NATURAL RESOURCES AND ENVIRONMENTAL AFFAIRS
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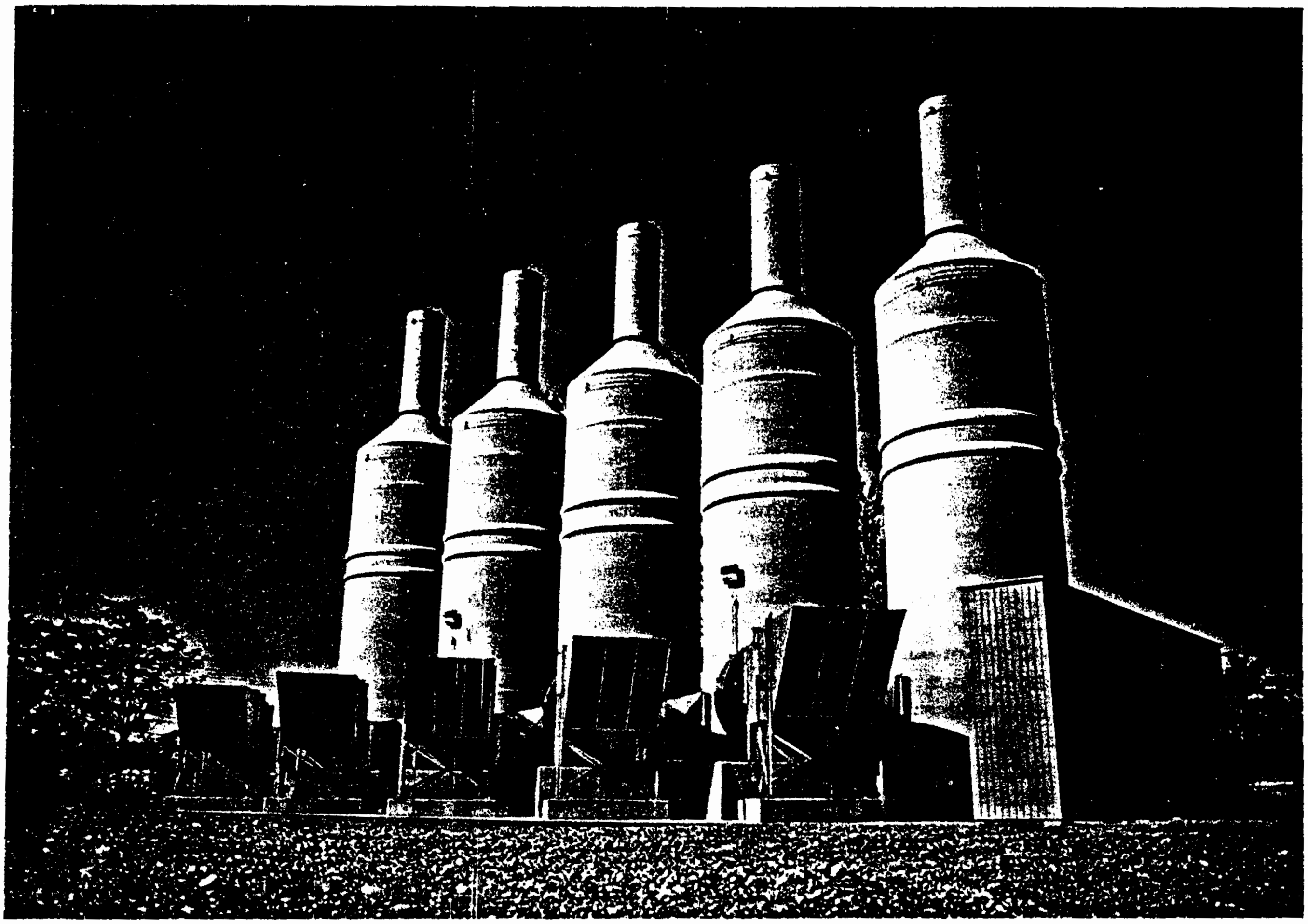

Air stripping towers used at Tacoma Well 12A to prevent further contamination of the well's water.

Air stripping provides fast solution for polluted well water

ROBERT D. SCHILLING

Using air stripping towers to clean up a city's well water supply may not be unusual, but getting five towers designed, constructed, and operating effectively within six months is.

It was discovered in late 1981 that one well water source of the drinking water supply for the City of Tacoma, WA was contaminated with chlorinated organic solvents—suspected carcinogens. While the exact source remains under investigation, the major concentration was found in Well 12A, one of 13 wells supplying up to 30 percent of the city's drinking water during peak summer demand periods.

As soon as the contamination was discovered, the well was shut down. This did not present a problem during the summer of 1982 since several nearby industrial plants were shut-down due to the economic downturn, enabling the city to meet reduced water needs with other available sources. However, cleaning up the pollutants was still important from a health standpoint.

This particular industrial area in Puget Sound's Commencement Bay was one of the top 100 sites on the EPA Superfund National Priority List. Even though the well field was not being used, clean up was mandatory. Concentrations of contamination in the parts per billion were found directly northeast of the well field. Specifically, the major pollutants found were in the following concentrations:

1,1,2,2-Tetrachloroethane 17 to 300 ppb
1,2-Trans dichloroethylene 30 to 100 ppb
Trichloroethylene 54 to 130 ppb
Tetrachloroethylene 1.6 to 5.4 ppb

With the natural groundwater flowing very slowly from south to north, these contaminants were moving away from the well field and, most notably, beyond Well 12A, the northernmost well in the field. However, if any of the wells had been operated, this natural flow would have been reversed and the pollutants would have rapidly contaminated the entire field.

For this reason, Well 12A was targeted for treatment. It would operate as a blocking well by collecting the contaminants before they could reach the other operating wells. Acting as a blocking agent, Well 12A would pump the water to the surface, clean it, and make it suitable for discharge, or possibly, for use in the municipal drinking system.

The need for water

In 1983, industrial activity picked up along with the economy, creating a rising demand for water. Coupled with health-related needs for removing the contaminants—and with the only alternative being water rationing—the renewed demand prompted the EPA to take action. A feasibility study to find the most economical method of treating Well 12A was authorized. The well would block the contamination and allow the other wells to be put back in operation.

The design objective was to remove the 1,1,2,2-Tetracholoroethane (a fairly rare solvent no longer used) since the other volatile organics, being in lesser concentrations and more readily extractable, would be removed along with it. When EPA authorized construction in late March, there remained only three months to sign contracts, construct the air stripping towers, and get the system operating.

Pilot studies had been conducted in CH2M Hill's laboratory in Corvallis, OR and in the U.S. Bureau of Mines laboratory in Albany, OR in January. Such conventional treatments as coagulation and sedimentation, softening, filtration, and chlorination are ineffective in controlling volatile organic contamination, so the two treatments evaluated were air stripping and activated carbon adsorption. Either would have been effective, and both could have been developed within the time limits, but it was determined that the carbon method would be three to five times more expensive than air stripping. Thus, air stripping was selected. Engineering design as well as preparation of four documents for procurement and one construction contract were completed in early March.

The system

In analyzing the most cost-effective number and size of air stripping towers, it was determined that, considering the percent removal of 1,1,2,2-Tetrachloroethane, five towers of the largest practical size would be the most efficient number. The primary guideline was to design a system that could be constructed quickly. A modular design which could be assembled onsite was selected. This allowed for the system to be moved to another site when conditions changed. Following are the final specifications:

- Five stripping towers, each 12 ft in diameter and 50 ft in height overall, including an air discharge stack 4 ft in diameter and 16 ft high;
- 30,000 cfm air flow, produced by a 60 hp fan/motor, on each tower;
- 700 gpm flow rate to each tower delivered by an underground well pump for a system rating of 3500 gpm;
- Cleanup efficiency of 88 percent of the 1,1,2,2-Tetrachloroethane and essentially complete removal of the other volatiles;
- Minimal noise disturbance for nearby residents (within 300 ft).

Regular meetings were conducted with all the governmental agencies involved from the beginning. Besides the EPA and the City of Tacoma Water, Health and Building Departments, agencies involved included the Washington State Department of Ecology and Social and Health Services and the Puget Sound Air Pollution Control Agency. Of significant help in meeting the deadline was EPA Project Manager Phil Wong, who coordinated all the agency activities and provided close client support for the project.

Onsite construction and assembly of the pre-purchased equipment were performed by J.P. Francis, Inc., a firm with mechanical and piping experience, which further facilitated completion by the target date. Even though a large amount of preparation was required, construction proceeded in a fairly normal sequence; the pace was simply accelerated.

The contractor was required to perform earth moving work; dig trenches for pipe installation; form and pour 110 yd of concrete for the tower and fan base pads; install an effluent diversion valving system in a buried vault; erect the towers; install the packing material; mount and connect the fans, motors, and noise abatement silencers; fabricate and install the piping and valves, and install the electrical control and wiring.

Each of the specially-fabricated fiberglass towers contains over 21 ft of one-inch plastic saddle packing to break the water stream into small drops and improve the stripping action.

The towers were delivered within 11 weeks, and delivery of the packing material—14,000 ft of it—began in mid-April and continued until early July. Individual fans were installed for each tower, further facilitating their possible future move to another site. Water from the existing well is distributed to the towers through a 24-in. piping header near the top of the 12 ft section. An 8 in. pipe carried the water to the inlet distributors. At the base of each tower is a 10 in. water trap, which protects against possible air leakage from the tower into the water system.

The results

The system was finished by mid-July, on time and before the peak demand hit. Several days of testing confirmed that the system was completely operational; all objectives were met—or, in some cases, surpassed. Final results:

- Instead of the targeted 88 percent efficiency, the system achieved almost 95 percent removal of 1,1,2,2-Tetrachloroethane, with approximately one part per billion remaining (the equivalent of one square foot in 36 square miles). During both the summers of 1983 and 1984, the treated water consistently was suitable for the drinking water system and was used to meet the city's needs as determined by the Tacoma Water Division.
- The total project was finished approximately $300,000 under its $1.4 million budget.
- Effect on the air quality of the region has been negligible because the solvents are diluted by the high air flow through the towers and dispersed once they leave the stacks. Tests have shown that in the worst possible case—with light air movement and an inversion, when the contaminants would settle to the ground—the concentration would be about one ten thousandth of the eight-hour limit established by the Occupational Safety and Health Administration (OSHA).
- Noise pollution, likewise, is negligible. Noise silencers on the fan inlets make it possible to carry on a conversation near the air inlet at almost normal voice levels. At the boundary of the site, the noise is virtually undetectable.

Although the EPA owns the system, the agency immediately turned it over to the City of Tacoma Water Department for operation. Annual operation and maintenance costs have been approximately $50,000.

While the towers could be operated effectively for an indefinite period, they were constructed as a temporary solution. The EPA is currently studying alternatives for permanently cleaning up the site. When that is accomplished, the agency may opt to move the towers to another emergency location.

In fact, Well 12A's success has paved the way for similar projects. One is at Ponder's Corner, only a few miles away. Under another EPA Superfund authorization, CH2M HILL has installed two air stripping towers there to purify the water for that drinking system.

Water departments all over the country have similar needs. Whichever system—air stripping or carbon adsorption—is determined to be more economical in a given situation, cleaning up groundwater contamination is expensive, even when the construction firm brings the project in under budget.

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