers in diameter and greater than 20 micrometers in length are "potent carcinogens" in rats; and, he said in 1974, "it is unlikely that different mechanisms are operative in man." A micrometer is a millionth of a meter (and a meter is about three feet). Since that time, studies have continued to appear, showing that fibers of this size not only cause cancer in laboratory animals, but also cause changes in the activity and chemical composition of cells, leading to changes in the genetic structure and in the cellular immune system. Although these cell changes may be more common (and possibly more important) than cancer, it is the cancer-causing potential of glass fibers that has attracted most attention.

In 1970, Dr. Stanton announced that "it is certain that in the pleura of the rat, fibrous glass of small diameter is a potent carcinogen." The pleura is the outer casing of the lungs; cancer of the pleura in humans is called mesothelioma and it is caused by asbestos fibers. Stanton continued his research and showed that when glass fibers are manufactured as small as asbestos fibers, glass causes cancer in laboratory animals just as asbestos does. [4] Asbestos is a potent human carcinogen, which will have killed an estimated 300,000 American workers by the end of this century. [5] The finding that fiberglass causes diseases similar to asbestos was chilling news in the early 1970s, and an additional 25 years of research has not made the problem seem less serious.

Workers in fiber glass manufacturing plants are exposed to concentrations of fibers far lower than the concentrations to which asbestos workers were exposed, yet several industry-sponsored epidemiological studies of fiber glass workers in the U.S., Canada, and Europe have reported statistically significant increases in lung cancer. [6]

The International Agency for Research on Cancer (IARC), of the World Health Organization, listed fiberglass as a "probable [human] carcinogen" in 1987. In 1990, the members of the U.S. National Toxicology Program (NTP) --representatives of 10 federal health agencies --concluded unanimously that fiber glass "may reasonably be anticipated to be a carcinogen" in humans. [3] NTP members were preparing to list fiberglass that way in the SEVENTH ANNUAL (1992) REPORT ON CARCINOGENS, the NTP's annual listing of cancer-causing substances, which is mandated by Public Law 95-622. But industry intervened politically.

Four major manufacturers of fiberglass insulation campaigned for three years to prevent their product from being labeled a carcinogen by NTP (see RHWN #367). They managed to delay the publication of the NTP's SEVENTH ANNUAL REPORT ON CARCINOGENS for more than two years, but on June 24, 1994, the Secretary of Health and Human Services (HHS), Donna E. Shalala, signed the REPORT and sent it to Congress, thus making it official policy of the U.S. government that fiberglass is "reasonably anticipated to be a carcinogen." In the U.S., fiber glass must now be labeled a carcinogen.

Announcing this decision, government officials tried to play down its significance. Bill Grigg, a spokesperson for the U.S. Public Health Service (a subdivision of Health and Human Services) told the WASHINGTON POST, "There are no human data I'm aware of that would indicate there's any problem that would involve any consumer or worker." [7] To make such a statement, Mr. Grigg had to ignore at least six epidemiological studies showing statistically-significant increases in lung cancer among production workers in fiber glass factories. [6] Indeed, according to researchers in the Occupational Safety and Health Administration (OSHA, another division of Health and Human Services) fiber for fiber, fiberglass is a more potent carcinogen than asbestos. [8]

Fiberglass --a material that nature does not make --is now measurable everywhere in the air. The air in cities, rural areas, [1] and remote mountain tops [4] now contains measurable concentrations of fiber glass. If the dose-response curve is a straight line (that is to say, if half as much fiber glass causes half as much cancer) and if there is no threshold dose (no dose below which the cancer hazard disappears), then exposing the Earth's 5.7 billion human inhabitants to low concentrations of fiber glass will inevitably take its toll by causing excess cancers in some portion of the population.

According to OSHA researchers, an 8-hour exposure to 0.043 glass fibers per cubic centimeter of air is sufficient to cause lung cancer in one-in-every-thousand exposed workers during a 45-year working lifetime. [8, pg.580] In rural areas, the concentration of fiberglass in outdoor air is reported to be 0.00004 fibers per cubic centimeter, about 1000 times below the amount thought to endanger one-in-every-thousand fiberglass workers. [1] But people in rural areas breathe the air 24 hours a day, not 8 hours. Furthermore, a human lifetime is 70 years, not the 45 years assumed for a "work lifetime." Moreover, one-in-a-thousand is not adequate protection for the general public; U.S. Environmental Protection Agency uses one-in-100,000 or one-in-a-million as a standard for public exposures. (And, finally, in urban air, there's 10 to 40 times as much fiber glass as in rural air.) Therefore, the amount of fiber glass in the outdoor air in theU.S. and Europe (and presumably elsewhere) already seems higher than prudent public health policies would permit. Assuming a straight-line dose-response curve and no threshold, we believe there is ample reason to be concerned about the human health hazards posed by fiber glass in the general environment. (And this says nothing about the hazards to wildlife.)

It has been 25 years since researchers at the National Cancer Institute concluded that fiberglass is a potent carcinogen in experimental animals. During that time, additional research has confirmed those findings again and again. [8] During the same period, the amount of fiber glass manufactured has increased rapidly year after year. Ninety percent of American homes now contain fiber glass insulation. All of this fiber glass will eventually be released into the environment unless special (and very expensive) precautions are taken to prevent its release. We believe the likelihood of Americans taking such precautions is nil. Billions of pounds of fiber glass now in buildings will eventually be dumped into landfills, from which it will leak out slowly as time passes. Elevated concentrations of fiberglass are already measurable in the air above landfills today. [4]

In 1991, PATTY'S INDUSTRIAL HYGIENE AND TOXICOLOGY, a standard reference book on workplace safety and health, said about fiberglass, "...it is prudent for industrial hygienists to treat these materials with the same precautions as asbestos." [1, pg. 324] How do we treat asbestos? In the U.S., all new uses of asbestos have been banned. A ban of fiber glass is long overdue.
--Peter Montague
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[1] Jaswant Singh and Michael A. Coffman, "Man-Made Mineral Fibers," in George D. Clayton and Florence E. Clayton, editors, PATTY'S INDUSTRIAL HYGIENE AND TOXICOLOGY FOURTH EDITION, VOLUME 1, PART B (New York: John Wiley & Sons, 1991), pgs. 289-327.
[2] Michael A. Coffman and Jaswant Singh, "Asbestos Management in Buildings," in George D. Clayton and Florence E. Clayton, editors, PATTY'S INDUSTRIAL HYGIENE AND TOXICOLOGY FOURTH EDITION, VOLUME 1, PART B (New York: John Wiley & Sons, 1991), pgs. 387-420.
[3] The annual list of carcinogens is drawn up by an inter-agency Working Group for the Annual Reports on Carcinogens, which includes representatives from the Agency for Toxic Substances and Disease Registry

(ATSDR); the Centers for Disease Control (CDC); the National Institute for Occupational Safety and Health (NIOSH); the Consumer Product Safety Commission (CPSC); the U.S. Environmental Protection Agency (EPA); the Food and Drug Administration (FDA); the National Cancer Institute (NCI); the National Institute of Environmental Health Sciences (NIEHS); the National Library of Medicine (NLM); and the Occupational Safety and Health Administration (OSHA).
[4] Reported in Katherine and Peter Montague, "Fiber Glass," ENVIRONMENT Vol. 16 (September 1974), pgs. 6-9.
[5] Philip J. Landrigan, "Commentary: Environmental Disease--A Preventable Epidemic," AMERICAN JOURNAL OF PUBLIC HEALTH Vol. 82 (July 1992), pg. 941.
[6] See Peter F. Infante and others, "Fibrous Glass and Cancer," AMERICAN JOURNAL OF INDUSTRIAL MEDICINE Vol. 26 (1994), pgs. 559-584, which reviews the following studies, among others: L. Simonato and others, "The International Agency for Research on Cancer Historical Cohort of MMMF Production Workers in Seven European Countries: Extension of the Follow-Up," ANNALS OF OCCUPATIONAL HYGIENE Vol. 31, No. 4B (1987), pgs. 603-623; Philip E. Enterline and others, "Mortality Update of a Cohort of U.S. Man-Made Mineral Fibre Workers," ANNALS OF OCCUPATIONAL HYGIENE Vol. 31, No. 4B (1987), pgs. 625-656; Harry S. Shannon and others, "Mortality Experience of Ontario Glass Fibre Workers--Extended Follow-Up," ANNALS OF OCCUPATIONAL HYGIENE Vol. 31, No. 4B (1987), pgs. 657-662; and John R. Goldsmith, "Comparative Epidemiology of Men Exposed to Asbestos and Man-Made Mineral Fibers," AMERICAN JOURNAL OF INDUSTRIAL MEDICINE Vol. 10 (1986), pgs. 543-552; G.M. Marsh and others, "Mortality Among a Cohort of US Man-Made Mineral Fiber Workers: 1985 Follow-Up," JOURNAL OF OCCUPATIONAL MEDICINE Vol. 32 (1990), pgs. 594-604; P. Boffetta and others, "Lung Cancer Mortality Among Workers in the European Production of Man-Made Mineral Fibers--A Poisson Regression Analysis," SCANDINAVIAN JOURNAL OF WORK, ENVIRONMENT, AND HEALTH Vol. 18 (1992), pgs. 279-286.
[7] Frank Swoboda and Maryann Haggerty, "U.S. Suspects Figerglass as Carcinogen, Calls Insulation Safe,"WASHINGTON POST July 2, 1994, pg. C1.
[8] Peter F. Infante and others, "Fibrous Glass and Cancer," AMERICAN JOURNAL OF INDUSTRIAL MEDICINE Vol. 26 (1994), pgs. 559-584.
Special thanks to the advocacy organization, Victims of Fiberglass (VOF), for keeping us informed about these issues over the years. VOF publishes an excellent newsletter, FIBERGLASS ROOTS OF CANCER; contact Bob Horowitz, Victims of Fiberglass, P.O. Box 894, Bryte, CA 95605-0894; phone (916) 371-0656.

Descriptor terms: fiberglass; fiberglass; fiberglas; fibrous glass; glass wool; mmmf; man-made mineral fibers; carconogens; cancer; lung cancer; studies; epidemiology; energy conservation; insulation; asbestos; iarc; international agency for research on cancer; who; world health organization; national toxicology program; ntp; victims of fiberglass; health and human services; occupational safety and health administration; hhs; osha

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Air Quality Sciences

Testing in a chamber helps the manufacturers of office cubicles make sure that their products don’t emit toxic pollutants.

A typical cubicle has at least a dozen components, including coatings, varnishes, fiberglass, textiles, fabrics, adhesives, and finishes, according to Lou Newett, director of environmental health and safety for Knoll, Inc., a major office furniture manufacturer. By making the first measurements of the emissions coming from cubicles in the mid-1980s, Black revealed that some of those components were sources of toxic compounds. For example, testing documented that the hydrocarbon-based adhesives used at the time emitted volatile organic compounds (VOCs) such as naphthalene, benzene, trichloroethylene, perchloroethylene, and 1,4-dioxane 94 all of which are regulated as hazardous air pollutants in outdoor air.

That was an incentive for action, especially given that some of Black's first cubicle tests were conducted as part of a legal settlement. Employees had alleged that the cubicles inside U.S. EPA buildings—including the Waterside Mall headquarters in Washington, D.C.—made them sick. Newett and other furniture manufacturers point out that such complaints about "sick buildings" were an outgrowth of the energy crisis of the 1970s. In the process of "tightening" buildings to increase their energy efficiency, their occupants sealed them up so that "the different compounds emitting off of furniture, carpeting, and wall coverings were pretty much staying in the building and being recirculated," Newett explains. Sick buildings were blamed for fatigue and dizziness, as well as ailments such as coughs, scratchy throats, sinus infections—and cancers.

Another incentive for office furniture companies to reduce their products' emissions came in 1990, when the Occupational Safety and Health Administration (OSHA) began requiring that manufacturers label their products that have detectable formaldehyde emissions. The latest OSHA standard says that any product "capable of releasing formaldehyde at levels above .5 parts per million (ppm) must [be labeled to indicate that it is] a potential cancer hazard." Dave Rinard, director of corporate environmental performance for Steelcase, Inc., another major office furniture manufacturer, says, "Clearly, products carrying the label won't sell very well."

These pressures forced the companies making office cubicles "to transform almost everything they did" over the following years, Black says. Between 1985 and 2005, the average levels of formaldehyde released from office systems furniture—with the exception of all-wood products—have dropped by 52%, she says. The amount of chlorinated VOCs in the cubicle emissions has decreased by more than 90%, primarily from the elimination of certain adhesive formulations, cleaning chemicals, and blowing agents, she adds. And total VOC emissions have gone down by 40–70%, she says.

But the most significant shift took place during the past decade, when the insights that manufacturers gleaned through the process of reducing their furniture's emissions of these toxic compounds served as a catalyst—together with market forces—for fundamental changes in how office furniture is designed, developed, and marketed. In recent years, "greenness" has become a competitive advantage, and cubicles are now actively marketed as low-emitting products, says Tom Reardon, executive director of the Business and Industry Furniture Manufacturers Association (BIFMA). As a result, tests that prove that the products are as green as they claim to be are crucial.

Of all the chemical emissions that cubicle manufacturers have grappled with to get to this point, formaldehyde has arguably represented the biggest challenge. The first measurements showed that office furniture generated much more formaldehyde than expected, says Kirsten Ritchie of Scientific Certification Systems, which verifies air emissions and other claims for a wide variety of products. Even now, formaldehyde remains the largest detectable emission from cubicle products, Black says.

Everyone in the office furniture industry had known that particle board, which is a mainstay for constructing office cubicles, was a major source of formaldehyde emissions, recalls Bob Dutmers, supervisor of sales engineering and agency approval for Haworth, Inc., another major office furniture manufacturer. The conventional process for creating particle board, or pressboard, products uses a urea–formaldehyde resin to hold the sawdust pieces together, Black explains.

In the late 1980s, Black was in an ideal position to help cubicle manufacturers collect the detailed information about exactly how much formaldehyde—and other potential toxics such as VOCs—was being released from office cubicles. Her then-fledgling company, Air Quality Sciences, had a closed testing chamber, and Black had been measuring the airborne emissions of furnishings and building materials since the early 1980s as a professor of chemical and environmental health at the Georgia Institute of Technology, better known as Georgia Tech. She built her first testing chamber in 1983 to help the U.S. Department of Housing and Urban Development devise methodologies and standards for testing and evaluating formaldehyde emissions in pre-manufactured mobile homes. Air Quality Sciences has built 50 testing chambers of all sizes, including the ones used by the U.S. Consumer Product Safety Commission. Other laboratories that perform testing similar to that conducted by Air Quality Sciences are the Research Triangle Institute in North Carolina and Berkeley Analytical Laboratories in California.

Air Quality Sciences uses its largest chamber, which contains 1000 cubic feet of space, for testing office cubicles. The testing process involves placing the cubicles inside the closed chamber for a week and measuring the emissions after repeated air changes. These air changes are set so that they mimic the size of the facility in which the cubicles were designed to be used and the expected frequency of building air exchange. Air Quality Sciences uses thermal desorption, gas chromatography, and mass spectrometry to analyze samples to discern individual VOCs in the parts-per-billion range. High-performance liquid chromatography is used to measure formaldehyde and other common irritants.

Some of the first tests revealed that the relief holes cut into the back of many cubicles to stop the pressboard surfaces from warping were serving as escape holes for formaldehyde, Black recalls. The need to reduce formaldehyde and VOC emissions inspired Haworth to replace its urea formaldehyde veneers with ones made of polyvinyl acetate and to change to a water-based adhesive to apply fabrics to the cubicle walls, says Jim Kozminski, senior project engineer in the company’s environment department.

In other cases, companies found new sources of formaldehyde. “We initially focused on the particleboard, but we found that there were still issues surfacing,” Rinard recalls. Continued testing revealed that the acid-catalyzed finishes on Steelcase’s cubicles were producing formaldehyde, Rinard says. Some additional sleuthing revealed that sunlight was the culprit. It caused the finishes to cure and generate formaldehyde, he says. Steelcase ultimately persuaded the coating manufacturer to reformulate it.

The fact that many of the components in most office cubicles are made by outside vendors complicates the challenge that furniture manufacturers face, Black says. For example, because fiberglass can contain varying amounts of formaldehyde, furniture manufacturers usually stipulate that the fiberglass they purchase can contain no more than a certain percentage, she says. “If fiberglass is undercured, it can produce formaldehydes. If it’s over-cured, it produces trimethylamines,” Rinard explains.

Now that greenness and low emissions have become marketable advantages (*Environ. Sci. Technol.* **2004**,*38*, 222A), office furniture companies have become more reliant on testing to ensure that their products perform as expected. In fact, some companies have purchased their own testing chambers. Indoor air quality is a major component of the Leadership in Energy and Environmental Design (LEED) system developed by the U.S. Green Building Council (USGBC). Although the LEED rating system was initially developed for new buildings (*Environ. Sci. Technol.* **1998**, *32*, 412A–414A), USGBC has also promulgated standards for major renovations, existing buildings, and commercial interiors. In LEED’s complicated equation for green building designations, 23–29% of the available points are associated with indoor air.

All of these programs are contributing to the rapidly growing market for certifiably low-polluting office furniture and products, says Henning Bloech, director of communications for the Greenguard Environmental Institute, a nonprofit organization that Black founded to develop standards for certifying low emissions claims for manufactured products. Organizations such as Greenguard Environmental Institute and Scientific Certification Systems certify that products meet the air emission requirements stipulated by programs such as LEED and Germany’s Blue Angel.

The certifications provided by organizations like GREENGUARD are important because “there are hundreds of building materials and furnishings that are being promoted as being green,” said Lynn Simon of Simon & Associates, a green building consulting firm, at the Environ-Design Conference held in New York City last April. Not all of these green claims hold up, she stresses. “Greenwashing’ is rampant,” adds her colleague, Miriam Landman.

The process of obtaining a GREENGUARD certification ensures that the chemicals emitted by the tested product meet national and international guidelines, including those developed by the International Agency for Research on Cancer, EPA’s Integrated Risk Information System (IRIS), and the Agency for Toxic Substances and Disease Registry (ATSDR) of the U.S. Centers for Disease Control and Prevention. It is sufficiently demanding that many of the companies Black works with have a difficult time maintaining their certifications, she says. These difficulties are often traced to problems with outside product suppliers or manufacturing changes, she explains. For example, in order to ensure that Steelcase consistently was supplied with fiberglass produced in the “very narrow band where fiberglass can be cured and meet GREENGUARD requirements,” Rinard says that his company worked with its fiberglass supplier to produce a new formulation.

Even the greenest office cubicles usually emit 200–300 different chemicals, says Black. By the end of a week of testing, that number has usually declined to 30–50. In addition to the inevitable formaldehyde—and aldehydes associated with it, like hexanol and nonanol—higher-molecular-weight chemicals, such as pinene and other terpenes, are also commonly found, she says.

GreenGuard uses the=2 Omission-rate data to project the levels of emissions to which the cubicles’ occupants would be exposed anywhere from one week to six months later.

Products that carry the GREENGUARD certification label have emissions that are 60% lower, on average, than those of conventionally produced products, Black says. Most of these products do not cost any more than uncertified products, Black and Reardon concur. In fact, the LEED certification process "is moving toward becoming a standard of care, something that's expected," she says. The industry is driving toward lower and lower emissions from products," Reardon agrees.

In fact, the furniture industry is actually going beyond LEED at this point, says Mark Bonnema, a senior Design for Environment engineer for Haworth. Both Steelcase and Haworth are working with Bill McDonough and Michael Braungart to use their "cradle-to-cradle" (*Environ. Sci. Technol.* **2003**, *37*, 434A–441A) approach to designing office furniture. "We have switched from a mindset of considering off-gases to the McDonough–Braungart approach of designing products well up-front," Kozminski says. To date, however, none of the largest office furniture manufacturers has introduced a product that is based on cradle-to-cradle principles, Reardon says. But Bonnema promises that "what you're going to see in the next five years is much more fundamental changes that will have a very large impact." —KELLYN S. BETTS
http://pubs.acs.org/journals/esthag/bios.html

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Duct Cleaning and Indoor Air Quality
Florida Energy Extension Service and Gary Cook

With concern about secondary smoke, dust mites, formaldehyde emissions and bioaerosols, the public has become more aware of indoor air quality problems. Heating, air conditioning and ventilation units as well as associated ductwork can be the sources of mold, fungi and other microbial pollutants as well as particulates of dust, secondary smoke and pieces of dead dust mites. Along with the public's concern has been the development of businesses directly associated with indoor air quality. Some of these businesses are reputable and supply effective indoor air quality services; others, on the other hand, offer little more than technical jargon and will take advantage of the unwary consumer. Duct cleaning has been an area that has been attracted by both reputable and unscrupulous businesses. A Florida International University study was undertaken to determine the effectiveness of three commercial HVAC duct cleaning processes in reducing the level of airborne particulate matter and certain bioaerosols in fiberglass board duct systems. They investigated three procedures: (1) the contact method in which conventional vacuum cleaning of the interior ducts was performed, (2) the air sweep method in which compressed air is introduced to the duct for dislodging dirt and debris and are carried downstream through the duct and out the system by vacuum collection equipment, and (3) the mechanical brush method in which a rubbery brush is inserted into the ductwork to agitate or dislodge debris and, as with the air sweep method, are drawn through the duct out of the system by vacuum collection equipment.

Their conclusion was that duct cleaning using the air sweep and mechanical brush methods was only modestly effective in the short-term for indoor air quality improvement. The contact method was least effective. The effectiveness of the contact method was inconclusive in that one of the experimental homes showed reduction while the other experienced an increase of particulates at the one micron level and above.

The air sweep and mechanical brush methods indicated a reduction at the one micron level when readings were taken two days after the cleaning. With respect to bioaerosol reductions, homes cleaned with the air sweep method showed the greatest reduction two days after cleaning. Based upon FIU's study, it appears that the air sweep is most effective at reducing both particulates at the one micron level and above and bioaerosols. FIU found that both particulates count readings and bioaerosol concentrations were higher when the cleaning was in progress than before or after. This may be due to disturbances caused by the cleaning process. The general conclusion was that at the 0.3 micron level, no significant changes occurred between the pre-cleaning and post-cleaning readings. Particulates less than one micron cause the most health problems and respiratory damage. One micron is about 1/10 the thickness of a sheet of paper. Cigarette smoking produces 0.3 micron particles which were at elevated levels in homes that had smokers.

The air sweep and mechanical brush methods reduced the bioaerosol contaminants by approximately 85%. This measurement is expressed in terms of (cfu/m^3) and was taken two days after cleaning. However, the remaining concentration will quickly reproduce to previous levels unless the underlying condition of high humidity is reduced. The shortcoming of the FIU study was that readings were only taken immediately prior to cleaning, during cleaning and two days after cleaning. A follow-up study is currently underway to determine the long-term effectiveness of duct cleaning.

It is the conclusion of other indoor air quality experts such as T. Brennan, J. Lstiburek and J. Bower, that generally between one and three months after duct cleaning has taken place, the bioaerosol counts and particulate levels will increase to near their pre-cleaning levels. Studies also suggest that cleaning techniques that agitate the duct systems, particularly fiberglass ducts, may pose a greater problem by loosening fiberglass particles from the duct board.

Fiberglass now is a suspected carcinogen or cancer-causing agent. The problems originally associated with how the air ducts became dirty in the first place are generally not addressed by duct cleaning methods. It is more important to fix leaking ducts and ensure cooling coil condensate pans are clean and draining properly. Often these pans will become clogged due to debris, dust and microbial growths. If the drip pan becomes clogged, moisture carryover can occur, wetting adjacent ducts in the process. If these are made of uncoated fiberglass ductboard, they will become wet and serve as a media for dust mites, mold and other microbial growths which will affect the air quality downstream. Dr. Virginia Peart in her internal, unpublished factsheet *Is Your House a Sick House?* (H-2001) on cleaning of fiberglass ducts, quotes Dr. Thad Godish and Dr. Harriet Burge. These comments were made at the *1990 Indoor Air Quality in Homes: Synthesizing the Issues and Educating Consumers* Symposium. Dr. Godish stated: "A lot of fiberglass ducts are used, and in high humidity environments, they are going to trap organic dust which can result in mold and bacteria growing on them. In response to that, a number of companies are selling a service which really is not going to do much good simply because the ducts are re-contaminated so quickly. It is not possible for the cleaning to be as effective as it needs to be. One of the problems with fiberglass ducts is that they have a very rough surface which makes an excellent trap for dust. A lot of dust is organic dust, and if you have organic dust you are going to get the growth of mold and bacteria." Dr. Harriet Burge answered the question, "Can fiberglass-lined ductwork be cleaned?", as follows: "Fiberglass lined ductwork that is merely dirty (i.e., that has accumulated dust and dirt) can be cleaned if care is taken not to damage the fiberglass. However, if such ductwork has become wet (that is, if mold is actually growing on the fiberglass), it cannot be cleaned. The mold penetrates into the fiberglass and will begin to grow again as soon as surface growth is removed. The use of biocides (agents designed to kill molds and bacteria) is not recommended in ductwork because of the danger to the building occupants of exposure to the biocide." Dr. Peart recommends certain precautions before engaging duct cleaning services. "What do you know about the company? What questions should you ask?

Consider these: How long has the company been in business? Written testimonials can be impressive, but it can be more important to talk with company clients of a year ago or longer. Most treatments cannot be guaranteed for long periods of time. Test results of mold or other microorganisms before and soon after cleaning do not tell you if molds return in a few months. What chemicals are used in the treatment process?" The best duct systems are made of galvanized sheet metal with outside insulation covered by a vapor retarder. The smooth surfaces in these ducts facilitate cleaning and the zinc coating serves as a fungicide which prevents mold and mildew growth. From an energy conservation and indoor air quality point of view, controlling the pollution source seems to be the best way of keeping duct systems clean and free from trouble. It is important to change filters regularly and to have the air conditioning system serviced by an HVAC contractor once a year. During this process it is important that they vacuum the heat exchanger, clean coils, and assure that the drip pan is clean and draining properly.

The Use of Ozone in Duct Systems

Some businesses are promoting a duct cleaning method using high concentrations of ozone in the duct system. EPA points out that ozone is a very corrosive and toxic gas which is harmful to humans in any concentration. So it is imperative if this method is used that occupants be cleared and remain away from the house until ozone levels are back to normal. Generally ozone concentrations of five to seven parts per million are needed to kill microbial and other bioaerosol contaminants that occur in the ducts. While it has been shown to be effective at killing dust mites, bacteria and germs, the EPA points out that dead toxins such as dust mite carcasses and incapacitated mold and other bioaerosol agents can be just as allergenic as the live ones, if not more so. In addition, if the ductwork is wet, only the surface layer containing contaminants will be affected. Ozone, being very corrosive, has the capability of fading carpets and draperies and rusting or oxidizing metals if not controlled properly. EPA and most experts do not generally recommend the use of biocides, air fresheners and cleaning agents in the filters or the duct systems unless they have been specifically approved for that purpose by EPA. Some harsh cleaning agents that kill germs and bacteria may also harm the delicate lining in human lung tissue and in itself be a carcinogen or allergen. The overall conclusion about duct cleaning is that the air sweep and brush methods appear to be only modestly effective in the short-term and in the long-term it may not be effective at reducing air pollutants. A more effective approach is to properly select ducts prior to construction and to keep the air conditioning system clean with proper filtration and servicing of the drip pan and cooling and heating coils once a year by a qualified service contractor. Ozone cleaning methods and the use of biocides, germicides, cleaning agents and deodorants should only be used with great caution and only if approved for that purpose by EPA.

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Footnotes

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