

Engineering Design and Injection Considerations When Using Caustic Activated Sodium Persulfate: A Case Study Review and Lessons Learned

By: Gary Cronk, JAG Consulting Group, Inc. Santa Ana, CA,
Nicole Persaud, Antea Group, San Jose, CA,
and Jack Sheldon, Antea Group, West Des Moines, IA

Invited Presentation

Caustic soda (sodium hydroxide) is one of the most aggressive means of activating sodium persulfate and can be effectively used for destruction of many chlorinated compounds and petroleum hydrocarbons. The most important design consideration for high pH activation is the initial determination of the soil buffering capacity, which is determined from bench scale laboratory testing. In addition, during the caustic injections, the pH in nearby monitoring wells should be regularly measured to confirm an increase in the pH over 10 pH units and to maintain that pH for up to one week. It is important to inject the required dose of caustic, since maintaining the optimal pH and duration is critical for proper activation, while still allowing for the aquifer pH to recover.

To obtain optimal results, the caustic should be injected simultaneously with the sodium persulfate during direct push injections using a specially built two-hose adaptor installed just before the injection rod. During injection into dedicated injection wells, the caustic should be injected before or simultaneously with the persulfate to ensure the groundwater pH is maintained at an optimal level.

Among the issues encountered and lessons learned from caustic injections at four sites with widely varying conditions:

1. At a Torrance, CA gas station site, good reductions in TPH as gasoline, benzene, MTBE, and TBA were attained despite the fact that the caustic was over-dosed and pH levels remained elevated (over 11 pH) in three injection wells for one year after injection. A second injection at this site was performed using persulfate only (acidic solution) in order to bring the pH levels back to normal.
2. At an industrial site near Chicago, IL (a vadose zone soil treatment), the early onset of freezing weather was a continuing problem, as were the chemical daylighting issues due to the clayey soils and shallow water table. Despite these issues, the injections achieved excellent reductions of chlorinated compounds in the soils.
3. At a printed circuit board site in Newport Beach, CA, good to excellent reductions in chlorinated compounds were achieved in one monitoring well, but in two other monitoring wells only low reductions were achieved (due to matrix diffusion).

4. At a Milpitas, CA gas station site, the amount of caustic used was under-dosed (due to issues with a bench scale laboratory testing method) and the pH levels in the monitoring wells did not reach optimal levels for activation of persulfate.

Gary Cronk, P.E.

JAG Consulting Group, Inc. 3340 S. Crawford Glen, Santa Ana, CA 92704. email: gary@JAGConsultingGroup.com Telephone: 714-241-7722, Fax: 714-241-9922

Nicole Persaud

Antea Group, Inc., 1155 North 1st Street, Suite 201, San Jose, California 95112. email: Nicole.Persaud@anteagroup.com Phone: 800-477-7411 Fax: 925-886-8830.

Jack Sheldon

Antea Group, Inc., 4401 Westown Parkway, Suite 108, West Des Moines, Iowa 50266, email: Jack.Sheldon@anteagroup.com Phone: 515-223-2328.

Presenting Author: Gary Cronk