

The struggle to meet PVC safety standards

Many producers claim that they cannot comply with OSHA's 1-ppm requirement

The vinyl plastics industry is not ready to show the white flag in its fight to get stringent worker-exposure standards reduced. But the Supreme Court's refusal this week to extend the Apr. 1 compliance deadline does not augur well for the Society of the Plastics In-

dustry's battle to overturn the regulations. So companies that work with the material are struggling to meet the standards in case SPI loses.

The 22 polyvinyl chloride manufacturers are facing the biggest challenge. They polymerize vinyl chloride, believed to cause cancer in humans, into PVC resin, which is then fabricated into a wide variety of industrial and consumer goods. Workers in PVC plants are exposed to high levels of vinyl chloride gas whenever the tank-like reac-

tors in which the polymerization takes place are opened for cleaning. What is more, a PVC plant is a veritable spaghetti bowl of pipes and pumps, and vinyl chloride "excursions" can occur at any one of the hundreds of flanges and valves. Many PVC producers say they cannot possibly comply with the Occupational Safety & Health Administration ruling that by April, 1976, workers may be exposed to an average of no more than one part per million of the gas during an eight-hour shift, and to no more than 15-minute peaks of 5 ppm. To meet these standards, workers may have to wear respirators, a fact that does not sit well with them. As Edwin W. Harrington, director of plastics manufacturing at B. F. Goodrich Co., flatly states, "2 ppm or 3 ppm is the lowest we could ever hope to get."

Goodrich effort. Goodrich, the nation's largest PVC manufacturer, is already spending some \$42-million on improved cleaning methods and the like. It has managed to lower exposure level at its five PVC plants from 50 ppm to an average of 6 ppm, but the mandated 1-ppm level remains out of reach. Other companies—particularly those with old reactors like Goodrich's that must be manually cleaned every other day, and indoor plants where ventilation is poor—have had similar failures. "The flanges are under 35 lb. of pressure per sq. in., and VC molecules still get through," says one plant manager who says he has spent \$25,000 on the development of better gaskets and seals. Such frustrations are not unique. Despite the recession-caused slump in demand, VC and PVC producers are already spending \$200-million to comply with the OSHA standards, estimates John R. Lawrence, SPI's technical director. Success remains elusive for most.

Because the leaks are so difficult to eliminate, several companies are turning to better cleaning methods to reduce worker exposure. Japan, with only a 25-ppm voluntary standard for the vinyl industry, is ahead of the U. S. in this area. According to the Japanese PVC Assn., all Japanese plants use mechanized high-pressure water jets to clean facilities in order to minimize workers' contact with gases.

U. S. producers are starting to follow suit. Most have installed powerful vacuum hoses to purge reactors of VC fumes before they are opened for cleaning. And many are using high-pressure spray cleaning devices to reduce the frequency of manual scraping and cleaning operations. After each



Point of danger: Workers are most exposed to vinyl chloride when they clean reactors.

The larg reactor is one answer

"Large reactor technology" may prove the most feasible way out of the vinyl chloride emission morass. One large reactor for polymerizing VC resin into PVC requires hundreds fewer flanges and valves than do a dozen small ones. This drastically slashes the number of potential VC leak points.

The concept is already working for Japan's Shinetsu Chemical Industry Co., which built Japan's only 35,000-gal. PVC reactor in 1970. And it is now working for Shintech, Inc., a joint venture of Shinetsu and Robintech, Inc., of Fort Worth, Tex. Shintech's Freeport (Tex.) PVC plant is using four 35,000-gal. reactors to produce the same amount of PVC that would be made in some 30 smaller reactors in traditional plants. The giant reactors require manual cleaning no more than once a year. Shintech's experiences since the plant came on stream in October have been more than encouraging. "All our tests indicate we're well below the 1-ppm level without the use of respirators," claims James M. Danial, Shintech vice-president.

Treatment. The key to Shintech's sharply reduced cleaning schedule is a

proprietary treatment applied to reactor walls after each batch of PVC is made. The coating is sprayed on under high pressure after the reactor is purged with a hydraulic spray and a vacuum.

"The whole plant is tighter than older PVC plants," claims Joseph L. Brawner, Shintech's plant manager. "We've used welded construction on lines holding vinyl chloride wherever we could, eliminating flanges." The plant is entirely computer-controlled and operates with only 25% of the 163-man work force required at Robin-tech's older Painesville (Ohio) plant, which has about the same capacity.

Tenneco Chemicals, Inc., has licensed the technology for its new PVC plant in Pasadena, Tex. The plant has five 35,000-gal. reactors and a capacity of 250-million lb. According to Joseph P. Fath, a Tenneco Chemicals vice-president, the plant incorporates some reactor cleaning technology that Tenneco developed on its own which will "obviate reactor opening and entry in the long run." But, Fath admits, there may still be maintenance situations where respirators are needed.

batch of PVC is made, the tanks are hosed down to flush out unreacted vinyl chloride monomers and accumulated PVC resin. "We are down to manual cleaning after only 2% of batches," says Goodrich's Harrington. "With hydraulic spraying, we are at 5 ppm for only five minutes instead of 30 minutes when we clean a reactor," adds Eli Zinn, plant manager at Diamond Shamrock Chemical Corp.'s Deer Park (Tex.) plant.

Both Goodrich and Diamond Shamrock use water hydraulic sprays. Other PVC manufacturers, such as Union Carbide Corp. and Monsanto Co., are trying closed-reactor solvent cleaning systems, and Carbide officials claim that reactors at their Texas City plant now need manual cleaning only once every two months.

Another problem. Even with perfected cleaning methods, however, the vinyl plastics industry will still have another hurdle to overcome: recovering unreacted VC monomer that may be trapped in finished PVC resin. If the monomer is not removed before shipping, it can escape when the resin is heated for fabrication. This then threatens fabrication workers with exposure to unacceptable VC levels.

Recovered VC can be recycled back into the PVC process, so PVC manufacturers are especially interested in developing technology for stripping unreacted monomers from the resins. But

so far, they are facing a Catch-22 type of problem. While the goal is to let fabricators heat the resin without releasing vestiges of VC, current stripping methods also require heating. The result can be overheating, which causes hydrochloric acid molecules to break away from the resin. The resin then turns brown and weakens. "Once this degrading starts at the PVC manufacturing level, it continues throughout fabrication, so the goal is to get the vinyl monomer out faster without excess heat," explains Goodrich's Harrington. One new process that looks promising involves use of a vacuum in the reactor to strip much of the unreacted monomer before the resin is dried. A number of PVC manufacturers have programs under way to develop recovery methods. Goodrich, for one, hopes to market a system by yearend.

But OSHA is leaving nothing to chance so far as claims for any system go. Its vinyl industry standard not only specifies exposure limits but mandates that all vinyl producers keep records of worker exposure and monitor vinyl chloride levels wherever they are expected to exceed 0.5 ppm.

The fabrication plants may escape the monitoring problems, because most can establish that they have exposure levels below 0.5 ppm. "In most fabricating plants, there are already ducts and vents above the blenders to meet earlier dust and fume regulations," notes

SPI's Lawrence. Fabricators may face exposure levels above 1 ppm in PVC resin storage areas, but "the over-all concern for reducing exposure is with the PVC producers," Lawrence says.

The monitoring requirements are a problem for PVC makers. The equipment is not cheap—Diamond Shamrock, for one, has already spent \$350,000 to monitor its Deer Park plant. And much of the monitoring technology is still embryonic. Only recently have vapor detectors and analyzers been able to work with levels as low as 0.5 ppm.

Bendix system. Most PVC producers are pursuing combination systems that include continuous area monitoring, portable monitoring, and personal monitors. Bendix Corp. pioneered most of the vinyl chloride monitoring equipment when the original PVC cancer scare broke a little more than a year ago, and the company's monitoring systems are still among the most widely used. At Goodrich's plants, the Bendix system includes funnel-like air samplers scattered throughout the work area. The samplers suck up air and feed it back into a gas chromatograph in a continuous stream. The chromatograph can detect VC monomer concentrations down to 1 ppm. In most plants, the chromatograph is hooked into an alarm system that is quickly

triggered when concentrations go above 25 ppm.

If area sampling indicates an upsurge in VC monomer, portable organic vapor analyzers are dispatched to the spot to pinpoint the valve causing the VC leak. These monitors are rarely accurate below a 5-ppm concentration, but that is good enough for the purpose. "They don't actually distinguish

The vinyl plastics industry says \$200-million still hasn't produced success

vinyl chloride, but tell us if there is alien vapor in the air so we know which trouble spots to check further," says a Goodrich spokesman.

Personal monitoring comes closest to detecting actual worker exposure. This is the method used by OSHA inspectors themselves. Workers wear a battery-powered device about the size of a transistor radio. It houses a charcoal tube, which absorbs VC vapors. The tube is inserted in a gas chromatograph, which can determine the amount of VC the worker was exposed to. Such personal monitoring may prove the crucial area for OSHA compliance. Says Robert N. Rylands, manager of Goodrich's Avon Lake (Ohio) plant, "As far as the OSHA standard is

concerned, the real story is told with the personal monitoring."

Even if the vinyl companies manage to meet OSHA's exposure and monitoring rules, they may face additional problems from the Environmental Protection Agency. The EPA is in the preliminary stages of developing an emission standard for vinyl chloride. Unlike the OSHA standard, the EPA rule is unlikely to pinpoint parts-per-million limits. Most industry sources expect that the agency will stress add-on pollution control devices, such as carbon adsorption and solvent absorption scrubbers, and incineration of captured VC gas.

But the SPI's Lawrence and several EPA officials are optimistic that many of the measures that will satisfy OSHA will also satisfy the EPA. Better seals and ventilation in plants, improved maintenance procedures for flanges and seals, and advanced stripping technology can all help. "If they can remove the monomer in the stripping process, they won't need so much control equipment downstream," admits Susan R. Wyatt, departmental engineer at the EPA's Office of Air Quality Planning & Standards. Lawrence agrees, saying: "Many things the industry is doing to meet the OSHA standards will go a long way in meeting EPA requirements." ■