Practical Application of Peroxide for Iron & Hydrogen Sulfide

By Michael Urbans

Hydrogen peroxide chemically known as H₂O₂ has been gaining in popularity with water treatment professionals. It is no longer thought of as that topical agent found in the funny brown bottle under your bathroom sink. Hydrogen peroxide is a powerful oxidant. When applied correctly peroxide can provide amazing results. Hydrogen Peroxide has many uses for the water treatment professional. Most popular is RO membrane cleaning, iron, hydrogen sulfide, and manganese removal, VOC reduction, and UV oxidation.

Two of the toughest challenges facing the water treatment professional today are effective iron and hydrogen sulfide removal. Over the years water treatment professionals have spent countless time and money battling these elements. However, before you charge into applying peroxide to your worst nightmare, it is important to follow some basic guidelines.

Hydrogen peroxide is available in 35 percent 400 grams per liter (g/l), 50 percent 600 g/l and 70 percent 900 g/l solutions. Due to the volatility of highly concentrated H₂O₂ it is recommended that dealers use a seven percent solution. Danger is in the concentration. Extreme care should be taken when handling concentrated H₂O₂. Research all safety and handling procedures as recommended by the manufacturer.

For household use, I recommend the use of ONLY a 7% solution. Seven percent H₂O₂ will have a pH of 5.6. Seven Percent solution is readily available in 5 and 1 gallon containers. Trucks must carry signs labeling contents as “oxidizers” when transporting H₂O₂ greater than 8 percent.
The key to understanding hydrogen peroxide is how it chemically reacts with contaminants and water. This chemical reaction known as Fenton’s rule which creates heat and liberates oxygen. The greater the concentration of peroxide the more the reaction creates heat and oxygen. 70% hydrogen peroxide can be explosive.

Peroxide has several distinct advantages over many popular water treatment chemicals.

- Peroxide does not produce disinfection byproducts such as Trihalomethanes (THMs).
- Low concentrations have no odor and is non-flammable.
- Although a less powerful oxidizer than ozone, peroxide requires less equipment to feed and maintain your application. In most cases a peristaltic pump and static mixer are all that is required.
- Peroxide has a greater oxidant potential than potassium permanganate without the purple mess.
- It is a generally accepted method of treatment in the agricultural industry, potentially expanding your market base.
- Limited availability to consumers insures stable profit margins.
Rules of Application:

The following simple rules of application take the guess work out of applying peroxide.

- When feeding peroxide use only a peristaltic pump. Positive displacement pumps will destabilize peroxide causing it to “gas out” resulting in a loss of prime.
- Feed peroxide from a single properly labeled, ultra violet blocking container.
- Use only reverse osmosis, deionized or distilled water to mix or dilute your peroxide. Remember contaminated water will cause a reaction.
- Never mix hydrogen peroxide with alkaline substances (soda ash, sodium hydroxide, hypochlorite, limestone or ammonia), which cause peroxide to rapidly decompose, possibly resulting in a violent reaction. The risk of a violent reaction is greatly reduced by storing peroxide in 7 percent solution strength versus 35 percent.
- Use separate feed pumps and storage tanks when raising pH for H₂O₂ applications.
- When diluting or mixing concentrated peroxide, always add concentrated solution to the less concentrated solution. It is a smart practice to combine two small measures of your mixture to see if they are compatible.
APPLICATION FOR IRON AND HYDROGEN SULFIDE:

As mentioned earlier, liberated oxygen is the key to making peroxide work. Most media react positively to the added boost of oxygen. This liberated oxygen produces an oxidant potential twenty eight times greater than chlorine. (Note potential chart). The unleashed oxygen will oxidize iron and hydrogen sulfide much faster than chlorine. Therefore virtually eliminating contact tanks. Typically only a static in-line mixer is all that is required on all but the most difficult job. It is not uncommon to oxidize seventy parts per million hydrogen sulfide with peroxide.

The following reaction shows the oxidation and precipitation of iron and hydrogen sulfide with hydrogen peroxide:

\[ \text{H}_2\text{S} + \text{H}_2\text{O}_2 \rightarrow \text{Hydrogen sulfide dissolved in water is oxidized.} \]

\[ 2\text{H}_2\text{O} + S \]

\[ 2\text{Fe}^{2+} + \text{H}_2\text{O}_2 + 2\text{H}^+ \rightarrow 2\text{Fe}^{3+} + \text{H}_2\text{O} \]

\[ \text{H}_2\text{O}_2 \rightarrow \frac{1}{2}\text{O}_2 + \text{H}_2\text{O} \]

\[ 2\text{Fe}^{2+} + \frac{1}{2}\text{O}_2 + \text{H}_2\text{O} \rightarrow 2\text{Fe}^{3+} + \text{OH}^- \]

Precipitated iron and hydrogen sulfide can be easily removed with a back washing multi-media, catalytic carbon (Centaur) or redox alloy (KDF) filters. Manganese greensand, manganese ore, or manganese treated media are NOT recommended for post filtration of peroxide. Peroxide’s high oxidant potential can cause a manganese to leach off of these media.
FEED RATE REQUIREMENTS:

The most frequently asked question is “How much peroxide feed is required?” I can furnish several rules of thumb, but as any experienced dealer knows iron and hydrogen sulfide levels can fluctuate greatly rendering all rules of thumb useless. The nice benefit of peroxide is that it has a built in feed rate indicator. Peroxide destruction produces micro bubbles. These bubbles will make the treated water appear nearly white. Experienced peroxide users say “pump until you get bubbles, then back off the feed pump until they disappear.” Observe the bubble test post treatment equipment. Over feeding the peroxide can cause pockets of gas in contact tanks and treatment equipment. Gas pockets are most prevalent when using catalytic activated carbon. Frequent back washing will sufficiently purge your post treatment. To reduce frequent back washing, a gas off tank can also be used prior to the final treatment.

Peroxide is gaining in popularity as an expected method of treatment among water treatment professionals. Although it should not be considered a cure all, it should be considered a key addition to your arsenal to combat those difficult water problems where existing methods have failed.

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