

## Silicon Valley Seeks New Ways to Attack High Tech Pollution

By Conrad de Aenlle

SANTA CLARA, California — Creating the world of tomorrow can be a dirty business. That fact confronts dozens of electronics companies in California's Silicon Valley as they battle to cut chemical emissions and clean up the mess they have made over the last three decades while turning out semiconductor chips and computer paraphernalia.

By most accounts the industry is succeeding, thanks to the same inventiveness and entrepreneurial spirit for which it is famous. A study of 75 large manufacturers in Silicon Valley, a stretch of Santa Clara County running south from Palo Alto to San Jose, found a 74 percent drop since 1987 in the amount of chemicals released into the county's air or carted off to treatment or disposal facilities. Still, some industry observers argue that even that sharp reduction is not enough and that cleaner manufacturing methods need to be developed.

It is something of an irony that much of the waste released into the environment comes from the exacting process of cleaning silicon chips, the elemental components of computer memories, and parts such as circuit boards and disk drives.

In the early years, that is, until about a decade ago, parts were cleaned with a substance called trichloroethylene, or TCE. The substance is a universal solvent used in many industries but not without a price. "It takes the spots out of suits, and it's also a pretty fierce carcinogen," noted Randy Scherago, an analyst at the San Francisco research firm Robertson, Stephens & Co.

"All the computer companies used it to clean their silicon chips, then they stuck it down a hole in the ground," he said. "They didn't

care. All that high tech — it ain't so clean."

Maybe not, but at least it isn't as bad as it used to be. According to a study by the Santa Clara County Manufacturing Group of 25 of its largest members, total emissions fell to 1.5 million pounds last year from 5.8 million pounds in 1987.

When the toxicity of TCE was discovered, many manufacturers switched to chemicals such as chlorofluorocarbons, which are less toxic but were later found to seriously deplete the protective layer of ozone in the earth's atmosphere. It is mainly emissions of those chemicals, known as CFCs, that have been sharply cut in the last several years.

In addition to CFCs, harmful substances used by the industry include trichloroethane, a solvent that is less damaging to the ozone layer than CFCs; arsenic and phosphorus, which are used to induce electrical charges in silicon chips, and hydrochloric acid, used to etch patterns on circuit boards.

WHEN Silicon Valley companies stopped using TCE, the problem did not go away. Actually, it spread into the soil and groundwater from tanks in which TCE had been buried. When leaks were discovered in the early 1980s, the companies built concrete vaults around the tanks and started to clean up the spills.

Because of the industry's prompt attention, Tom English, director of environmental programs for the manufacturing group, takes exception to Mr. Scherago's remark that the companies "didn't care."

"We think of ourselves as a clean industry," Mr. English said. "When we found that some of these tanks leaked, we were shocked."

Elizabeth Ahrens, a spokes-

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woman for the Santa Clara Valley Water District, agreed that the "big companies made a big effort to clean up" the leaking tanks. As for calling the industry ecologically insensitive, she said, "At one time, that may very well have been fair, but it's not fair to say now."

Nevertheless, Ted Smith, executive director of Silicon Valley Toxics Coalition, a citizens' watchdog organization, said that "from our perspective, the industry has significant problems in terms of groundwater pollution, air pollution and worker exposure." But he added, "There's been some significant progress, there's no doubt about that," and cited International Business Machines Corp. and Intel Corp. as leaders in the environmental effort.

IBM has cut releases of CFCs from 1.5 million pounds in 1987 to just 58,000 pounds last year, said June Andersen, manager of environmental programs at IBM's San Jose disk drive plant. The world's largest computer company expects to eliminate all use of CFCs at the plant in the next four to six months and worldwide by 1993.

Intel, one of the largest makers of semiconductor chips, has set a goal of eliminating all CFCs and trichloroethane by next year, said Howard High, a company spokesman. It also has developed an innovative technique for making chips conduct electricity that involves arsenic in its solid rather than gaseous states.

"That was done as a worker safety issue," Mr. High explained. "It does have ramifications if there's a leak." Indeed, a study done by Digital Equipment Corp. showed that its women employees had more than twice the likelihood of miscarriages when they worked in an environment with a high risk of exposure to metals such as arsenic.

Even if Silicon Valley companies entirely cease spewing out chemicals, their fight against pollution will not be over for many decades. It will take that long to clean up the last 30 years' releases, especially into the groundwater. How is such a chore tackled?

"Basically, you spend a lot of money," said

Mr. English. Since 1981, he said, Santa Clara County companies have spent roughly \$400 million to clean up leaks. If some of them are lax in going about it, it is usually because they are small and lack sufficient money, industry officials said.

The first step in the process is to find out where and how much the damage has spread. Holes are drilled at leak sites, samples are

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taken and maps are drawn up. The computer projections of the spill's course are made.

After the leak is mapped, the water is pumped out, treated and then recycled.

IBM's cleanup project in San Jose has been acclaimed because it reuses 100 percent of the water it treats, which is especially important economically and ecologically because California has suffered through a drought for the last five years. Using machines called strippers, because they strip chemicals from the groundwater, IBM treats 1.25 million gallons a day, or close to 5 million liters. The water is then used in the manufacturing process, or else to irrigate the 100 acres (40 hectares) of walnut groves on the property.

IBM estimates that the cleanup will not be completed for 10 to 20 years. After that, the site must be monitored continually to make sure there is no new contamination.

Monitoring water is a techno-art in itself because some substances need to be measured in minute concentrations of just a few parts per billion. That is possible with high technology — "If there's one drop, we'll find it," said one IBM engineer — and also with low technology. At Intel, baby trout are used in a test. Because young trout have such sensitive gills, if they survive a requisite number of days in treated water, the stuff is judged to be all right.

Computer companies live and die by their ability to innovate and so are reluctant to share their technology. But they do not mind passing around findings from their environmental research.

"We don't consider environmental research to be proprietary," Mr. High said. "If someone finds a better way to do it, it's quickly shared throughout the industry."

"When some industries are ordered to clean up environmental damage," he said, "the solution is to hire 100 lawyers" to try to find ways to get around complying. But the computer industry has actively tackled its pollution problems and without too much prodding.

Because it is still a relatively new field, many top executives are the engineers who founded the companies, Mr. High pointed out, and they consider environmental matters a challenge instead of an obstacle. The prevailing attitude is: "We're engineers; engineers solve problems. Go solve it."

Nevertheless, some companies are less gung-ho than others. At National Semiconductor, said Richard Banks, manager of environmental affairs, "we try to keep up with the latest treatment techniques and use them if necessary," but the company does not devote a great deal of its resources to devising new methods of its own.

Mr. Smith of the Toxics Coalition said National is one of the companies along with Advanced Micro Devices, Texas Instruments and Motorola, that are "not nearly as far along" in their ecological programs.

"The ones that are doing a proper job have learned at least one lesson over the last 10 years that is pushing them to develop cleaner technologies. As Mr. High noted, "It's a hell of a lot easier not to have the waste than to get rid of it once you've got it."

That is why many companies, including IBM, have gone to a different type of material to clean their chips and drives: aqueous cleaning solution — by any other name, soap and water.

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