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Latest word on asbestos won't be the last

Scientific evidence against asbestos continues to accumulate, and OSHA's much-delayed exposure standard goes on bringing criticism from all concerned parties. Meanwhile, millions of workers remain exposed to asbestos dust in plants throughout the world.

□ Bad news about asbestos continues to make headlines. In September, for instance, Joseph A. Califano, Secretary of Health, Education, and Welfare (HEW), drew attention to an alarming statistic in a new study by the National Cancer Institute (NCI) and the National Institute of Environmental Health Sciences (NIEHS): An astonishing 17% of all cancer deaths in the U.S. over the next few decades will be linked to some previous exposure to asbestos.

Speaking at the AFL-CIO National Conference on Occupational Safety and Health, Califano said that the NCI/NIEHS report definitely rejects the conventional estimate that 1 to 5% of all U.S. cancer incidence is related to occupational exposure to carcinogenic agents. Estimates of 20% to as high as 38% are not unreasonable, he added.

EXPOSURE THAT KILLS—The joint

study estimates that between 8 and 11 million U.S. workers have been exposed to asbestos since the beginning of World War II. Of these, about 4 million have been "heavily exposed,"—i.e., worked directly with the material most of the time—and 4 to 7 million have received "peripheral" exposure—e.g., of the sort that a maintenance worker would get in a plant where asbestos was being installed.

The NCI/NIEHS report assumes that 20 to 25% of those in the first group will die of lung cancer, 7 to 10% of pleural or peritoneal mesothelioma (a particularly lethal cancer), and 8 to 9% of gastrointestinal cancer. Assuming that the risk to the second group is 25% that of the first one, the report concludes that a total of 2.15 million workers will die over the next 30 to 35 years, or about 67,000 per year. This

represents a whopping 17% of all cancers detected annually in the U.S.

The joint study's figures on exposure for workers are taken from HEW estimates (the department believes that 1.5 to 2.5 million U.S. workers are still being exposed to asbestos), while the fatality percentages are borrowed directly from a World Health Organization (WHO) position paper issued in early 1977. This link with the WHO document is confirmed by Joseph Wagoner, special assistant for carcinogenesis with the Occupational Safety and Health Administration (OSHA), who was a member of the group of health experts that authored the WHO study.

Meanwhile, a spokesman for NCI/NIEHS says that the joint report is basically an update of epidemiological data on asbestos, in the light of new information uncovered in the past year.

Whatever its origin, the NCI/NIEHS work is attracting its share of criticism by way of an attack on Califano's recent statement. Some claim that the HEW secretary is unnecessarily alarming the public. Asbestos no longer causes widespread sickness because working conditions have changed, they say.

Dr. Irving J. Selikoff, a well-known authority on asbestos, and director of Mt. Sinai Medical Center's Environmental Health Laboratory (New York City), notes that "Califano's remarks are projections based on limited data, and probably represent an upper limit." But he warns that even if Califano's figures are off by a factor of two, the problem is enormous.

However, a spokesman for the American Cancer Soc. (ACS), New York City, feels that the NCI/NIEHS report does overstate the problem.

INDUSTRY RESPONSE—The Asbestos Information Assn. (AIA), Arlington, Va., an organization of asbestos processors, says that the NCI/NIEHS data are being analyzed by the group's scientific advisors, and that a statement will be issued when the study is complete. Meanwhile, an AIA press release calls the report "simply another extrapolation in statistical terms from the same data which have been available to the international scientific community for some time."

Another AIA press release, issued in response to a Califano statement (made in April) regarding a large



Fiberglass insulation, an alternative to asbestos, is considered safer

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methane. Another popular process, the Winkler route, yields some methane, but no liquids (*Chem. Eng.*, July 22, 1974, pp. 91-92).

Products obtained from synthesis gas, besides ammonia and methanol, include acetic acid, ethylene and ethylene glycol. Monsanto and BASF have both operated commercial acetic-acid ventures feeding on a methanol/carbon monoxide feedstock. Ethylene can be worked up from synthesis gas via a number of schemes, including Fischer-Tropsch synthesis, methanol homologation to ethanol, followed by dehydration, dimethyl ether cracking, and direct synthesis from CO/H₂, and possibly someday via the Mobil route. Chem Systems Inc. (New York City) has identified methanol homologation as the ethylene route with the "best potential," though the method nevertheless rates poorly against conventional steam cracking of naphtha or gas oil.

But that's not all. Old-timers like Du Pont's Carnell (he joined the firm in 1942) remember that before World War II the world chemical industry was largely coal-based. Even Du Pont's first polyethylene was made from ethylene derived from coke-oven gas (though the process would hardly be worthwhile at today's production scale). Du Pont products based on ammonia and methanol at that time are listed in the table.

When coal gasification attracted renewed attention a few years ago, initial thinking centered on the large "first-generation" plant providing pipeline-quality gas for fuel use only. Since "first-generation" meant Lurgi in many cases, some chemical byproducts were also foreseen, though much of these byproducts are considered plant fuel.

A number of such substitute natural gas plants were announced earlier this decade, though only one seems still alive today, and barely alive at that. This is American Natural Resources' North Dakota lignite gasifier, recently reorganized under the name Great Plains Gasification Associates, a consortium including American Natural and four other utilities. However, last month the Federal Energy Regulatory Commission declined to certify construction of a 137.5-million-Btu/d unit, arguing that no five firms alone should bear the heavy financial risk involved.

CHEMICAL RECOVERY—Chem Systems has performed an economic analysis of chemical byproduct output from Lurgi-type SNG plants, while recognizing the uncertain outlook for this manner of coal utilization. The firm found that the recovery of benzene, toluene and xylenes from the crude gas-naphtha stream of Montana sub-bituminous and Illinois bituminous appears economic. Sulfur and ammonia, while not profitable, would usually be recovered also, in order to meet environmental constraints. Recovery of anything else appears marginal for chemicals, more likely for fuel. Whatever the degree of chemicals recovery, substances obtained this way would barely dent U.S. supply needs—filling no more than 7% of demand in the year 2000, assuming 25 coal-based SNG plants, 75% of which would employ the Lurgi process.

For chemicals obtained not as direct byproducts but by processing synthesis gas, Chem Systems believes that ammonia and methanol produced via "second-generation" gasifiers, such as the Texaco and slagging Lurgi versions now being investigated with DOE support, could compete with steam-methane reforming in the 1980s. However, the success of this competition depends on a trade-off between coal's lower raw material cost, and a coal-based plant's higher capital risk. Synthesis-gas-based ethylene glycol, for example, is not now competitive with either conventional ethylene-oxide-derived glycol, or that obtained from the newer acetoxylation route, though the picture might change if ethylene prices take off, Chem Systems indicates. And ethylene synthesis itself, as already noted, cannot yet compete with steam cracking of naphtha or gas oil.

In the area of coal liquefaction, Chem Systems points out that even if 25 plants rated at 100,000 bbl/d capacity were to come onstream by the year 2000, the contribution to U.S. feedstocks supply would be small. Benzene production could meet only 9% of projected demand. The C₂/C₄ feedstocks obtainable for ethylene production could meet only 15% of estimated demand for the olefin.

FINANCING—Joseph P. Leonard, of Chem Systems, points out that financing methods are one of the greatest determinants of economic viability of coal conversion projects. What's gen-

erally needed, he says, is a highly leveraged utility-style financial package, comprised of about 75% or more debt. Such financing not only lowers costs, but also spreads the risks. Considering the high price tag on coal gasification projects—an estimated \$2 billion for Exxon's East Texas complex, for example—risk reduction is especially important.

H. James Michaels and Howard F. Leonard, of Koppers Co.'s Engineering & Construction Div. (which builds K-T units)—in a paper presented at last June's 85th national meeting of AIChE, in Philadelphia—call the financing method the "largest single factor," at least when it comes to determining the cost of hydrogen made by coal gasification.

C. Edward Lorenz, director of the feedstocks division of Du Pont's Central Research & Development Dept., observes that in order to put together projects of this sort, clear policy decisions are also needed from the federal government. Whether Du Pont would want to get involved in a utility-style project, presumably tied in with an assortment of credit guarantees and regulatory restrictions, poses a "legal muddle" that cannot be answered today, Lorenz states.

Whatever the financial arrangement, the concept of a centralized medium-Btu-gas facility, as embodied in Exxon's East Texas project, fits the organizational pattern of a utility.

At the Fifth Annual International Conference on Coal Gasification, Liquefaction and Conversion to Electricity, held at the University of Pittsburgh, Aug. 1-3, Carter Oil's John P. Racz described the thinking that went into the plan, starting in 1974.

The company placed its highest priority on an assured outlet for products. Some of the other chief criteria: a low-cost, reliable and suitable source of coal, proven technology, favorable public attitudes at chosen sites for such facilities, and fairly close proximity of mine and gasification plant to markets. Carter Oil has made lignite discoveries in Texas that meet these criteria.

Realizing that industrial natural gas users would be the first affected by shortages, and that a good many of these users are concentrated in the Gulf Coast area, Exxon's thinking gravitated naturally to the medium-Btu utility-style project.

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U.S. firms still use it, despite its checkered career

The term "asbestos" comprises a group of impure magnesium silicate minerals—e.g., chrysotile, amosite—that occur in fibrous form. Reports of the toxic properties of asbestos date back to the 1920s in the U.S. However, it wasn't until the war broke out, when millions of workers were employed in shipyards insulating warships, that mass exposure to asbestos dust occurred in this country.

The material enjoyed wide popularity as an insulator in plants and buildings until 1970, when, in response to mounting evidence of its toxic properties, manufacturers stopped producing insulation made of loosely bound asbestos fiber.

The Asbestos Information Assn. says that the 3,000 asbestos products made today in the U.S. contain chemically and physically bound fibers that do not flake off. Current end-use breakdown: asbestos cement products (pipe, sheets), 22.4%; roofing products, 34.9%; asbestos paper, 4.3%; flooring products, 15.6%; packing and gaskets, 2.8%; thermal and electrical insulation, 1.2%; friction products (brake linings), 8.8%; coatings and compounds, 2.7%; plastics, 3.0%; textiles, 1.0%; and miscellaneous, 3.3%.

outbreak of asbestos-related diseases among World War II shipyard workers, explains that such a heavy exposure to asbestos existed before medical information revealed the dangers involved. Since then, millions of dollars have been spent in dust-control equipment by miners, millers, processors and manufacturers of asbestos.

In addition, note other asbestos-industry spokesmen, the type of products made in the past—e.g., asbestos thermal insulation—are no longer produced. They were phased out in the early 1970s, when the inherent hazards became apparent (see box).

Nevertheless, asbestos is still used as an insulator or fire retardant in more than 3,000 products ranging from water pipes to brake linings. And an estimated 500 million tons of the material are still around in plants and buildings throughout the U.S., according to Roy Steinfurth, administrator of the insulation health-hazards programs for the International Assn. of Heat and Frost Insulators and Asbestos Workers (Washington). Workers still exposed to asbestos are not adequately protected, charges Selikoff.

CIGARETTE LINK—Industry spokesmen also point out that exposure to asbestos alone may not be enough to cause lung cancer—the disease most commonly associated with the breathing of asbestos fibers—and that the connection between exposure and cigarette smoking has not been stressed enough. Says John A. McKinney, president of Johns-Manville Corp. (a

leading maker of asbestos products): "Clinical evidence shows that lung cancer in asbestos workers is virtually limited to those who smoke cigarettes, and that for practical purposes, lung cancer as an asbestos-related disease would not be a problem were it not for cigarette smokers."

AIA is currently on a vigorous campaign to persuade industry workers to stop smoking.

"There is no doubt that exposure and cigarette smoking have a synergistic effect," says an ACS spokesman, "but since so many workers included in past studies were smokers or ex-smokers, it's difficult to assess the risk to non-smokers."

The synergism is acknowledged in the WHO document. "Both cigarette smoking and exposure to asbestos independently cause lung cancer. However, when present together, they act in a multiplicative fashion." The NCI/NIEHS study agrees, and admits that it would be an error to attempt to blame each type of cancer mentioned in the report on an exclusive cause.

A NEW STANDARD?—The current flareup of the asbestos controversy is of more than marginal interest to OSHA, which has been trying to modify present rules governing exposure to the material (the agency is studying the NCI/NIEHS report).

For more than three years, OSHA has been pushing a proposal to reduce the permissible level of airborne fibers in the workplace from a present value of 2 fibers/cm³ to 0.5 fiber/cm³ on an

8-h, time-weighted basis, with a 15-min ceiling of 5 fibers/cm³. All limits apply only to fibers longer than 5 μ m. (NIOSH, which serves in an advisory capacity, has recommended a limit of 0.1 fiber/cm³.)

OSHA is currently evaluating the economic impact of the proposed standard, which is bound to affect both processing and use of the material.

Predictably, industry response to the idea has not been favorable. AIA calls the 0.5-fiber/cm³ limit "not technically feasible," and recommends instead the adoption of 2 fibers/cm³ as a permanent standard—one that can be realized at a reasonable cost for dust control.

On the other side of the spectrum, Roy Steinfurth, the asbestos workers' spokesman, feels that the only acceptable level is no asbestos exposure at all. The union official says that, even if the exposure level is reduced to 0.5 fiber/cm³, a worker would breathe in 4 million fibers in an 8-h workday. He estimates that as many as 50% of the members of his organization will eventually die of asbestos-related diseases.

In Europe, there is also a move to cut down on the exposure level, which has been 2 fibers/cm³ in the past few years. Italy, which lacks asbestos deposits, is attempting to phase out the material completely. Sweden moved to a 1-fiber/cm³ standard a year ago, and U.K. authorities are clamoring for a reduction of the present limit.

Critics who complain that the OSHA proposal does not go far enough in protecting workers also question why the standard should apply only to fibers longer than 5 μ m. Both Selikoff and Wagoner, for example, believe that the smaller fibers are even more active in producing lung tumors. And, according to Selikoff, "For each fiber longer than 5 μ m, there may be as many as 100 shorter ones."

OSHA's Health Standards Project Officer William Warren says that the 5- μ m length was the most practical alternative because detection equipment does not pick up anything smaller. Warren notes that available monitoring units detect only "from a few percent to 50%" of the actual number of fibers in a sample.

INSULATION DANGER—Spot checks with a number of U.S. insulation manufacturers turned up no one still making the asbestos-containing version. However, there are still tons of it

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installed in chemical plants all over the world. Since the asbestos is loosely bound, the cutting, handling and tearing down of such insulation poses a health hazard.

"If the insulation is intact, there's no problem," says an engineer with Britain's ICI, Ltd., "Whenever maintenance requires stripping down and removal, we replace with a substitute material." He adds that the firm does not specify asbestos for any new plants.

"We stopped using asbestos for insulation about seven or eight years ago," claims the safety manager of a U.S. refinery. "Although it is cheaper and easier to apply, the health risks persuaded us to switch to fiberglass and calcium carbide." He further notes that although some asbestos is still used, it is of the bonded type, which does not present a potential dust hazard.

The indirect risks of asbestos insulation were highlighted in a recent study of maintenance workers at American Cyanamid's facility in Bound Brook, N.J. The survey, commissioned by the

International Chemical Workers Union (ICWU), Washington, and carried out by the Mt. Sinai Medical Center, identifies the risks faced by maintenance workers (other than insulation installers) when working in the vicinity of an insulation job.

According to Larry Ahern, director of health and safety for ICWU, the results show that 44% of all workers, regardless of job function, had some form of asbestos-related lung abnormality. One group of workers exposed for less than one month experienced a significant increase in the incidence of lung disease.

Worse, the researchers discovered that many of the workers' relatives, who had not been in direct contact with the material, were affected. "About 123 wives were sick," says Steinfurth.

HOW ABOUT SUBSTITUTES?—Such popular asbestos replacements as fiberglass, mineral wool and calcium silicate may have health hazards of their own, but these have yet to be identified.

In a criteria document issued in

April 1977, NIOSH said: "Fibrous glass seems to be considerably less hazardous than asbestos . . . and, until more information is available, the recommended standard can also be applied to other manmade mineral fibers." The NIOSH paper suggests a standard of 3 fibers/cm³ for fibers of less than 3.5- μ m dia. Larger fibers are not thought to be respirable.

Ralph Zumwalde, an industrial hygienist at NIOSH, points out that most of the exposure to fiberglass involves fibers with diameters greater than 3.5 μ m, even though some special products contain thinner ones.

"Fiberglass is an irritant, and can cause skin irritation or upper respiratory irritation," says Dr. Donald J. Billmaier, assistant medical director of Owens-Corning Fiberglass Corp. (Toledo, Ohio), "but our studies show that there are no chronic adverse health effects from using the material."

Calcium silicate is classified as a nuisance dust, not a fiber. The OSHA standard is 15 particles/cm³ for the respirable fraction.

Vincent Cavaseno

Gulf Coast buildup may ease olefin glut

□ A more hopeful outlook for ethylene derivatives is triggering major expansions in the Gulf Coast area, and these may help alleviate, at least locally, the ethylene surplus that is predicted through the early 1980s (*Chem. Eng.*, Mar. 27, p. 80).

Consider, for example, the current buildup at the Raporte, Tex., complex of the USI Div. of National Distillers and Chemical Corp. The company, which last year increased its high-density polyethylene (HDPE) capacity to 500 million lb/yr, boosted its low-density polyethylene (LDPE) capacity by 200 million lb/yr this spring. Another ethylene-consuming addition is under way—USI will complete early next year a vinyl acetate monomer expansion. This will raise monomer capacity from 375 million lb/yr to 600 million lb/yr. The three expan-

sions will consume a total of just under 500 million lb/yr of ethylene.

Shell has marked the tenth anniversary of its complex at Geismar, La., by inaugurating ethylene oxide and ethylene glycol trains, now about 60% completed. About a year ago, the company began work to increase oxide production from 300 to 700 million lb/yr, and glycol output from 150 to 350 million lb/yr. "This expansion will be ready for startup in early 1979," says plant manager Fred Foster. The ethylene oxide boost will require 340 million lb/yr of ethylene raw material.

Shell will also add flexibility to the Gulf Coast ethylene distribution system with a new 254-mi ethylene pipeline that will run from Mont Belvieu (just east of Houston) to Napoleonville, La., near Shell's petrochemical

plant at Norco. The company is building a 1.5-billion-lb/yr ethylene plant there, which is expected to go onstream in 1981. Says A. R. Flora, Shell's olefins business manager, "The pipeline will help to eliminate spot shortages in Texas and Louisiana complexes, which are the heart of the petrochemical industry."

USI executives now speak more optimistically about the future of downstream products, and predict a better supply/demand balance. According to George Kappas, vice-president of National Petrochemicals Corp. (jointly owned by National Distillers and Owens-Illinois), HDPE is currently moving away from oversupply.

"At present," says Kappas, "there is a slight surplus of HDPE. However, producers are not building up year-end inventories, and demand is growing steadily. Consequently, in 1980 and 1981, supply and demand will be somewhat tighter than they are today." Kappas notes that domestic need for the resin has grown at an average annual rate of more than 11% since 1971. LDPE will be in balance by 1980, according to USI estimates.