Installers of blowing wool—mineral wool in particular—might face health risks. But batt installers are probably safe from harm.

FIBERGLASS, MINERAL WOOL & YOUR HEALTH

The jury is still out, but research suggests that insulation workers should take reasonable precautions

by Paul Hanke

It has long been known that asbestos is a serious environmental hazard, causing lung cancer, asbestosis, and other diseases in humans. According to the U.S. Environmental Protection Agency (EPA), there is "no known safe level of exposure" to asbestos. Indeed, the very word may be enough to strike fear into the hearts of the most stalwart builders, architects, and homeowners.

One result of asbestos's decline has been greater use of alternative substances such as fiberglass and mineral wool. The EPA estimates the annual production of fibrous glass to be in the neighborhood of 1.5 million metric tons, and rock wool at about 1.1 million metric tons. Of this, at least 90 percent is used for thermal or acoustical insulation.

The question then arises as to whether these so-called *man-made mineral fibers* (MMMFs) also pose a health risk, and if so, to whom and how great a risk. For the last several years, researchers have been trying to answer these questions. At present, fiberglass and mineral wool seem to be much less of a health risk than asbestos, although some questions remain unanswered.

The Fiber Factor

The primary factor linking asbestos with cancer seems to be particle size rather than on other physical or chemical properties. Studies have concluded that so-called "long, thin" fibers seem to have the greatest ability to induce cancer. In general, these are fibers in the range of 0.5 to 2.5 microns (millionths of a meter) in diameter and 10 to 80 microns in length. (By way of comparison, a human hair measures about 70 microns in diameter.) The thin fibers penetrate most deeply into the lung, and relatively long fibers appear to interfere with the body's natural defense against foreign substances.

Asbestos is apparently pretty resistant to this defense. According to one theory, it may be the body's enzymes trying to dissolve the foreign material that stimulates scarring of lung tissue, which is an early stage of lung cancer. Persistent fibers, such as asbestos, would therefore present the worst hazard. Less durable fibers (fiberglass, mineral wool, and ceramics, in that order) would present decreasingly less risk.

In recent years, manufacturers have sought to increase the insulating value of fiberglass and mineral wool by reducing the diameter of the fibers. For instance, a study by Dr. William T. Lowry found that 80 percent of the fibers in Certainteed's *Insul-Safe III* were between 0.6 and 0.9 microns in diameter and 10 to 20 microns in length, solidly in the zone of potential harm.

Lowry's research was funded by a group called National Consumer Products Marketing, Inc., headed by a Mr. Richard Munson. Through an advertising campaign and a barrage of letters to

public officials, Munson has been seeking to have the health effects of fiberglass and mineral wool investigated. Munson's motives and credibility have been questioned, however, because of his connections with the cellulose industry, which is a direct competitor of fiberglass and mineral wool. His efforts appear to have had some effect though, and both the EPA and OSHA are now reviewing their standards in this area.

To sum up, asbestos is a proven *carcinogen* (cancer-causing agent). Fiber size is the major link to respiratory disease. Fiberglass and mineral wool are known to have fibers in the troublesome-size range. The question is, do they too cause disease? Based on human and animal studies the answer seems to be "maybe," but probably not.

The Studies

Since the early 1970s a number of studies have been conducted-looking at both animals and humans. The animal studies have involved both surgical implantation and breathing of fibers. Human studies are *epidemiological.* That is, they examine the health of large groups of people exposed to the material at work or otherwise. What follows is a brief synopsis of the various studies and their conclusions.

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National Cancer Institute. The first major studies on the health effects of MMMFs were conducted by the late Dr. Merle Stanton of the National Cancer Institute (NCI) and reported in 1972 and 1977. It was he who determined that long, thin fibers can induce cancer, and recommended that all respirable fibers be viewed with caution.

NIOSH '77. In 1977, the National Institute of Occupational Safety and Health (NIOSH) proposed regulations limiting workers' exposure to breathable glass fibers, based in part on a 1976 NIOSH study that found elevated levels of non-malignant lung disease among workers at several fiberglass factories. The *proposed regulation* would limit exposure to 3 fibers of "breathable" size per cubic centimeter (cc) of surrounding air. These guidelines were originally proposed to prevent skin, eye, and upper respiratory irritation and pulmonary fibrosis, before the cancer risk question became an issue.

Breathable fibers were defined by NIOSH as being less than 3.5 microns in diameter and greater than 8 microns in length. One NIOSH researcher claimed that typical exposure for a blowing-wool installer may be 10 to 16 times the recommended standard. However, a later study found much lower exposure levels in the field, as we shall see below.

Field Exposure Levels. Most research studies to date have focused either on animal experiments with drastically elevated exposure levels, or on workers in fiberglass or mineral-wool manufacturing plants. What about installers of these products in the field? The sole research in this area seems to be a study of blowing wool and batt insulation installers conducted by the University of Pittsburgh's School of Public Health in 1981. That study found the average exposure to blowers to be 0.12 to 5.3 fibers per cc of air. Mineral-wool workers were exposed to the highest amounts, at a maximum of 20 fibers/cc, while fiberglass installers received only 5 fibers/cc at most.

Breathable fibers accounted for 21 to 55 percent of the total exposure. "Breathable" was defined in this study as fibers less than 1 micron in diameter and longer than 5 microns, slightly different than the NIOSH standards cited earlier.

WHO '82. An international symposium on the health risks of MMMFs was held in 1982 in Copenhagen, Denmark, under the auspices of the World Health Organization (WHO). At this gathering Professors Philip Enterline and Gary Marsh of the University of Pittsburgh School of Public Health presented the results of a major human study.

Enterline and Marsh studied 16,730 employees who had worked in 11 fiberglass and six mineral-wool manufacturing plants for at least one year between 1945 and 1963. Their findings, updated in 1982, indicated a 33-percent higher-than-average level of deaths from lung cancer among workers at the 17 U.S. plants. Other European and Canadian reports presented at the conference seemed to support the U.S. findings.

Surgically implanted fibers cause tumors, at least if you're a laboratory rat. But breathing the fibers doesn't seem to increase the risk of lung cancer.

Critics of Enterline and Marsh's work, most notably the Thermal Insulation Manufacturers Association (TIMA), quickly pointed out that data from Owens-Corning's Newark, Ohio, plant (which by itself accounted for 38 percent of the 14,815 fiberglass workers studied) was unfairly skewing results. Enterline initially disagreed, but reassessed his findings prior to the next WHO gathering in 1986, as we shall see.

Brookhaven. The next major salvo in the debate was a study done at Brookhaven National Labs, ending in 1985 and funded by TIMA. This six-year experiment studied the effects of MMMFs on the respiratory systems of rats. Some had glass fibers surgically implanted in the lung, others were subjected to forced inhalation via a tube. The most interesting finding was that both long and short fibers were cleared from the rats' lungs at about the same rate, with more than 90 percent of the material gone after 17 months. The glass fibers did not reduce the lifespan of the animals, or produce tumors.

Los Alamos '86. Close on the heels of the Brookhaven study came another major TIMA-funded report by Los Alamos National Lab. This is the largest animal study done to date—involving 1,900 hamsters and rats, and lasting 7 years (at a cost of $2.5 million).

The animals breathed aerosol clouds of four types of glass fibers, one mineral-wool fiber, and one ceramic fiber for 6 hours per day, 5 days per week, for two years. Exposure levels were 10 to 1,500 times more than is currently allowed in the workplace.

According to TIMA, the study concluded that there was no statistically significant increase in cancer, tumors, lesions, or other unusual illnesses in the test groups. Remarkably, many of the animals exposed to MMMFs lived slightly *longer* than the control groups—although the reason is unknown.

Battelle '86. In another major study in 1986, researchers at Battelle Labs studied 500 rats and 60 monkeys who were exposed to airborne fibers during a "simulated" work week for 21 and 18 months respectively. This NIOSH-sponsored study found no evidence of lung cancer or *mesothelioma* (a rare cancer linked to asbestos) in the test animals. However, the researchers found an increased incidence of leukemia in the exposed rats. This led the researchers to propose that glass fibers in the lung or lymph tissues may have altered the rats' immune functioning. They noted that fiber-exposed workers have also shown increased leukemias and lymph tumors. They conclude: "In view of these facts, one may speculate that fibrous glass may predispose man to an increased incidence of lymphoma and leukemia."

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Copenhagen '86. In October 1986 another WHO-sponsored conference was held in Copenhagen. Here a reexamination of Philip Enterline's data was reported. When recalculated and compared with cancer rates by state, the overall difference in lung cancer rates was only 18.6 percent, not the 33 percent reported earlier. Moreover, the Owens-Corning plant at Newark, Ohio, accounted for most of the cancers. It showed a 23 percent increase, whereas the remaining ten plants showed no increased cancer risk.

WHO/IARC. As a final note, at a 1986 meeting in Lyons, France, scientists from WHO's International Agency for Research on Cancer (IARC) gave fiberglass a relatively clean bill of health. They classified fiberglass and mineral wool in Group 2B *(possibly* carcinogenic to humans), rather than in Group 1 (sufficient evidence of human cancer), or Group 2A *(probably* cancer causing). This brings us up to date on worldwide research efforts.

Summary and Conclusions

Asbestos definitely causes cancer. *Surgically implanted* fibers of glass and mineral wool cause tumors, at least if you are a laboratory rat. *Breathing* MMMFs doesn't seem to produce increased risk of lung-cancer death in animals or humans based on currently available inhalation and epidemiological studies. However, it does appear that there is a possibly increased risk of leukemia, which needs further investigation.

Who Is At Risk?

Ned Nisson, writing in *Energy Design Update,* cites Philip Enterline as saying the risk to homeowners is "zero" and the risk to batt installers is very close to zero. Blowing wool installers might be more at risk, especially mineral-wool workers, due to possibly higher exposure levels and the greater resistance of mineral wool fibers to the body's defense mechanisms.

Protective Measures

At the present time NIOSH considers the hazard from fiberglass to be greater than a nuisance dust, but less than coal dust. They do not consider it to be cancer-causing. NIOSH still recommends that occupational exposures to breathable fibers be kept below 3 fibers/cc. In addition, they recommend that manufacturers label fiberglass with a warning, that employers inform their employees of the possible risks, and that workers protect skin (especially hands, arm, neck, and underarms) and eyes. Pre-placement medical exams and annual follow-ups are also recommended, with attention to skin and respiratory functioning. Respirators are advised in construction or demolition conditions where high volumes of dust will be generated or where acceptable limits cannot be achieved by other means. NIOSH also recommends that employers keep certain records for at least 30 years following an individual's employment.

On the other side of the regulatory coin, the Occupational Safety and Health Administration (OSHA) still classifies fiberglass as merely a "nuisance dust," allowing exposure levels much higher than 3 fibers/cc.

To help inform consumers and workers about the potential hazards, insulation manufacturers are now issuing Material Safety Data Sheets (MSDSs), which carry a statement cautioning users about the risks and advising on signs and symptoms of exposure, protective measures, and first-aid procedures. You can obtain a copy from your insulation supplier or manufacturer.

The EPA, in a preliminary draft document on asbestos substitutes, suggests only exercising "some caution in allowing indiscriminate exposure to fibrous glass," and urges further study. They acknowledge that mineral-wool hazards are "intermediate" between fiberglass and asbestos but offer no specific advice on protective measures.

Based on the evidence so far, I personally would use protective clothes, goggles, and a respirator as routine procedure. Contractors might also rotate blower, bin loader, and helper on a three-person crew to limit exposure and perhaps offset the minor inconvenience and inefficiencies associated with respirators. Finally, you might be erring on the safe side to choose fiberglass over mineral wool. But bear in mind what a litigious society we have become. Pressure your employees/employer to become health and safety conscious.

Unanswered Questions

Despite the relatively reassuring results of the studies to date, continued research seems advisable. While fiberglass and mineral wool appear to be much less dangerous than asbestos, relatively few workers have been followed for the long periods of time necessary to develop lung cancer. The question of leukemia also needs more research. Finally, we can't know for sure how relevant animal studies are to humans.

Contractor Responses

How are contractors responding to increased awareness of the possible hazards of MMMFs? According to a survey in the September 1987 issue of RSI, 80 percent of the 400 respondents were

aware of the recent scientific concerns about MMMFs. Forty-one percent had begun providing better respirators, while 34 percent indicated they were undertaking better work-site practices based on what they now knew. Only 4 percent were keeping medical records, and a mere five contractors said they had stopped using fiberglass or mineral wool products. Thirty-one percent took the health concerns "very seriously." Another 31 percent were taking no additional precautions, but these would include many who thought their safety measures were adequate. Sixty-four percent of the RSI respondents thought more research was called for. Twenty-two percent felt that health concerns were "overstated," and they perhaps accounted for the bulk of those taking no special action. The question remains: What will you do based on current information?■

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Respirators

As pointed out in the December 1987 issue of *NEB*, (See "Protecting Ears, Eyes, and Lungs") an ordinary "throw-away" dust mask, or even many "dust-and-mist" respirators will not protect you from asbestos fibers or MMMFs in the same size range. To protect you from these fibers at concentrations up to 15,000,000 fibers/cubic meter (about 5 times the NIOSH 3 fiber/cc limit), NIOSH recommends a NIOSH- or Mine Safety and Health Administration (MSHA)-approved mask with cartridges rated for "highly toxic particulate" filtering.

A catalog on my shelf lists two such half-face models, one listing at $40 for the respirator body plus $15 per pair for the cartridges, or an economy model at $17.50 for the body plus $16 for two filters. A powered full-face unit (for applications involving higher concentrations) lists at $250.

Remember, half-face masks typically do not work well for bearded builders. If you fit into that category, you'll have to pass the hazardous work along to clean-shaven co-workers, take a shave, or prepare to part with some bucks for a more elaborate protection device.

–NEB

The insulation fibers thought be harmful are asbestos-sized, Far protection from this size fiber, NIOSH recommends an asbestos-rated mask.