



Carbon Systems Help County Clean Up Groundwater

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The non-profit Suffolk County Water Authority (SCWA) is the largest public water supplier on Long Island, New York. Serving over 300,000 accounts and 1.2 million consumers, SCWA pumps nearly 44 billion gallons of potable water each year - all from groundwater supplies. Groundwater is pumped from 400 active wells in 180 well fields strategically located across Suffolk County's 85-mile long, 10 mile-wide, 850-sq mile area.

Until recently, the only water treatment required was chlorination, addition of hydrated lime to adjust pH levels, and addition of sequestering agents at some well sites to control high iron levels.

During the past decade, however, the SCWA began investigating additional treatment options after it discovered trace amounts of pesticides and volatile organic compounds (VOCs) in water at approximately 15 percent of its well sites. Extensive testing at SCWA's state-certified laboratory identified 19 agricultural pesticides and 53 organic compounds in the well waters. The pesticide of greatest concern was aldicarb; the most common VOCs were tetrachloroethene (PCE), trichloroethene (TCE), 1,1,1 trichloroethane (TCA), and 1,2 dichloropropane (DCP). Sources of VOCs include sewage septic tanks, dry cleaning operations, leaking underground gasoline storage tanks, and many industrial facilities that used and disposed of solvents and other organic chemicals.

SCWA's need for a reliable, cost-effective treatment technology was accelerated by the January 1989 effective date of a new 5 parts per billion (ppb) VOC limit imposed by the New York State Department of Health. The limit formerly was 50 ppb. (Federal standards for many of the VOCs found at Suffolk County, including PCE, TCE, and TCA, are also set at 5 ppb under recent Amendments to the Safe Drinking Water Act.)

Air stripping technology was considered as a possible water purification solution, but it proved to be too expensive. Based on analysis of vendor bids for treatment of one well pumping 1000 gpm, the SCWA determined that it could purchase and install three high performance carbon adsorption systems for the installed price of one air stripper.

Furthermore, the SCWA had good prior experience with pilot carbon systems designed by its own engineers for removal of agricultural chemicals at individual wells; some of this early work was sponsored by the EPA's Office of Drinking Water.

With the cooperation and approval of the Office of Water Resources-Suffolk County Department of Health Services, the SCWA began an aggressive, large scale carbon treatment program in 1988 that would put the Authority in compliance with all regulations while also meeting consumers' demands for high quality water.

After bids were reviewed, Calgon Carbon Corporation, Pittsburgh, Pennsylvania, was awarded an initial contract for the supply of five pre-engineered Model 10 dual vessel carbon adsorption systems. Each 10-ft diameter vessels contains 20,000 lb of virgin Filtrasorb-300 carbon. These standard units are designed for a maximum operating pressure of 125 psig. They typically handle flows ranging from 500 and 1,800 gpm.

Satisfied with performance of the first five units, the SCWA awarded a series of additional contracts between 1988 and 1992 to Calgon Carbon for the following: 33 Model 10s, 10 Model 10s, then 10 more Model 10s, then three Model 10s with higher pressure ratings of 200 psig, then a system with two 2000-lb carbon capacity adsorbers for a lower flow rate application, and equipment and engineering services for three single vessels for lower flow well fields.

According to Calgon Carbon, this total of 65 carbon systems dedicated to one customer's needs represents the largest groundwater treatment project of its kind in the United States. With carbon systems valued at more than \$ 9 million and virgin carbon replacement averaging 800,000 lb per year, the Suffolk County project also ranks amount the company's most significant efforts in the water treatment industry in the U.S. and Europe.

This massive project provided many challenges and practical learning experiences for engineers and operations staff from both the SCWA and Calgon Carbon. Both technical staffs learned more about the logistics of quickly installing and/or moving the carbon adsorption units from one problem well site to another, the handling of carbon, the need for proper equipment to load and unload carbon, the need to have clean water available for unit backwashing, and the need for unit corrosion and freeze protection.

Getting Started

Convinced that activated carbon treatment was the most cost-effective approach for groundwater purification, the SCWA requested that the first five units be delivered and installed at four different well fields. One of the original sites was Woodchuck Hollow. In November 1988, two dual adsorber units, each holding 40,000 lb of carbon, were connected to two deep wells (each 500 ft deep), each pumping in excess of 1500 gal of water per minute. Set up for parallel operation and contact times under 10 minutes, these first units effectively reduced a variety of low level VOCs - including DCP, TCE, TCA and TCP - to below the pending 5 ppb regulation. The four adsorber system treated a flow of more than 300 million gal before the carbon became saturated with contaminants and was replaced with virgin carbon.

The second purchase order, issued in September 1988, requested delivery of 33 additional carbon units by Memorial Day 1989. SCWA officials were aware that the new maximum contaminant level standard for VOCs° could potentially force shutdown of 28 wells - an alarming loss in light of the drought, high summer demand, and fire protection needs.

This purchase order posed a major logistical challenge for Calgon Carbon. At one point in time, the company's project management and operations team was overseeing the work of five vessel fabricators, four lining applicators, and many other part suppliers - while also coordinating truckload carbon shipments from its production plant in Kentucky and selection of New York contractors to install multiple systems throughout Suffolk County. Ultimately, this was all done on time and coordinated with SCWA's maintenance staff.

At the same time, the SCWA had to develop strategies on how best to stage current and future implementation of the treatment systems; supervise clearing of land to accommodate the adsorption equipment; prepare specifications and select contractors for concrete slabs to support the adsorption equipment; and render piping drawings for connection of the problem wells to the adsorbers by SCWA crews. In addition, SCWA engineers developed preliminary designs for expandable, color-coordinated buildings that would enclose and protect the carbon units from severe weather conditions.

Since 1988, the SCWA has relocated more than a dozen Model 10 adsorbers to address rapidly changing contaminant levels at various well sites; some moves were completed in less than one week. These redeployments were simplified because the buildings housing the carbon systems were designed with removable roofs for easy access to the equipment by large cranes. Also, the design of the carbon units facilitated their quick disassembly, transport, and reinstallation. These skid-mounted systems are provided with pre-assembled piping sections for influent and treated water, utility water and compressed air, carbon transfer, and venting. Water and utility piping need only be brought to the Model 10 and connected to complete the installation of the treatment process.

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Table 1 - VOC Concentrations, g/l			

Samuel Street # 4	6/9/89 Inf/Eff., g	3/12/90* Inf/Eff., g	3/29/90 Inf/Eff., g	1/16/92* Inf/Eff., g
Total Xylene	5.9/N.D.	4.4/N.D.	3.1/N.D.	1.1/N.D.
1,1,1,-Trichloroethane	57.0/N.D.	57.0/1.1	29/N.D.	44/1.0
1,1-Dichloroethylene	6.1/N.D.	57.0/1.1	11/N.D.	3.5/N.D.
Benzene	32/N.D.	29/N.D.	22/N.D.	5.7/N.D.
CIS-1,2-Dichloroethylene	0.5/N.D.	0.7/N.D.	0.6/N.D.	1.0/N.D.
Tri-chloroethylene	1.5/N.D.	1.6/N.D.	1.3/N.D.	1.4/N.D.
Toluene	1.8/N.D.	1.0/N.D.	1.2/N.D.	-
Tetrachloroethylene	5.3/N.D.	8.5/N.D.	6.1/N.D.	3.8/N.D.
1,1-Dichloroethane	5.0/N.D.	4.7/2.5	5.2/N.D.	4.9/1.6
1,2-Dichloroethane	1.1/N.D.	1.0/N.D.	0.8/N.D.	1.0/N.D.
TOTAL	116.2/N.D.	116.8/3.6	80.3/N.D.	66.4/2.6

* Just prior to carbon replacement

Locust Avenue # 2	8/22/90 Inf/Eff., g	8/16/91 Inf/Eff., g	7/1/92 Inf/Eff., g
COMPOUND			
Tetrachloroethylene	4.6/N.D.	5.3/N.D.	-
Trichloroethylene	16.0/N.D.	180.0/N.D.	59/N.D.
1,2-Dichloroethene	0.7/N.D.	2.4/N.D.	3.4/0.6
CIS-1,2-Dichloroethylene	-	2.2./N.D.	2.2/N.D.
1,1,1,-Trichloroethane	-	0.7/N.D.	0.6/N.D.
1,2-Dichloropropane	-	-	2.8/N.D.
Tetrachloroethylene	-	-	4.1/N.D.
TOTAL	21.3/N.D.	190.6/N.D.	67.2/0.6

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Maple Avenue #2	5/25/89 Inf/Eff., g	8/10/90 Inf/Eff., g	11/4/91 Inf/Eff., g
COMPOUND			
2 Chlorotoluene	1.1/N.D.	-	-
CIS-1,2-Dichloroethylene	1.2/N.D.	-	-
Chlorobenzene	37.0/N.D.	3.9/N.D.	0.6/N.D.
Ortho-Dichlorobenzene	3.2/N.D.	0.7/N.D.	-
Meta-Dichlorobenzene	2.2/N.D.	0.9/N.D.	-
Para-Dichlorobenzene	3.9/N.D.	1.3/N.D.	0.8/N.D.

1,3,5-Trimethylbenzene	0.8/N.D.	-	-
TOTAL	49.5/N.D.	6.8/N.D.	1.2/N.D.

Note: N.D. refers to no data applicable.

Testing confirms Efficacy

Having operated the carbon treatment systems for more than four years - and tested their performance at well sites as often as once per week - the SCWA has collected extensive data to show that VOC and pesticide reduction goals were achieved. Those data, showing contaminants and influent/effluent from the carbon system at various sites, are summarized in Table 1.

The following observations can be made:

Samuel Street #4. Carbon removed a wide range of types and concentrations of hydrocarbons; for the most part, the concentrations in the well were decreasing; the percent removal ranged from 96 to 100 percent.

Locust Avenue #2. The mix of organics changed during the operation; the carbon successfully removed trichloroethylene, even though there was an eleven-fold increase in the inlet concentration; the percent removal ranged from 99.1 to 100 percent.

Maple Avenue #2. The influent decreased dramatically during the operation; the percent removal remained at 100 percent throughout the operation.

Since 1988, the Suffolk County Water Authority has employed 65 Calgon Carbon adsorption systems for removal of VOCs and pesticides from groundwater supplied for potable water use. Treating billions of gallons of contaminated water, these systems have provided the Authority with the following key benefits:

- Compliance with very stringent 5 ppb state regulatory limits for VOCs in groundwater;
- Reduction of pesticide levels to below 5 ppb;
- Ability to meet water supply needs by keeping problem wells in service or by bringing closed, contaminated wells back into service;
- Rapid production and delivery of 65 carbon units for this huge, multiple phase remediation project;
- Quick installation;
- Flexibility to move carbon units from one problem well site to another;
- Easy operation;
- Low maintenance;
- Low noise (especially as compared to fan-driven air strippers);
- Ability to use systems in parallel or series operation;
- Capability to collectively treat 73,000 gpm of contaminated waters at various well sites, based on typical use of 61 Model 10 units averaging 1200-gpm capacity.
- Achieved cooperation from Calgon Carbon in all phases of this project, including requested design changes and retrofits to carbon equipment. Some of these changes included installation of thicker vessel linings, increase of vessel pressures from 125 to 200 psig, and modification of vessel pressure relief systems; and
- No surprises regarding operating costs. The annual cost of carbon change-outs has remained within budget for the life of the project.

Bringing more than 60 wells back in service, the adsorption technology has helped the SCWA solve a variety of groundwater contaminant problems, increase the available water supply during drought conditions, and provide sufficient capacity for fire protection needs.

In summary, the carbon systems have been an essential component in upgrading both the quality and quantity of water available to Suffolk County consumers. Even with the rate hike to \$1.21 per thousand gallons, Suffolk County residents are getting the highest quality water at the lowest cost in the metropolitan New York area.

Acknowledgments. The success of this large scale carbon project can be attributed to the hard work, sacrifice of

personal time, and cooperation among many individuals - including Suffolk County Water Authority's Patrick Dugan, Jr., Chief Chemist; Herman Miller, Director of Water Supply and Distribution; the entire Engineering Department staff; Joseph Baier, Suffolk County Health Services Department's Supervisor of the Office of Water Resources; and Calgon Carbon's Joel Neulight, Senior Account Manager, and Nelson Muchler, Operations Department Senior Field Manager.

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Reprinted from PUBLIC WORKS MAGAZINE, June 1994