New Technique for Iron Removal

By Nicole Mitchell

The first home water treatment system that completely oxidizes iron in water for total iron removal uses a patented dissolved oxygen generator (DOG). It can also reduce problem water issues such as manganese and hydrogen sulfide.

Oxidation

Oxidation is a method of converting iron, manganese or hydrogen sulfide into a form that can be filtered and removed. The chemical reactions that explain how these minerals are oxidized are is illustrated below:

- Iron: $4\ Fe + 3\ O_2 = 2\ Fe_2O_3$
- Manganese: $3\ Mn + 2\ O_2 = Mn_3O_4$
- Hydrogen sulfide: $H_2S + O_2 = H_2O$ (water) + S (elemental sulfur)

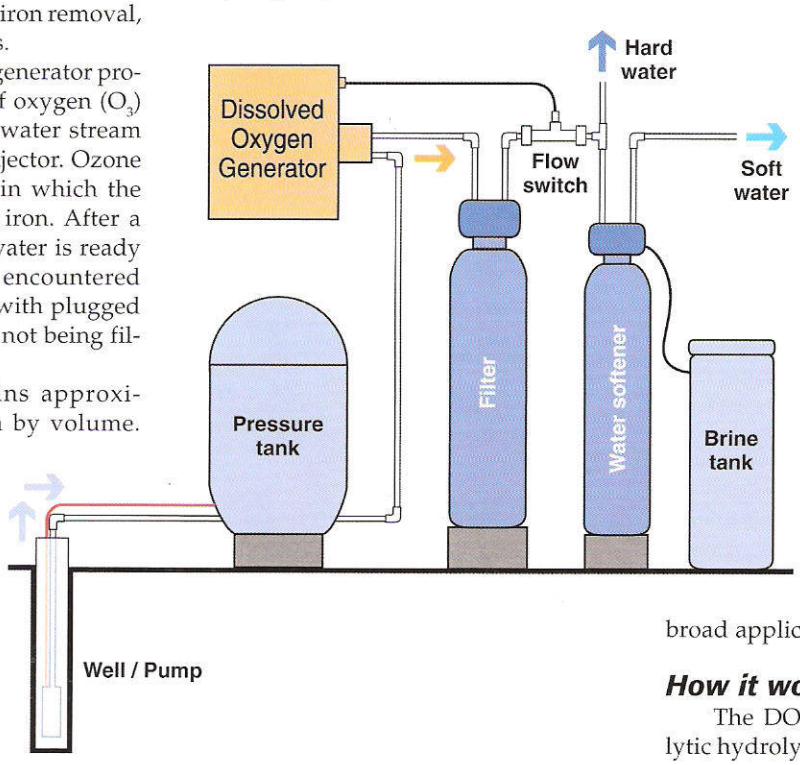
Various removal methods

Current technology available for iron removal is often bulky, noisy and requires expensive, time-consuming maintenance. Aeration and ozonation are well-known techniques for iron removal, with significant drawbacks.

Ozonation: An ozone generator produces an allotropic form of oxygen (O_3) which is then fed into the water stream through a diffuser or air injector. Ozone requires retention tank(s) in which the ozone can oxidize ferrous iron. After a lengthy contact time, the water is ready to be filtered. A problem encountered with ozonation is dealing with plugged pipes due to contaminants not being filtered completely.

Aeration: Air contains approximately 21 percent oxygen by volume. Aeration is used to oxidize ferrous iron into the insoluble ferric form. When sized correctly, aeration systems can be effective; however, they have large space requirements. These systems are designed with an air compressor, a Venturi or an injector set-up. The system will either use the existing pressure tank (if there is water/air contact) or an additional retention tank, along with an air volume control. In cases where high flow is needed, two to four retention tanks may be required to provide the necessary retention time.

Drawbacks of aeration include the amount of dedicated space required for the equipment; partially oxidized iron; milky water from the tap; collection of iron ahead of the filter; air volume control failures and service requirements. As with ozonation, plugged pipes (due to contaminants not completely filtering out) may require attention.



Chemicals: Treatments such as hydrogen peroxide and potassium permanganate have been used, but these chemicals are very hazardous to human health and the environment.

Electrolysis (electrolytic reaction)

The ability to increase the oxygen level in water via electrolysis is not new. Typically, electrolysis requires large amounts of electrical current to be passed between an anode and cathode positioned in the water solution. This current creates positive and negative electrochemical charges that separates the water molecule into its component parts, oxygen and hydrogen gas. Being a larger, heavier molecule, oxygen will stay in solution, contributing to the dissolved oxygen content of the fluid, or will dissipate across the water-air interface. Hydrogen is smaller and lighter than oxygen and therefore leaves solution; it can be collected or allowed to dissipate into the atmosphere. While research on this technology has progressed for many years, the DOG device is the first to apply electrolysis technology efficiently and economically using a low-voltage process.

Electrolysis is used to oxygenate water for a variety of specialized industrial water treatment applications where economics is secondary to function. This is an important consideration because current methods of electrolysis utilize large amounts of energy and are inefficient, expensive and slow, making their use in broad applications impossible.

How it works: the science

The DOG technology uses electrolytic hydrolysis in a unique way. This in-

novative technology generates extremely high levels of dissolved oxygen in water. It oxygenates water in real-time, at controlled oxygen levels and at various flow rates. The extremely high levels of oxygen produced by the DOG oxidize 100 percent of iron and manganese in water for easy removal by filtration, while eliminating iron oxide and hydrogen sulfide odors.

Microbubbles

When it comes to bubbles, size matters. The thickness of a human hair is about 75 microns. The smallest bubbles created with the DOG technology, as measured by an independent testing laboratory, were approximately 70 microns in diameter (0.0025 inches).

By comparison, the diameter of the smallest air bubbles produced by a standard line aerator is 0.020 inches, 7.5 times greater. A comparison of surface area and volume shows air bubbles created with the DOG are therefore 56 times smaller by surface area and 424 times smaller by volume.

It is this smaller size, plus the fact that the bubbles are 100 percent oxygen (compared to air bubbles at 20.9 percent oxygen) that gives this technology a clear advantage in transferring oxygen to water and keeping that oxygen from escaping.

Development and testing

Residential prototype testing of the DOG unit was conducted at 15 test sites ranging from 120 to 570 days (with an average length of 270 days) to confirm performance claims and ascertain reliability. The sites were carefully selected to provide a wide range of water chemistry (hardness, conductivity, ppm iron) and flow rates (with and without lawn irrigation). Water conductivity ranged from 300 to 1,400 microsiemens; iron from four to 27 ppm; hydrogen sulfide up to 10 ppm and manganese up to 2.5 ppm.

The DOG removed the iron (up to 27 ppm), manganese (up to 2.5 ppm) and hydrogen sulfide (up to 10 ppm) in all 15 test applications at flow rates up to 20 gpm.

In addition, multiple prototypes were subjected to numerous conditions, including environmental (temperature and humidity), electrical (dielectric, leakage current, line transience, etc.), shipping/vibration, abnormal operation (no water, blocked fan, hydrostatic pressure, etc.) and other performance tests with excellent results.

Units were submitted to Underwriters Laboratories (UL) where they were subjected to a battery of tests as defined in *UL 979 for Water Treatment Appliances* and *The Canadian National Standard for Motor-Operated Appliances (Household & Commercial) CAN/CSA C22.2.* UL's conclusion was that the unit complied with all the applicable standards and was judged eligible to bear UL's mark, a significant achievement. The *Notice of Completion Letter* from UL was received in December, 2007.

Since DOG technology requires no pumps, compressors or injectors, customers enjoy extremely low operating costs of just pennies-per-day. It operates on a real-time basis and since no retention time is needed, no retention tanks are required. The DOG performs at up to 20 gallons per minute (gpm), making it capable of meeting indoor and outdoor water needs. A green product, it is completely chemical free, safe for customers and the environment.

Space requirements are minimal: the device is compact, with a footprint of three feet by three feet. Quieter than other equipment, it requires very low maintenance. It was designed to tackle extreme problem water at high flow rates.

About the product

♦ *The WATER D.O.G.® Iron Hunter HD was developed by WATER D.O.G. WORKS in 2006 using the patented D.O.G. technology. The product is the first home water treatment technology using the Dissolved Oxygen Generator. For more information on the Iron Hunter HD or to become a WATER D.O.G. dealer, visit www.waterdogworks.com or call (952) 224-0177.*

The WATER D.O.G. WORKS team will be at the WQA Aquatech 2008 Convention. Visit them in booth #1211.

About the author

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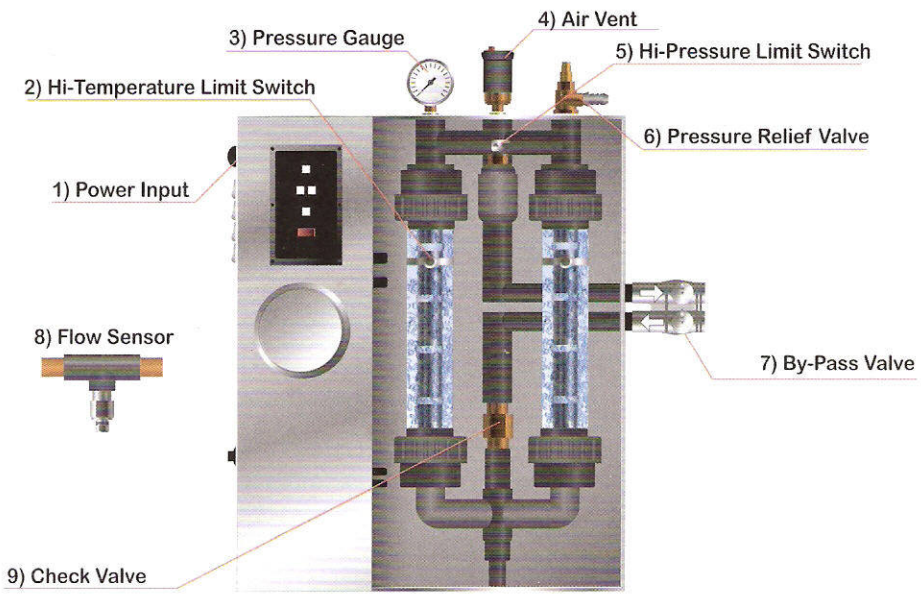

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