

vented tube from each engine blows air at very high pressure and forces gravel away from the engine intake.

Other operating problems include temperatures that are 50F to 60F below zero, 60-mph winds, and total darkness in December and January in the High Arctic. Engines on airstrip equipment such as trucks and snowplows are not turned off from Dec. 1 to Mar. 15.

Though the regionals, too, face fuel problems, all are predicting revenue increases this year. They see their biggest growth potential in scheduled passenger service, although no one is scoffing at the big bucks to be made in hauling drilling equipment—and beer—to oil teams in the Arctic or to the off-again, on-again \$6-billion James Bay hydroelectric project in northwestern

PWA ships cattle to the Orient and oil-drilling equipment to the Arctic

Quebec. Nordair flies there from Montreal, and Quebecair operates cargo-only service.

Cattle plane. In the eyes of many industry observers, Pacific Western is the best run of the regionals. Its fleet consists of seven Boeing 737s, with three more on order, plus two 727s, two long-range 707s, five Convair 640s, four Hercules jet-prop freighters, and a few flying boats. PWA's operations range from its scheduled passenger services to shipping cattle to the Orient and extensive relief work in such places as Nigeria and Bangladesh. Scheduled passenger services account for roughly 65% of PWA's revenues, charters for about 10%, and cargo services for the remaining 25%.

Its cattle plane is typical of PWA's willingness to provide specialized services to meet special needs. A conventional Boeing 707-320C, the plane can be equipped with either 13 stalls holding about 85 1,000-lb. cattle or double tiers of pens that will accommodate a great many more smaller animals. Donald N. Watson, PWA president, says that the plane has carried as many as 700 cattle from Toronto to Athens.

The real keys to profits for PWA and the other regionals, however, have been jets and charters. The jets boosted available seat-miles on routes with good load factors, and the charters gave the carriers the capability to use their aircraft more economically.

Keith Miller, executive vice-president of Eastern Provincial Airways, estimates the seat-mile cost on a 109-passenger 737 at 2.2¢ a mi., compared with 5.5¢ for each mile on the 41-seat Handley Page Herald. The 737s are replacing. The break-even load factor on the jets is 42%, vs. about 80% on the prop planes. "The stimulation of a 737 is very substantial," Miller says.

TECHNOLOGY

Industry's latest cancer scare

The deaths of five workers in ten years seem linked to working on the plastic

Federal officials met last week with plastics industry executives in Cleveland and Washington to try to determine whether the industry has unknowingly been exposing some of its 6,500 blue-collar workers to fumes that can lead to a rare form of liver cancer known as angiosarcoma. The focus was on 28 of the 42 plants in the U.S. that make vinyl chloride or use it to produce polyvinyl chloride resin (PVC), one of the most common plastics.

The hearings grew out of the deaths of four workers over the last six years at a B. F. Goodrich Chemical Co. plant in Louisville, Ky. They could ultimately bring costly new rules for the PVC industry, whose resins are used in such items as pipe, floor tile, phonograph records, and latex wall paints. "Improvements in work practices will probably require a 100% increase in the work force," says Walter B. Connolly, Jr., labor counsel for Firestone Tire & Rubber Co., which operates PVC plants in Pottstown, Pa., and Perryville, Md.

In any case, the current PVC hullabaloo is certain to spark new demands by organized labor for closer examination of the possible long-range ef-

fects on workers of other industrial chemicals. "The cancer took 15 to 20 years to develop," says one federal epidemiologist. Other chemicals could have similar "latency" periods, he says, so there could be more eruptions in the years ahead. "I hope we're not seeing the beginning of a health collapse."

The vinyl chloride case is not the chemical industry's first encounter with OSHA over carcinogenics. Last May the agency invoked emergency standards for 14 chemicals (BW—May 19, 1973). Final rules for these materials went into effect last week, though both industry and labor are suing for judicial review.

The prospect of new, petrochemical versions of such health time bombs as "black lung" and mercury poisoning, makes plastic industry leaders shudder. And indeed, new data presented at the standing-room-only OSHA hearing by Italian researcher Cesare Maltoni, of Bologna's Institute of Cancer, leave little doubt that vinyl chloride is carcinogenic—at least to rats. He exposed 67 rats to air containing 250 parts per million of vinyl chloride on and on for 52 weeks. By the end of 127 weeks, Maltoni reported, two had contracted angiosarcoma and nine contracted other forms of cancer. Many chemical industry executives had downgraded the importance of earlier animal test results because the dosages were mas-

A solvent that crippled chemical workers

Last August, Thomas F. Meade, 22, was stricken with a nerve disease after two years of work at Columbus Coated Fabrics Co., a subsidiary of Borden, Inc., in Columbus, Ohio, that makes vinyl-coated fabrics for luggage and wall coverings. The disease, diagnosed as peripheral neuropathy, left Meade crippled, and today he wears leg braces. He is the most severely affected of some 130 workers at the plant who have suffered symptoms of the disease. The lesser symptoms include weakness and loss of coordination.

When the symptoms became widespread last summer, state health officials tested the nerve responses of the plant's 1,124 employees and told 200 of them to stay home for two months. Many others stayed home, too, out of fear. By December, most employees had returned, and many who had showed neuropathic symptoms appeared well again.

Meanwhile, Ohio health officials had

zeroed in on an ink solvent, methyl butyl ketone, used in applying decorative patterns, as the most likely culprit. While continuing to monitor the plant's air, they banned the use of MBK. The plant's managers have switched to a substitute, improved ventilation, issued respirators to print shop workers, and moved lunch areas away from work areas.

But Corwin Smith, president of Local 487 of the Textile Workers Union of America, which represents the plant's workers, is not satisfied. He says that 26 members are still out with the disease, that eight of them are severely crippled, and that three workers whose condition improved are now sick again. On Feb. 9, the local struck the plant as negotiations collapsed on a new contract; one of the union demands was a "proper work environment." Says Smith: "People here don't know whether they will be crippled in the future or not."

sive, on the order to 5,000 to 30,000 ppm.

The bombshell. The cancer crisis hit the vinyl industry just a month ago. Noting an unusual number of liver ailments among the Louisville plant workers, B. F. Goodrich physicians ran blood tests last fall on the 271 workers in the plant's PVC facility and found 55 with apparent liver abnormalities. The company reviewed medical and insurance records and by Jan. 16 had discovered three deaths since 1971 that were attributable to angiosarcoma. Federal health officials estimate the annual death toll in the U.S. from this rare form of cancer at only about 20. On Jan. 29 further review by Goodrich turned up a 1968 death (two more cases, including a 1964 death, were identified this week).

The company's top management had already decided on public disclosure. It reported the situation to the National Institute for Occupational Safety & Health and to the Kentucky Labor Dept. It also began notifying employees in all of its vinyl chloride and PVC operations, and it sent a release to the press. "We are doing our utmost to express our real and serious concern," says John J. Bell, the company's public affairs director, "and yet prevent any undue panic."

NIOSH, which had immediately sent experts to Louisville, held a briefing early last week in Cleveland to tell management and labor leaders in the industry what it knew about the carcinogenic effects of vinyl chloride. And on Friday, many of the same executives showed up in Washington for the OSHA hearing. The federal agency will determine whether the situation warrants either an emergency standard or at least a start on the regular rule-making process.

The attitude of organized labor was a major concern. Anthony Mazzocchi, legislative director of the Oil, Chemical & Atomic Workers, who attended the NIOSH briefing, says: "It's apparent we're dealing with a carcinogen. We want to reduce exposure to zero. But we have a wait-and-see attitude right now."

While the fatalities at Louisville came as a shock to the industry, vinyl chloride has been suspect for a long time. Some 15 years ago Dow Chemical Co., based on its own studies, adopted an average exposure limit of 50 ppm for its workers—well below the 200-

ppm limit recommended since 1972 by the American Conference of Government Industrial Hygienists. In 1970, Italian researcher Dr. P. L. Viola reported that rats exposed to heavy doses of vinyl chloride developed malignant tumors. Several European chemical companies banded together to support research by Maltoni, and in the U.S., the Manufacturing Chemists Assn. began to discuss an industry-wide research program. A year ago, the MCA set up an animal test program that will not be completed until late 1975. The association also contracted with Tabershaw-Cooper Associates, of Berkeley,

nors, Jr., general manager of the Plastics Div. of Diamond Shamrock Chemical Co., which also observes that limit, "there are not enough fumes in the air to smell." Where concentrations are higher, he says, "we have ordered our men to wear gas masks."

Vinyl fumes arise partly from leaks in pipes and valves. But another likely source is the polymerization vessels, when they are opened for cleaning and maintenance. NIOSH officials are concentrating now on the polymerization process, but they plan to extend their studies eventually to monomer production, as well as PVC fabrication and even consumer use of PVC products.

Since safe limits for vinyl chloride are unknown, NIOSH is emphasizing safe work practices rather than arbitrary concentration limits. Its recommendations for the Louisville plant, for example, include such things as overhead cleaning, daily showers and clothing changes for workers, and expanded air monitoring. **Pinning it down.** Goodrich's Louisville plant uses about 50 different chemicals, and there is no proof of a direct link between vinyl chloride and the liver cancer cases. But NIOSH officials are certain that the link exists, and the MCA's Johnson concedes that "vinyl chloride is the material of primary

suspicion." Only two other carcinogens, arsenic and thorium-232, are proven causes of angiosarcoma, and medical records on the four Goodrich workers showed no exposure to either.

Both NIOSH and industry officials hope, though, that the link is peculiar to Goodrich's Louisville plant. Says NIOSH Director Marcus M. Key: "We still hold to the possibility that the cause could be a combination of two or three things acting together in the manufacturing process."

The Louisville plant is Goodrich's oldest PVC plant and, unlike most newer plants, is enclosed. It also has a number of older workers on the line. Some workers may have been affected by an epidemic of hepatitis that swept the city a few years ago. A number of other rubber and chemical plants, and their fumes, are located nearby. And the plant is one of the few that uses vinylidene chloride as a copolymerizing agent. Rudolph Jaeger, a physiologist at the Harvard School of Public Health, told the OSHA meeting that test data appear to point to that chemical, too, as a carcinogen.



A B. F. Goodrich safety inspector uses a chemical "sniffer" to check whether vinyl chloride fumes are leaking from a polymerizing reactor.

Calif., to check the available death records of workers at other vinyl plants. "So far," says Kenneth Johnson, MCA technical director, "the results haven't been subjected to statistical analysis."

To Dr. Irving J. Selikoff, the history shows that "our approach to the prob-

NIOSH hopes that the cause is a combination of factors at only one plant

lem was, shall I say, leisurely." Selikoff, director of environmental medicine at New York City's Mount Sinai School of Medicine, has been a frequent critic of industrial health practices, and one chemical executive calls his remark, made at the OSHA meeting, "hindsight."

Belatedly or not, some PVC producers have been tightening up their operations. Goodrich, for example, says it had already done, or was doing, most of the things NIOSH recommended after visiting the Louisville plant, including sticking to a 50-ppm average exposure limit. "At 50 ppm," says Harry Con-