Application Bulletin

Treating H2S Wells with Catalytic Carbon

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When high levels of H_2S (hydrogen sulfide) are detected in a well, contractors often feel they have little alternative but to cap off the well. That was the situation faced by the California Water Service Co. in 1993. Unable to cost effectively treat H_2S at one of their wells in Bakersfield, California, they reluctantly shut it down.

"We drilled the well about four years ago and capped it off when we found H_2S," recalls Bruce Cabral, water quality manager for the California Water Service Co. "Then we heard about catalytic carbon."

Catalytic Carbon

Catalytic carbon is the result of a breakthrough in altering the surface structure of activated carbon. Catalytic carbon is produced through a patented process that modifies the electronic properties of the carbon surface. The result is added catalytic functionality which is significantly greater than traditional activated carbons.

Activated carbon is typically associated with adsorption - a physical process where molecules adhere to the internal surface. Catalytic carbon retains all the adsorptive characteristics of conventional activated carbons, but combines them with the ability to promote chemical reactions. In addition to concentrating reactants via adsorption, catalytic carbon promotes their chemical conversion.

Centaur® HSL catalytic carbon is specially designed by Calgon Carbon Corp. for liquid phase applications. For treatment of hydrogen sulfide in ground water, H_2S is first adsorbed and then oxidized on the surface of the catalytic carbon. The H_2S is oxidized to sulfate and other forms which are not odorous, thus eliminating the offensive nature of the influent H_2S.

California's Results

"We felt the data on catalytic carbon was worth a trial," Cabral says. "So we reopened the Bakersfield well, reworked it, and installed the catalytic carbon filters. The results were instantaneous."

Before treatment, the Bakersfield water exhibited hydrogen sulfide levels ranging from .01 to .2 ppm, with dissolved oxygen levels in the 4 to 5 ppm range. California Water Service installed Centaur HSL in a two-vessel system in parallel configuration to treat the 750 to 1000 gpm ground water stream. After catalytic carbon, H_2S levels are zero.

Based on those results - which have continued for more than three years - California Water Service has installed catalytic carbon at three more wells. According to Tim Treloar, assistant district manager for California Water Service Co., catalytic carbon's benefits are well demonstrated in numerous sites in Bakersfield. "We're using it at sites now that have relatively low levels of H_2S. One was a new well and the others were existing wells where H_2S presented itself over time. Any amount of H_2S is objectionable to customers." Generally, the California wells have flow rates between 750 to 1000 gpm through two vessels, each of which are loaded with 5000 to 8000 pounds of Centaur HSL (site dependant).

Treloar adds, "We're looking at H_2S levels anywhere from .01 to .2 ppm at these sites. By using catalytic carbon, we're completely removing any trace of H_2S - and with it any customer taste or odor objections."

Designing a Catalytic Carbon System

To treat ground water streams effectively with catalytic carbon, three factors must be considered: H_2S influent concentrations, dissolved oxygen, and desired flow rates. Catalytic carbon is recommended for ground water streams where the dissolved H_2S level is less than 2 ppm. Since the reaction on the surface of carbon involves oxidation, a minimum level of dissolved oxygen is required within the influent stream. Twice as much oxygen as H_2S is required, with a minimum dissolved oxygen level of 3 ppm. For example, if 1.8 ppm of H_2S is present, then 3.6 ppm of dissolved oxygen is required. If sufficient levels of dissolved oxygen are not available, they can be supplemented with direct oxygen injection prior to the carbon bed. To allow for the complete oxidation of H_2S, it is also important to maintain a minimum contact time of five minutes. Maintaining this minimum contact time in conjunction with the required flow rate will dictate equipment selection.

As iron is often present in streams contaminated with H_2S, it is important to not that catalytic carbon also provides an effective treatment method for iron as well. The oxidation reaction that is promoted on the surface of the catalytic carbon reacts with iron to its insoluble form, eliminating the iron fouling problems typical in these applications.

Streamlined Operations

Cabral reports that California Water Service had previous experience with chlorine injection to treat for H_2S. “The end result was effective,” he admits, “but it was difficult to control. Catalytic carbon is a passive system. You can nearly turn it on and walk away.”

Treloar agrees: “Catalytic carbon doesn’t require much in terms of maintenance, particularly if you’re using an automated backwash system.”

Changeout

California Water Service has not yet had to change out the catalytic carbon at any of its sites, even though the original installation has been on-line for more than three years.

“Changeout depends on several factors,” explains Treloar, “Including background organics, solids loading, throughput, influent contaminant levels, and how well you backwash. If an ongoing chemical equilibrium can be achieved, it could extend the life of the carbon significantly.”

Currently, California Water Service backwashes weekly, discharging the backwash water either to storm drains or sumps. “I’m trying to institute and automatic backwash system right now based on a predetermined run time or differential pressure,” says Treloar.

Future Plans

Treloar describes catalytic carbon as “a cost-effective solution.” Cabral concurs: “We have been so pleased with the results that we have four more catalytic carbon treatment sites planned in the next year.”

Residential Well Owners Also Realize Catalytic Carbon Benefits

Smaller, domestic wells are also taking advantage of the unique capabilities of catalytic carbon. Mark Kavish, water quality specialist for the contracting firm of Eichelbergers Inc., Mechanicsburg, Pennsylvania, recommends catalytic carbon to his customers who range from *Fortune* 500 commercial and industrial corporations to small, residential installations.

“The less ‘hands on’ our customers have to deal with, the better. The ease of use and performance advantages of a passive, activated carbon system have always been attractive,” Kavish claims, “but the longevity of traditional activated carbon for most of our H_2S removal applications made it prohibitive.”

Not anymore. Eichelbergers uses catalytic carbon in six distinct sites with, according to Kavish, “absolutely no bleed-through problems.” They supply Centaur HSL for both manual filter systems and those with automatic backwashing filters.

At one Eichelbergers job, catalytic carbon has been treating a well with 6 ppm of H_2S. Based on the customer’s own observations, the product is succeeding in removing 100 percent of the sulfur odor. Another installation teams up catalytic carbon with chlorination, using Centaur HSL as a post filter. Here the customer noticed at one point that the chlorinator had shut down completely. Eichelbergers was pleasantly surprised to discover that the catalytic carbon - on its own - had continued to remove 5 to 10 ppm of sulfur from the water.

“Our customers who already have water softeners installed are particularly attracted to catalytic carbon,” notes Kavish. In those sites, the catalytic carbon system is easily put in place after the softener, where it serves as a polisher of the sulfur odor.

The longevity of catalytic carbon is a big selling point for homeowners attracted by the promise of keeping maintenance to the barest minimum. It also appeals to users anxious to control initial installation costs.

Kavish concludes by saying, “Catalytic carbon is a straightforward, passive technology. Its capability for automatic backwashing means the system virtually maintain itself. That’s a big plus for many of our clients.”

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