



Methods for Generating Anaerobic Water for Bioaugmentation

Bioaugmentation Culture Injection

If a dechlorinating enrichment culture is needed (such as Terra Systems Inc. TSI-DC[®]), it can be injected at the same time as our patented the SRS[®] Family of emulsified vegetable oil if the aquifer is already anaerobic and the chase/dilution water is anaerobic. The chase/dilution water can be made anaerobic (dissolved oxygen less than 0.5 mg/L and less than -50 mV ORP) by several methods:

Anaerobic Water for Bioaugmentation (DO <0.5 mg/L, <0 mV ORP, Free Chlorine <0.1 mg/L, pH 6-8)			
Chemical	Benefits	Drawbacks	Dosage per 1,000 Gallons of Fluid
Sodium Ascorbate or Vitamin C (NaC ₆ H ₈ O ₆)	Non-toxic, food grade Neutral pH Soluble at 620 g/L at 25 C	None	2.5 pounds
Sodium Sulfite (Na ₂ SO ₃)	Soluble at 270 g/L at 20 C	Biocidal Alkaline pH (9.0)	20.9 pounds
Sodium Bisulfite (NaHSO ₃)	Soluble at 420 g/L at 20 C, removes chlorine	Toxic (preservative) and acidic when dissolved	20.9 pounds
Sodium Thiosulfate Pentahydrate (Na ₂ S ₂ O ₃ ·5H ₂ O)	Neutral pH Soluble at 701 g/L at 20 C	Biocidal	8.3 pounds

A chemical reductant that has worked well for Terra Systems is sodium ascorbate. At a dosage of 0.3 g/L, it removed the dissolved oxygen within four hours and reduced the ORP to below -50 mV. This compound is biocompatible and has a neutral pH.

Other chemical reductants that have been used are sodium sulfite, sodium bisulfite, and sodium thiosulfate pentahydrate. All three compounds are used as sanitizers and react with chlorine. They are classified as generally recognized as safe (GRAS). Drawbacks to these compounds are: they generate sulfate which is a competing electron acceptor; may adversely affect the microbial population; and are not as effective in rapidly removing oxygen as sodium ascorbate.

Other clients have used between 0.4 and 1.3 g/L (33 to 108 pounds of table sugar per 1,000 gallons) and 0.011 g/L to 0.015 g/L (0.092 and 0.125 pounds per 1,000 gallons) of live yeast to generate anaerobic water. If these reductants are used, we recommend adding 2 g/L (17 pounds per 1,000 gallons) of sodium bicarbonate to the anaerobic water to buffer the acids generated



from fermentation of sugar. Incubation overnight should generate anaerobic chase water. However if possible, we recommend adding the materials at least two days before you need the first batch to make sure that it is anaerobic.

Other clients have suspended zero valent iron in bags in the tank of anaerobic water and then recirculated water until it becomes anaerobic. The dissolved oxygen reacts with the iron to generate rust. Loadings and reaction times are unknown.

A procedure for injection of the TSI-DC[®] bioaugmentation culture is available from Terra Systems upon request.