Application Bulletin

GAC WATER PLANT NOW ONLINE

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At October's dedication ceremonies for Cincinnati's new granular activated carbon (GAC) water treatment facility, the significance of the plant for key regulatory and municipal officials was clear - the door to a new era in drinking water treatment technology had been opened.

The culmination of 15 years of research, design, and construction, this milestone project undertaken by the Cincinnati Water Works is the first U.S. application of GAC adsorption technology and "is the largest and most advanced public water treatment plant of any city in the nation," says Dwight Tillery, Cincinnati mayor. Now on line, this facility will remove a broad spectrum of organic chemicals from a major American municipal water supply, providing Cincinnati with high-quality, safe, good-tasting drinking water while protecting the environment.

Background

The major drinking water source for Cincinnati and 90 percent of suburban Hamilton County, Ohio, is the Ohio River. This water body is subject to contamination from a variety of sources: synthetic organic chemicals from industrial waste point discharges, pesticides, and agricultural chemicals from runoff and accidental spills from the more than 150 million tons of freight transported on the river each year. Studies of thousands of samples of Cincinnati's drinking water conducted in the late 70s confirmed the frequent presence of trace amounts of more than 200 organic compounds, many of which are or are about to be regulated under the Safe Drinking Water Act (SDWA) Amendments of 1986.

While concentrations of these substances in Cincinnati's drinking water are within current federal safety limits, the Water Works wanted to remove any doubt that long-term exposure to these chemicals could be a health concern. After considering various options, the water utility began investigating the feasibility of adding GAC treatment to its drinking water operation. Current water treatment technology offers a number of processes for removing specific dissolved organics. However, GAC adsorption has been shown to be the best broad-spectrum technology to reduce the total load of organic substances in drinking water. Although widely used in Europe as one step in drinking water treatment, it was not until the Cincinnati project got underway that GAC was applied in this country for anything more than reducing taste and odor in drinking water. At Cincinnati, it was believed GAC would guard against hazardous chemical and oil spills, and provide a *safety net* against the potential effects of new compounds.

An extensive, three-phase investigation was carried out by the Water Works, partially funded by a $3 million grant from the U.S. Environmental Protection Agency, virtually the largest ever directed to a single water project. Studies found that GAC was effective in organics removal, but that GAC contactors were more cost-effective than filter adsorbers, removing 70-100 percent of most organic contaminants. Carbon regeneration was found to be feasible and without adverse environmental effects. Carbon types and contact times were identified. Clearly, GAC adsorption was both effective and feasible for removing or reducing organics concentrations while treating the raw water for human consumption.

Water utility management decided in 1982 to implement a program to install GAC treatment as an additional process step at its California Water Treatment Plant in Cincinnati. Malcolm Pirnie, Inc. of White Plains, New York, was selected to design the facility, working in association with HDR Engineering, Inc. of Omaha, Nebraska, and project architect Henry Wilson and Associates of Cincinnati. Following additional studies of air emissions/dioxin control, air sampling, and risk analysis, final design was completed in January 1985.

Following 15 years of research, planning, design, and construction, Cincinnati's $ 60 million GAC facility will bring considerable health and environmental benefits to area residents

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Innovative Features

The innovative $ 60 million project processes 175 mdg of water from the Ohio River, using post-filtration GAC adsorption in deepbed contactors to remove a broad spectrum of organics. Water at the California Plant is first treated conventionally with rapid sand filtration to remove solids and bacteria, and then conveyed to the new GAC facility. There the flow is split and passes by gravity through one of 12 downflow deepbed GAC contactors, each 11.4 feet deep and holding 600,000 pounds of carbon. They were designed to provide an average of 15-20 minutes of empty bed contact time.

After many of the organics in the water are absorbed by the carbon, finished water is collected by an innovative stainless steel wedgewire underdrain system which conveys it to a single pipeline beneath the contactors. This underdrain equipment was manufactured by Johnson Filtration Systems of St.Paul, Minnesota. Calgon Carbon Corporation of Pittsburgh supplied over seven million pounds of activated carbon.

GAC-treated water is disinfected with chlorine, and lime is added for corrosion control. The water then enters two underground finished water clearwells with a combined capacity of 29 milllion gallons. From there, it is directed to the distribution system. Six large storage tanks on site hold virgin and spent GAC, keeping carbon transport distance short and minimizing attrition of the $ 4.5 million of carbon needed to operate the process. Because no chlorination occurs upstream of the GAC facility, the formation of trihalomethanes and other possibly problematic disinfection byproducts is reduced, and two-third less chlorine is needed to meet the required disinfectant residual levels.

Huge pipelines transfer conventionally treated and filtered water to the carbon contractors for removal or organic contaminants.

The Regeneration Process

Making this project economically feasible are the huge on-site multiple-hearth furnaces that regenerate the spent carbon to its virgin adsorptive capacity. These 40,000 lbs/day Von Roll furnaces remove adsorbed organic substances from the carbon. State-of-the-art air pollution control systems, including afterburners and wet scrubbers, ensure the destruction of dioxin, volatiles, and other potential contaminants in furnace off-gases.

A new computerized system control center allows operators to oversee functions at the existing plant and some distribution systems, in addition to all the GAC facility controls. Control and monitoring of plant operations is divided among several microprocessors and remote terminal units, all linked to a central host computer, and the system features state-of the-art computer graphics to display process and operating data.

The control system was designed by HDR Engineering. Bristol Babcock supplied the hardware and software.

National Significance

In addition to the considerable health and environmental benefits the GAC project brings to Cincinnati citizens, city officials and national water treatment authorities had more to celebrate at the plant's inauguration. The new GAC system enables the city to better meet evolving, more stringent federal safety limits on organic contaminants. GAC has been defined by the SDWA Amendments as the Best Available Technology for removing synthetic organic contaminants.

At an average cost of $ 3.3. million annually to operate and maintain plus $7 million a year for debt amortization, the facility will have minimal impact on consumers, increasing the average family's bill by an additional six cents a day, or $ 22 a year. The impetus to install this facility came directly from the greater Cincinnati community through the formation and advice of the Citizens/Scientist Committee on Drinking Water Quality, established in the mid 1970s.

by Richard Miller and Garret Westerhoff
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