Activating Klozur® SP with an 8% Hydrogen Peroxide Solution

BACKGROUND

Klozur® SP can be activated with hydrogen peroxide to generate sulfate radicals, which are capable of destroying a wide range of organic contaminants. In general, hydrogen peroxide is dosed in conjunction with Klozur SP in a ratio of 1 mole hydrogen peroxide to 1 mole persulfate up to 10 moles hydrogen peroxide to 1 mole persulfate. Typically, a molar ratio of 5:1 hydrogen peroxide to persulfate is sufficient to treat most contaminants under a wide range of site conditions.

SAFETY AND HANDLING

Hydrogen peroxide is a strong oxidant, capable of generating significant heat and gasses when applied in the subsurface.

Review the appropriate Safety Data Sheet (SDS) with all workers prior to use. Follow guidance contained within the appropriate SDS when handling Klozur SP or hydrogen peroxide.

Hydrogen peroxide is sold commercially in a variety of concentrations. Common concentrations include 50%*, 35%*, 27%, 17.5%, and 8% by weight. Highly concentrated forms of hydrogen peroxide may generate extreme exothermic reactions and gas evolution upon injection into the subsurface or when contacting high levels of contamination, potentially liberating significant quantities of gas. Care must be taken to avoid excessive heat and gas evolution as this may cause damage to utilities, buildings and represents a safety hazard if not properly controlled.

*As of 2014, hydrogen peroxide with a concentrations of 35% by weight and greater are classified as chemicals of interest by the Department of Homeland Security and subject to the CFATS regulations. Please see http://www.dhs.gov/chemical-facility-anti-terrorism-standards for further information.

PeroxyChem recommends hydrogen peroxide solutions of no more than 8% by weight be used to activate Klozur SP.

This will help to minimize the generation of heat and gas upon injection of hydrogen peroxide into the subsurface.

Use of hydrogen peroxide solutions in excess of 8% by weight may increase the risk of injury, loss of product containment, and equipment damage.

DETERMINING THE AMOUNT ACTIVATOR NEEDED

PeroxyChem recommends using a bench scale study to determine the optimum hydrogen peroxide to sodium persulfate molar ratio.

An example calculation for a 5:1 hydrogen peroxide to persulfate molar calculation is as follows:

1. Determine the quantity of Klozur SP in lbs to be injected into the treatment area
2. Determine the number of moles of Klozur SP:

   moles sodium persulfate = lbs of sodium persulfate / 238
3. Determine the number of moles of hydrogen peroxide needed;

   moles of hydrogen peroxide = moles of sodium persulfate x 5
4. Determine the lbs of hydrogen peroxide needed:

   lbs of hydrogen peroxide = moles hydrogen peroxide x 34
5. Determine the gallons of 8% hydrogen peroxide needed:

   Gallons of hydrogen peroxide = lbs of hydrogen peroxide / 0.684

APPLICATION GUIDELINES

Hydrogen peroxide can be injected after injecting Klozur SP.

It is recommended that if the Klozur SP and 8 wt% hydrogen peroxide solution are added simultaneously:

- No more than 5 gallons of 8% hydrogen peroxide should be added per gallon of 30% Klozur SP solution
- No more than 3 gallons of 8% hydrogen peroxide should be added per gallon of 20% Klozur SP solution
- No more than 2 gallons of 8% hydrogen peroxide should be added per gallon of 10% Klozur SP solution

It is always safer to inject the materials sequentially. If mixing hydrogen peroxide and Klozur SP above ground, PeroxyChem recommends inline mixing to ensure safe conditions. Use clean water and clean mixing and handling equipment. Transition metals in the supply water, such as iron, can result in rapid decomposition of the hydrogen peroxide. It is recommended that oxidant solutions be injected promptly into the subsurface and avoid delays resulting in the solutions remaining in mix tanks for extended periods of time. Also use vented tanks and piping when using oxidizing solutions. Always drain lines to empty and avoid trapping solution between valves for extended periods of time. Do not “dead head” pumps. When injecting hydrogen peroxide solutions, it is recommended that temperature and back-pressure be monitored and controlled to prevent highly exothermic, subsurface reactions.