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TECHNOLOGY

Spray fireproofing faces controls or ban as research links asbestos to cancer

The snow stopped falling last May in New York City. Residents had long been accustomed to walking near construction sites in any time of year and seeing what looked like snowflakes fall down on and beside them. Few of them were aware that the snow was actually asbestos fallout from spray insulation operations above. And had they known, few would have cared. Asbestos and construction have long been synonymous.

Then all asbestos spraying was halted by order of the city's Environmental Protection Administration. And the word went out to an amazed public about what medical researchers and an increasingly aware asbestos industry had known for years.

Human exposure to asbestos can kill.

Death comes slowly. Often it is 20 or 30 years after significant inhalation of the tiny asbestos fibers that, often invisibly, pollute the air of asbestos mines, manufacturing plants, construction sites and demolition projects. Some, of course, goes into the ambient air of the surrounding areas. How much of this is dangerous is not yet determined.

But the causes of death among persons exposed to quantities of asbestos on the job are known. Of asbestos workers who die in the New York City area, one of five dies of lung cancer. Almost half of them die with other forms of cancer. It is estimated that a man who smokes and works with asbestos increases his risk of incurring lung cancer 92 times over that of a man who does neither.

The chances that a man will die of cancer, however, depends on his surviving Asbestosis, the first disease diagnosed as the result of asbestos fiber buildup in the lungs. Asbestosis results in such fibrosis (scarring) of lung tissue that the victim is effectively strangled by his inability to get sufficient oxygen. Asbestosis also leaves a person prone to infectious pulmonary disease.

A magic mineral

Asbestos, which comes from a Greek word meaning inextinguishable, is used to describe a family of hydrated silicate minerals that have one common property. They can be separated into soft, silky fibers.

The fibers are incredibly—and microscopically—small. One million asbestos fibers is equivalent to only 630 hairs, or 8,800 glass fibrils, such as are contained in some insulation materials.

The known varieties of asbestos include two types and six variations, plus local characteristics of specific mines, most of which are in Canada and the Soviet Union. About 95 per cent of the asbestos used in the U.S. is chrysotile asbestos, mined from serpentine rock.

The most remarkable thing about asbestos is its virtual indestructibility. The tiny fibers are impervious to weather, heat and fire. They have the tensile strength of piano wire, unusual flexibility and they adsorb and filter well. They are also the only mineral fiber that can be woven into textiles.

The strength of asbestos is also its danger. Inside the human lung the fibers are as indestructible as in nature.

The earliest evidence of asbestos was found in the archaeological digs of a civilization in Finland 45 centuries ago. Here, the ancients used asbestos to hold pottery together before it was baked. And, according to legend, Charlemagne cleaned his asbestos table cloth by throwing it into the fire. The Greeks and Romans, however, noted that working with asbestos could cause lung illness.

Modern knowledge of the material dates back to 1879, when the first commercial mine opened in Quebec, producing 300 tons the first year. By 1910 production had increased ten times and it has been increasing ever since, to the present 5 million-ton output.

The U.S. is first

The United States is the largest single user of asbestos, consuming almost one quarter of the world supply. The U.S. is also the most creative user, taking the "mineral of 1,000 uses," as asbestos had been called, and finding over 3,000 industrial applications.

Over 75 per cent of available asbestos goes to the world-wide construction industry, with the asbestos-cement industry followed by the asbestos floor tile manufacturers, the biggest markets. According to the U.S. Department of Commerce, asbestos is used in shingles and clapboard, siding, roofs, interior and exterior wall sheeting, pipe, conduits, ducts and acoustical ceiling panels. Asbestos is also in paints, sealants, caulking, potter's clay, millboard and plastic reinforcement and filler. As a friction material, it is in brakelinings and clutch facings; it also is contained in fi hose, rugs, safety clothing an ironing board covers. Last, *an perhaps least,* asbestos is used fc spray fireproofing of structur steel.

According to Johns-Manvill Corp., the nation's largest a bestos producer, only a fraction o asbestos (1 per cent of their own goes into spray fireproofing. (J-M only supplies asbestos to spra manufacturers, but does no manufacture a spray product.)

The company, however, ha long been involved in researcl into the problems asociated wit asbestos exposure. In 1928, abou the same time British scientist identified asbestos as an occupational health hazard for textile workers, J-M started animal research on the effects of asbestos dust. The conclusion was that inhalation produced fibrosis of the lungs. A J-M study co-sponsored by the Metropolitan Life Insurance Co., in association with McGill University Medical School, followed in 1929, concentrating on the occupational hazards of asbestos dust. In 1935 they published studies showing that airborne asbestos produced pulmunary fibrosis in humans and recommending control measures. regular physical examinations and more research.

Today, millions of dollars and many studies later, the company is still heavily involved in medical research, with about $1.3 million worth of research now in progress. This includes co-sponsorship, with the International Association of Heat and Frost Insulators and Asbestos Workers, of a program called the Insulation Industry Hygiene Research Program. Since the program was inaugurated in 1968, with $362,500 in backing from its sponsors, it has resulted in new industry safety standards and equipment.

The director of this and other asbestos research programs is Dr Irving J. Selikoff, a pioneer in the field. As head of the Division of Environmental Medicine of the City University's Mt. Sinai School of Medicine, and director of its Environmental Sciences Laboratory, Dr. Selikoff had been working with the Insulation Union since 1962, when they agreed to make the records on their membership available for study.

Dr. Selikoff became involved in asbestos research in the 1950s, when he was head of a New Jersey clinic and had occasion to examine 17 men referred to him with

chest diseases. All had worked in a local asbestos factory, which has since closed, and all were ablebodied at the time. But by 1961, six were dead, and with time, the rest have either died or been disabled by Asbestosis or cancer.

When he approached the union for study, the leaders were all too willing to cooperate. They had been trying to make their problems known for years. What Selikoff discovered spelled out their difficulties in very clear terms.

Joined by two other doctors, E. Cuyler Hammond, of the American Cancer Society, and Jacob Churg, chief pathologist of the Barnert Memorial Hospital, Dr. Selikoff studied the case histories of the 632 union members who were on the union roles in 1942. They calculated there should have been 203 deaths by 1962, but discovered instead there had been 255, an excess of 20 per cent. A study of 370 union members conducted in 1967 had similar results. There were 94 deaths, instead of an estimated 47 among a comparable sampling of the general population.

The number of deaths was not the only alarming finding, but also the causes. None in the general population would have died of Asbestosis, but many of the asbestos workers did. There was also an extremely high incidence of cancer among the workers, especially of lung cancer. (No one died of lung cancer who was not also a smoker, but that is little consolation. Dr. Selikoff estimates that 75 per cent of the adult male population smokes.)

New York acts

Research reports from scientists such as Dr. Selikoff seemingly had little impact on the public or government until recently. But then the news broke.

Conferences, speeches, industrial programs such as Johns-Manville had sponsored and the unions finally caught the attention of officials. New York City's new Environmental Protection Administration, deeply concerned about the declining quality of New York City air, became alarmed at the visible emissions of asbestos fibers from city construction sites, the so-called snowflake effect. Soon they were checking the city for asbestos levels, following up any reports by citizens who had seen asbestos fallout.

After a series of meetings and hearings, which also attracted a good deal of public attention (if, sometimes, misinformation), the city took a stand against asbestos in the air. Working with Dr. Selikoff and representatives from industry, the unions and other advisors, the EPA Department of Air Resources issued regulatinons for spraying in the city, based largely on procedures proposed by the Sprayed Mineral Fiber Manufacturers Association.

To those who protested the city had overstepped its bounds, officials replied that air pollution in the city was its proper concern and that asbestos, which goes from the construction site into the ambient air, was a dangerous pollutant. The city's mayor has introduced a Comprehensive Air Pollution Control Code to the city council that would ban all asbestos spraying permanently. (At press time, Philadelphia's Board of Health issued regulations—pending legal review and hearings—that would prohibit all asbestos spraying and limit concentrations of airborne asbestos.)

Whether or not a complete ban is necessary for public safety is highly disputable. But, since no one knows the limits of human tolerance for asbestos fibers in the lungs, the city has decided to err on the side of safety. Until the ban, however, the word is control.

New York regulations (which may be adopted in similar form by other cities follow in brief:

1. Before spraying, the floor must be cleaned of dirt and objects and then covered with a plastic tarpaulin.

2. The entire work floor must be enclosed with tarpaulins that will prevent the visible escape of asbestos fibers into the city air. Interior open areas must also be enclosed.

3. Wet asbestos materials must be swept up and placed in a covered container immediately, ready for transport to an approved disposal area.

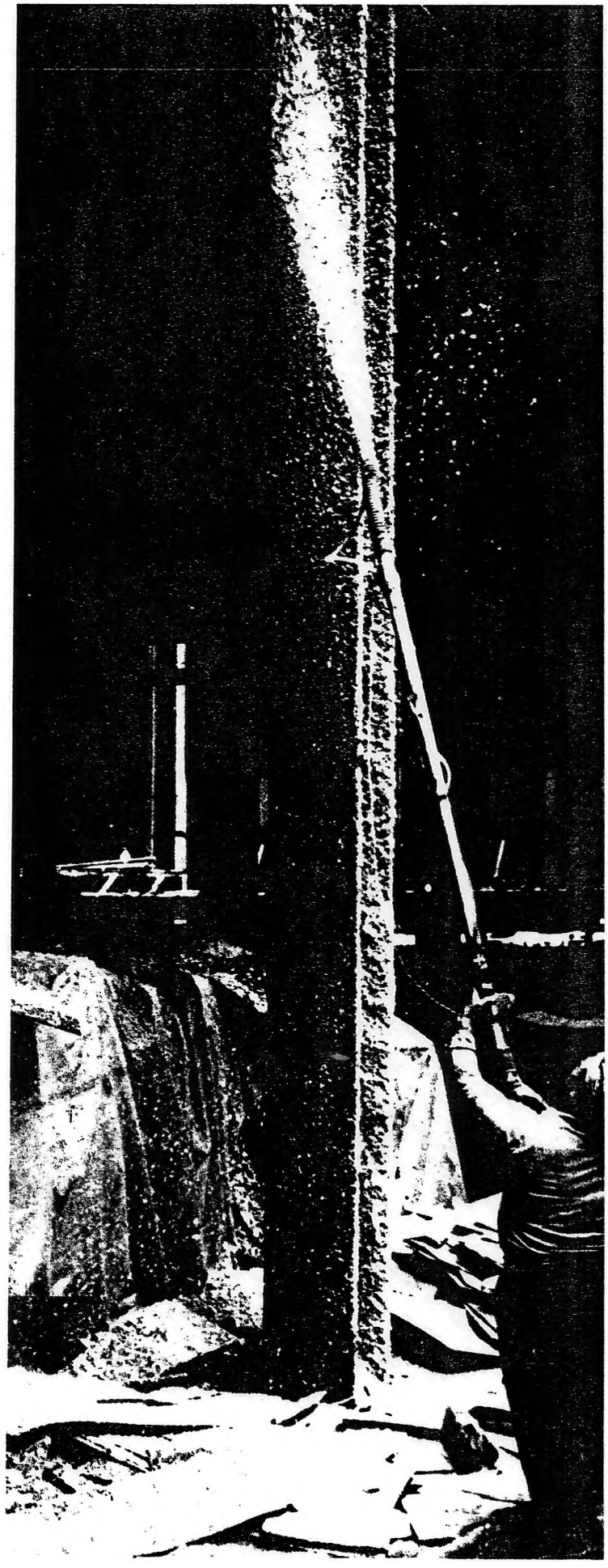
4. Floors must be vacuumed clean shortly after drying and material enclosing the area must also be vacuumed, with window sills cleaned, etc. before dismantling the enclosures.

5. Areas where asbestos supply bags are opened must be enclosed.

6. Signs must be posted outside enclosed areas warning people not to enter without protection.

7. All persons spraying must be furnished with approved respirators and coveralls, which must be left on site.

8. Any plenum or other asbestos-lined structure intended for



air circulation in a building must be cleaned of all debris and waste insulation, then coated with a sealant.

Implementation

Shortly after New York issued an interim version of its asbestos spray regulations, it found contractors still in violation and soon it effectively called a halt to all asbestos spraying in the city. "We cannot continue fireproofing tall steel buildings as in the recent past. If we cannot do it safely, construction might have to halt. But it can be done safely and this is why it is doubly wrong to permit hazardous conditions to continue," says city advisor Dr. Selikoff. He also feels that any regulations affecting the use of asbestos in any form must be industry-wide so that violators will not have a competitive advantage.

The interim regulations were issued April 13. By May 15, the city had followed up with 34 summonses, five to contractors in apparent violation of all the provisions of the regulations, which were then less stringent than the final version.

In addition, the city issued three show-cause orders to seal asbestos spraying equipment on three sites where asbestos emissions in the air were still visible, according to the Department of Air Resources, despite precautions taken. Included was the $600 million World Trade Center, under construction in lower Manhattan by the Port Authority of New York. It and another of the three served voluntarily shut down spray operations by April 23 and agreed to seek substitute materials. The third refused to give written notice of future plans to spray and this led to a hearing on the sealing order.

Today, asbestos, spraying has resumed on 25 city construction sites and, according to the EPA, all are in compliance with the city regulations. The contractors have had to learn to adjust to the extra time and money required. Explains a spokesman for Diesel Construction Co., which is spraying asbestos on two city sites: "In these days of ecology, there's no choice. The Department of Air Resources has the toughest people in the world. You do it their way or stop."

On one site, asbestos spraying has not resumed. The old asbestos spray areas have been covered with unmistakable green plastic sealer and the World Trade Center is using a non-asbestos spray fireproofing manufactured by the U.S. Mineral Products Co., of Stanhope, N.J.

The decision cost the Trade Center about 10 per cent more for the raw material than the asbestos version, with the project requiring a total of about 5,000 tons of the combined materials. (The manufacturer claims this cost differential no longer exists, that the two materials now cost the same since the asbestos price has risen.) The general contractor, for whom a subcontractor performs the spray job, using members of the Plasterers and Cement Masons Union, is Tishman Management Corp. A spokesman declined to comment on either the price or delay of the switch.

The new material is called Cafco Blaze-Shield Type D C/F (the project had been using an asbestos counterpart by the same company called Cafco D). According to the manufacturer, it is the only commercially available direct-to-steel spray fireproofing that is asbestos-free. The contractors are continuing to adhere to city asbestos spray regulations even though they are using the non-asbestos product because its long-term effects are not known.

Ray Monti, construction manager on the project, says the Port Authority decided to "switch and be done with it" when it became clear that asbestos would be a continuing concern. But, he says, the new material has proved a good alternative. "Besides being free of asbestos, the new material has a better K factor (for thermal conductivity), it stays up better and goes on more easily than the original spray with asbestos."

A safety inspector on the job confirms Monti's satisfaction, noting that other trades will now work closer to spraying operations than before, that there seems to be less waste and that the floors seem less slippery.

The lab tests at Mt. Sinai by Dr. William J. Nicholson indicate that Cafco D C/F is primarily mineral wool, or extruded glass, with fibers averaging four to five microns in diameter. Calculations suggested that 75 per cent of the fibers would be classified as nonrespirable. Also, because the fibers are larger and heavier than asbestos, the Mt. Sinai report to the Trade Center says that they are unlikely to remain suspended in the air as long.

Dr. Selikoff cautions, however, that, "We don't know whether or not the new Cafco is really safe. With such materials, many years are usually needed to determine health effects. It is therefore wise to work with it in a safe, approved manner."

More than foresight

The switch to a non-asbestos product is more than a tribute to the Port Authority's environmental foresight. It is also testimony to the autonomy of Port Authority operations in the city as a bi-state empowered agency.

Cafco D C/F does not yet have the full approval of the city's Department of buildings. It has approval only for columns and not yet for decks, pending formula analysis.

In fact, except for the Port Authority, which is exempt from the city code authority, no builder in New York has any choice but to spray with asbestos or close down construction. (Says one private builder: "Not even the city firemen have to answer a call to the Trade Center, but they do or the whole city could burn down.") There is no substitute material yet that has full city approval.

Other materials than Cafco are coming along, however. The city is already testing a product developed by the Spray-On Research Corp., of Ft. Lauderdale, and is awaiting lab test results. About six other manufacturers, including Johns-Manville and the Grace Co., are developing non-asbestos spray fireproofing for structural steel. But none of these is past the development stage.

Cafco's progress was aided by the Port Authority decision to use it, which meant accelerating a lot of the approval and test procedures. But the manufacturer also points out that the product was developed over the past two years and is already being used on "40 or 50" sites outside New York. Cafco D C/F also has been rated by the Underwriters Laboratory and will be listed for eighteen deck and beam applications, five column and wall systems, and three roof constructions. More ratings are expected to follow.

Precedents

Action in the U.S. about asbestos had long precedent in Britain, where, in 1900, a man was diagnosed as having died of asbestos-caused lung scarring at the age of 33. He had been the sole survivor of a crew working in an asbestos factory 14 years earlier.

Not until 1924 was an undisputed death by asbestos recorded in a medical journal. An autopsy had revealed "curious bodies" in the lungs of a woman who had died after 13 years in an asbestos-textile factory. The "bodies" were diagnosed as asbestos.

In 1928, a study revealed that 25 per cent of 263 asbestos workers had pulmonary fibrosis, with incidence in direct proportion to exposure. The average among workers with 20 or more years' exposure was over 80 per cent.

In 1931, Parliament classified Asbestosis a compensatory disease, which made autopsy mandatory and thus aided medical research. (This is an advantage U.S. researchers do not have.)

New regulations and the introduction of antibiotics, which minimized infectious lung disease, apparently improved the situation. But it was then discovered that those who survived Asbestosis were dying of cancer. The first report of an asbestos link to cancer was published in 1935, but there was little stir until 1949, when a study covering 1924 to 1946 revealed that 13 per cent of asbestos-caused deaths were of cancer. (A similar sampling in the general public would have had a 1 per cent incidence.)

By the late 1950s, other disturbing health problems were attributed to asbestos, including mesothelioma, or cancer of the chest membrane or the abdominal lining, usually a rare form.

Despite these and many other studies confirming the dangers of the material, the United Kingdom did not regulate the building trades until last year. Regulation then virtually eliminated use of the spray and builders turned to block insulation. The regulations for spraying include a written application giving 28 days notice and safety procedures similar to the New York guidelines.

The real importance of the spray asbestos problem may be as a test case of how society must learn to live with a potentially serious environmental hazard by learning to control it. The asbestos and other such problems *can be solved with present technology*. But a partnership of science, industry and government is required. Scientists must define the problem, industry and labor develop solutions, and government ensure that regulation is unilateral. —MARGUERITE VILLECCO