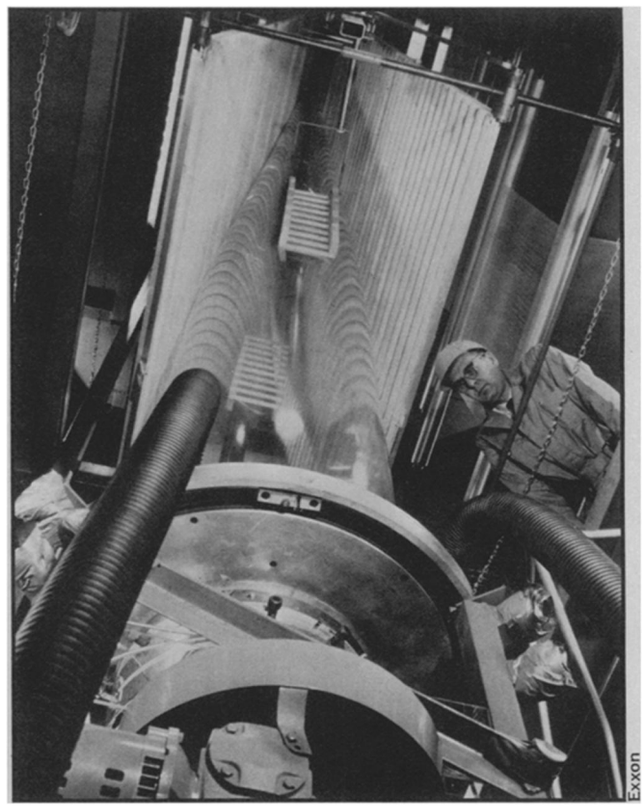
TOXIC SURPRISES FROM THE PLASTICS INDUSTRY

Dozens of plastics ingredients are now suspected of serious health effects



Plastics manufacture: Dangerous to workers' health?

by Janet H. Weinberg

First take a billion small units and zip them up into long chain molecules. For strength, add fillers like calcium carbonate, clay, asbestos, fiber glass or wood flour, and couple the mixtures with organic siloxanes. For flexibility add dialkyl phthalates and maybe some epoxidized soy oil and oleic esters. For color, titanium dioxide or iron oxide or cadmium or chromium or an organic dye. And don't forget stabilizers, antioxidants, ultraviolet absorbers, preservatives, lubricants, flame retardants and antistatic agents.

Once made, you can do any number of things with this synthetic soup. You can sleep on it, eat with it or take it to the beach. You can comb your hair with it, brush your teeth with it or sit on it. You can keep your beer in it or build your house with it or build an artificial heart with it. The world not only has a voracious appetite for plastics, but also has grown to rely on them for a virtually endless list of uses, from recreation to saving lives.

In the United States alone, more than 29 billion pounds of plastics are produced each year. An estimated 2.5 million workers are engaged in mass producing them. Chemists in hundreds of industrial laboratories experiment with chemicals, combining and recombining them into plastics with a variety of different properties. The chemicals mentioned—polymerizers, stabilizers, cross-linking agents, antioxidants, etc.—each impart a desired property to the end product, be it strength, brittleness, flexibility, color or resistance to degradation.

There is one big yellow streak across this rosy picture, though, and it was pointed out with drama and tragedy. Many of these chemicals used to make plastics are so toxic that they affect workers' health. Earlier this year, 15 vinyl chloride workers died from a rare, chemically induced liver cancer.

It now appears that not just vinyl chloride, but a host of plastics components are toxic, even in tiny concentrations. And the workers are alarmed. The chemical industry, scientists and the Government are working toward a solution but the problem is too complicated and far-reaching for quick answers.

Scientific evidence has poured in since the vinyl chloride deaths. The National Institute of Environmental Health Sciences (NIEHS), the Occupational Safety and Health Administration (OSHA), the National Cancer Institute (NCI) and other agencies are sponsoring toxicology research on the components of plastics manufacture. Studies were done prior to this year, of course, but the field has gained momentum since the vinyl chloride incident caught scientists with sufficient understanding of only the barest details of the problem.

The emphasis of current research is to anticipate future lethal surprises by investigating the biologic effects of some of the more reactive and suspect chemicals. Most plastics components have known toxic effects in animals from original industry testing, but the toxic levels in humans, and the disease pathologies and mechanisms are known for only a few.

Much of the data is on vinyl chloride (SN: 8/3/74, p. 71). It now appears that exposure to small, but still undefined quantities of vinyl chloride can cause fibrotic lesions on the liver after only a year or so of exposure. An enzyme in the body attacks unpolymerized vinyl chloride and breaks down the molecules into monochloroethylene oxide. This is probably the carcinogenic species that acts upon the membranes of the liver cells, eventually leading to lesion formation.

Many other plastics components show evidence of harmful toxicity. Hans Weill, from the Tulane University School of Medicine, has studied health effects on workers who produce toluene diisocyanate (TDI). This compound is used in the production of polyurethane foams and as an addition to nylon 6. TDI is derived from phosgene (lethal war gas), and stringent precautions must be (and are) taken to prevent workers' exposure. By studying a newly built TDI plant, Weill found that even a single exposure to TDI could cause acute respiratory symptoms. Two or three of the plant's workers became clinically sensitized to TDI and showed severe reactions to tiny exposures.

Rudy Jaeger and co-workers at the Harvard School of Public Health studied the specific modes of action of several toxic substances. One, 2-Chloro-1,3-butadiene, used to make neoprene (synthetic rubber), causes liver damage and hair loss. They found that this chemical, along with vinyl chloride monomer and other chemicals, has a more damaging effect on fasted test animals than fed. This is probably associated with the depletion of a membrane-protective substance, Jaeger says.

Sandor Szabo from the Harvard Medical School has shown that acrylonitrile, used in the production of acrylon, produces bleeding and tissue damage to the adrenal cortex in rats. A related compound, propionitrile, produces duodenal ulcer. By studying a group of such related compounds, he has been able to determine that the ulcerogenic activity of a toxic substance is "mostly but not exclusively" related to a two-carbon group bearing a reactive radical such as cyanide, nitrile, or sulfhydril. This information should help industry predict and regulate potentially dangerous substances.

Data on the lung carcinogenesis of chloromethyl-methyl ether (CMME) has been obtained by Roy Ernest Albert and co-workers at the New York University Medical Center and Benjamin G. Ferris at the Harvard School of Public Health. CMME is used as a cross-linking agent for polymer resins, and is laced with bis-chloromethyl ether, a proven lung carcinogen in animals. Studying the records of 1,800 CMME workers from six of the seven U.S. plants that produce it, they found that as a whole, the death rate from respiratory cancer in the group exposed to CMME was double that in a similar group of unexposed workers.

Evidence on the toxicity of plastics components could go on and on. As toxicologists study the effects of these chemicals on test animals and on workers more and better data will emerge. But at this point, a very proper moral question can be posed. Although exposure standards are set for many of these toxic substances, why have workers been exposed to chemicals whose toxic and carcinogenic effects are not completely known?

AFL-CIO health director Sheldon Samuels is an outspoken critic of the chemical industry on this point. "The men and women we represent," he says, reject the "barbaric attitude that death and disease are part of the sacrifice that must be made for food, clothing and shelter." Industry and Government have been lax in researching, setting and maintaining safe standards of exposure, he says.

Government agencies have been given a raft of laws and acts with which to regulate the exposures of workers, the public and the physical environment to toxic substances. But herein lies part of the problem—some feel that there are too many agencies, too many laws and too many loopholes.

Farley Fisher, a chief in the Environmental Protection Agency's office of Toxic Substances, says the current regulation of the plastics industry is fractionated and therefore in some respects, ineffective. The Occupational Safety and Health Act, administered by OSHA, is responsible for setting exposure standards and maintaining them through the surveillance of inspectors. (Samuels charges there are too few inspectors with too many duties, and that their surveillance is ineffective. Corruption was also charged after the revelation of the now famous Guenther Memo, SN: 7/13/74, p. 23.)

The Food and Drug Administration regulates the plastics that go into food and drug packaging. The Consumer Product Safety Commission regulates toys and housewares made of plastics, but neither of these agencies enforce before-the-fact testing on new or proposed plastics, Fisher says. The EPA administers the Clean Air Act and the Water Pollution Act which, respectively, regulate harmful atmospheric emissions and water emissions that kill fish, or injure the environment.

But, Fisher says, there is no one law or governmental unit authorized to act as a prescreening agency to monitor those chemicals proposed for large-scale production, and to require standardized testing on the human and environmental health effects of the new substances. The EPA feels this function is critically needed and has given its support to the Senate version of the Toxic Substances Control Act of 1973. It would, not surprisingly, give the administrative responsibility to that agency's office of toxic substances.

The act, called TOSCA, was passed on Capitol Hill after four years of effort by many groups. The Senate and House versions are similar in several respects. Both assigned to EPA the administrative responsibility. Both established test protocols to be followed by industry for the assessment of new (and some hazardous existing) substances. Both provide for premarket screening of chemicals and for annual reports by industry on all the chemicals it uses, develops, researches or imports. Both would establish an appointed Chemical Substances Board to review EPA decisions, and provisions are included in both bills for research, inspections, prohibitions and penalties, and for the establishment of relationships between this law and the plethora of others.

A member of the Senate Commerce Committee staff, Len Bickwit, says that although both bills were passed last year and a conference committee was convened to hammer out an acceptable compromise, no action has taken place in conference in about nine months. "There are two major stumbling blocks to a resolution of the differences," he says. "The Senate bill is more comprehensive and tougher. The first difference is the extent of premarket screening required. Both envision a list of dangerous chemicals and a requirement of testing all the chemicals on this list. But the Senate calls for premarket notification by the industry to the EPA of all chemicals developed, their structures and proposed uses. Then the agency would decide for each one if restrictions should be made or testing required."

Under the House bill the EPA would have to compile a list of substances *likely* to pose substantial danger to health or environment, then companies would have to submit premarket information only on listed chemicals.

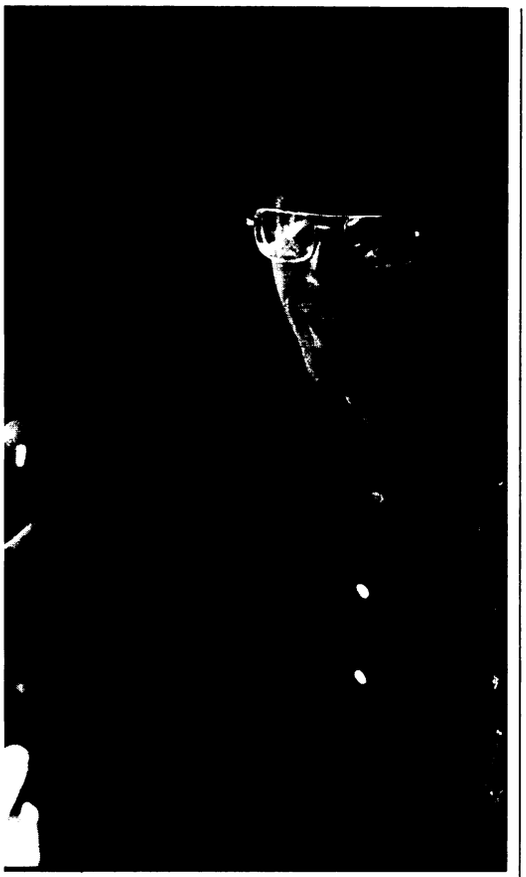
Another major difference is that the Senate bill says when two or more laws exist for regulating a certain chemical, the EPA will use the toughest or most effective one available. The House bill says use the other law (not TOSCA), no matter how ineffective.

Both sides discontinued conference meetings when a compromise could not be easily reached, and have met only once since to consider a compromise bill worked out by the staffs of both committees involved. EPA officials and others are urging the conference to reconvene before the end of the Congressional session in December.

There is much disagreement outside of Congress on the provisions of the bill. "The whole chemical industry is against the Senate bill," Bickwit says, and it has been lobbying for the House bill. A spokesman for the Manufacturing Chemists Association in Washington enunciated their position. "The manufacturers are competent to make our own determinations of whether our test results meet OSHA and EPA standards. We feel this bill would represent an unacceptable burden on the EPA and it would bring about delays in the development of new chemicals." Large companies, he said, generally favor the House bill, but smaller companies "take a dim view of any legislation in this area."

Elmer Fike, owner of the Fike Chemical Co. of Nitro, W. Va., exemplifies that view: "I think this bill is horrible and I don't see how a small company can survive with this burden of additional testing. The bill says, in effect, you can't make a chemical until you test it. Our company makes one of the most toxic chemicals in this country, ethylfluoroacetate. If this law were in effect 10 years ago, we couldn't have developed it. Because we did and it was

Continued on page 157



Njus: Looking for mutant rhythms.

ficial membrane, ion movement through the membrane changed.

If the cell membrane is indeed the site of the biological clock, which components of the membrane might serve as mediators of ions passing through? The Harvard biologists propose that ion fluxes, both passive and active, would probably be mediated by proteins in the membrane. But the properties of the proteins in turn probably depend on the fluidity of lipids in the membrane. Since circadium rhythms are temperature-compensated—the rhythms change little with any change in temperature—and since lipids in membranes are known to adapt to temperature, membrane lipids could well be the ultimate key to the biological clock.

The Harvard biological team is now trying to test their model experimentally. They agree that it's a tough challenge. Cell structures and functions can often be studied or measured by grinding cells up. But biological rhythms are neither structures nor functions, but a phenomenon. "As soon as we grind up the cell, the rhythms are gone," Njus laments. So they are taking another tack: isolating dinoflagellates whose biological rhythms deviate from the norm, then looking to see whether the mutants have mutated proteins in their membranes. "If isolated mutants have similar changes in their membrane structures," says Njus, "then it might be a key to the clock." □

. . . Plastics

available to researchers, they were able to use it as an intermediate in an important cancer drug.

"I think the guys down in Washington just get law happy. We in the chemical business, especially the small company, think this thing can be taken care of by voluntary means."

Small chemical companies generally don't have testing facilities and budgets comparable to larger companies, but some critics feel the dangers warrant increased spending and vigilance. A Providence, Md., physician, Pietro U. Capurro, recently made public his research (and growing alarm) about the high death rate in that town from similar cancers since a small chemical company opened there in 1961. Residents (presumably affected by air pollution) as well as plant workers have died in larger than expected numbers.

While disagreement and inactivity continue on amending Government regulation, there is a consensus on the need for more research on new and existing components of plastic manufacture. Several Government and university scientists made eloquent statements at a recent NIEHS meeting in North Carolina on the need for more research funds and more toxicologists. NIEHS Director David P. Raul says flatly, "The Government has just not allocated enough of its scarce resources to environmental research." OSHA health division administrator John P. O'Neill says his agency is now considering additional standards for several plastics components based on toxicology research, but "priorities have to be set for developing these standards because of limited administrative and research funds. The program will be greatly assisted as more data are available. When the standards were first written for the implementation of OSHA, it became evident that there were very little data available on the impact of chemicals on workers. Actually, much of the data we would need to establish effective standards lie in industry. They have experience with different control methods and workable standards, and these data are necessary if we are to avoid setting ivory tower standards.

"At this point," says O'Neill, "I think it would behoove the chemical industry to establish some strict exposure standards for themselves. Just because a chemical is not known to be toxic or deleterious at the time, there is no reason industry should permit unlimited exposure to the workers as is now done in some cases. They should take information from the list of hazardous chemicals already established by NIOSH, examine these chemicals in their own plants and control them now, and not wait for laws to be passed or for workers' health to be impaired." □