PERCARBONATES FOR ISCO

Sodium percarbonate has recently been touted as another oxidant for *in situ* chemical oxidation (ISCO). Sodium percarbonate is an oxygen-based bleaching chemical that was developed to substitute for chlorine-type bleaching agents, which have dominated the bleaching agent market. Sodium percarbonate is relatively safe to handle (it is widely used in laundry detergent) and it comes in a solid form. When percarbonate is mixed with water, it disassociates to hydrogen peroxide and sodium carbonate:

$$2Na_2CO_3\ 3H_2O_2 \rightarrow 2Na_2\ CO_3 + 3H_2O_2$$

The solution is alkaline (high pH) and also releases carbonates from the disassociation of the sodium carbonate. When mixed with a metal catalyst (such as ferrous iron or iron EDTA), the hydrogen peroxide that is released would react with the metal catalyst to produce hydroxyl radicals:

$$H_2O_2 + Fe^{+2} \rightarrow OH^- + Fe^{+3} + OH°$$

This is Fenton's chemistry, which is well known and has been extensively studied. Hydroxyl radicals are strong oxidizers and have been used for ISCO at many sites. Redox Tech examined percarbonate for ISCO many years ago because percarbonate is relatively inexpensive (about 50 cents per pound) and it is safe to handle. Unfortunately, the carbonate that is produced during the mixing of percarbonate consumes the hydroxyl radicals. This is known in the advanced oxidation research sphere as "free radical scavaging." The carbonate scavenger reacts very rapidly with hydroxyl radicals and lowers the oxidation capacity of the mixture. In any water system, there is an equilibrium established with carbonate (CO_3^{2-}), bicarbonate (HCO_3^{2-}) ions and carbon dioxide. Carbonate is a much stronger scavenger than bicarbonate (HCO_3^{2-}) ions. The negative effect of carbonate scavengers on advanced oxidation processes and hydroxyl radicals is widely studied. Below is a list of just of a few of the hundreds of publications on the topic.

The ultimate fate of the sodium percarbonate is carbonate, water and oxygen. The carbonate will increase the pH of most groundwater. The oxygen could provide oxygen for aerobic bioremediation. However, percarbonate has not been widely used for ISCO, and there will be some technical challenges associated with hydroxyl radical scavenging.

If you have any questions regarding percarbonate or other ISCO oxidants, please feel free to contact Dr. John Haselow or Dr. Joe Rossabi at 919-678-0140.

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