

# Application Bulletin

## A NEW LEVEL IN IRON REMOVAL TECHNOLOGY

by Ed Bockman

For years, dissolved iron in water has plagued consumers and industries alike. From rust-colored stains on plumbing fixtures and laundry to its telltale taste and odor, residents frequently cite iron as their number one nuisance. For industry, iron-laden water often leads to unsightly product staining and hazardous mineral deposits within process equipment. Although there are no known health problems associated with iron in drinking water, the adverse aesthetic factors it causes prompted the U.S. Environmental Protection Agency (USEPA) to set a Secondary Drinking Water Standard for iron at 0.3 milligrams per liter (mg/L).

Many methods have been used to address the problems caused by iron in water. These include oxidation by aeration, chlorination, chlorine dioxide, potassium permanganate or ozone; ion exchange by greensands, and the addition of sequestering agents and lime softening. A new type of activated carbon offers a simpler solution.

### Chemistry of Iron Oxidation

A mineral found in soil, iron normally exists in an insoluble oxide form, namely ferric oxide. If acidic- or carbon dioxide-containing water passes through the soil, the insoluble ferric oxide is reduced to the very soluble ferrous form. When water is pumped from the ground, oxygen from the air enters the water and is available for reaction with the ferrous iron. In the presence of oxygen, the ferrous form is eventually oxidized to the insoluble ferric form, resulting in the familiar red deposits that stain sinks and clothes.

In iron removal processes, the insoluble ferric hydroxide comes out of solution and is separated from the water by either filtration or settling. Catalytic carbon accelerates the reaction rate of ferrous to ferric iron dramatically, completely removing the iron in the relatively short time the water is in contact with the carbon.

Under normal conditions, the reaction rate of ferrous to ferric iron is fairly slow, even when excess oxygen is present. This slow reaction rate necessitates the use of large retention and sedimentation tanks to allow time for precipitation to occur. A separate filtration step is then required to remove the remaining particulate.

### Catalytic Carbon: A Better Solution

Activated carbon is typically associated with adsorption - a physical process where molecules adhere to the internal surface. Catalytic carbon, which is bituminous coal-based granular activated carbon (GAC) enhanced through a controlled activation process, retains all the adsorptive characteristics of conventional activated carbons but offers more catalytic sites for electron transfer promoting a wider range of chemical reactions. This is accomplished without the addition of chemical impregnates. In addition to concentrating reactants via adsorption, catalytic carbon promotes their chemical conversion. In treating iron-laden water, the catalytic properties of this form of granular activated carbon perform quite differently from standard activated carbon. The catalytic properties greatly accelerate the reaction rate of iron to an insoluble form. By oxidizing iron from a soluble to less soluble state, catalytic carbon serves to simplify iron removal.

The resultant increase in reaction rate that occurs by using catalytic carbon allows smaller pieces of equipment to be used. As with all oxidation techniques, oxygen is required - but a simple eductor or air injection pump is all that is required. As the reaction occurs, the precipitate is collected on the surface of the carbon, and a secondary filter is not required. Periodic backwashing is performed to remove this iron floc and return the carbon to a usable state.

Another benefit of catalytic carbon is its proven performance in removing hydrogen sulfide (H<sub>2</sub>S) from water. Many iron-containing waters also contain H<sub>2</sub>S and the same bed of catalytic carbon can be used to remove both.

### About the author

Ed Bockman is marketing manager for the OEM Business Unit of Calgon Carbon Corporation, of Pittsburgh, PA, which is the only maker of catalytically enhanced carbon. Bockman holds a B.S degree in chemical engineering from Carnegie Mellon University and has been working at Calgon Carbon for seven years.



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