ORC Advanced®

Compatibility with Underground Storage Structures and Pipes

The use of ORC Advanced in proximity to underground tanks and pipes is not a concern. Underground tanks and pipes are installed to meet the relatively corrosive conditions of wet soil. Also, the advent of Fiberglass Reinforced Plastics (FRPs) has greatly diminished the overall concerns in this area. Both metal and FRP installations are normally exposed to fairly wide ranges of pH, oxygen saturated water and even corrosive mineral contents. The biggest threat to system failure lies in poor installation and not in the presence of materials such as ORC Advanced.

Interactions with metals and plastics are an extremely complicated phenomenon that is dependent on time, temperature and concentrations. Given enough time, oxidizers and caustic solutions will slowly react with certain metals and plastics. ORC Advanced will produce oxic conditions, but oxygen levels are typically within the range of naturally aerobic groundwater, so the environment is not considered "highly oxidizing." In many cases, ORC Advanced simply restores oxygen levels in the aquifer that had been depleted as a result of contamination. ORC Advanced does has the potential to raise groundwater pH in aquifers with low buffering capacity, but the pH increase is generally localized within a few feet of the injection point. Furthermore, the pH increase is temporary and pH conditions will return to ambient levels once ORC Advanced is completely consumed. ORC Advanced will not affect most subsurface structures near the treatment zone. A detailed discussion of materials compatibility follows.

Metals

After ORC Advanced application, a pH increase is sometimes observed in monitoring wells located near the injection points. Theoretically, in beaker of unbuffered water, the pH of an ORC Advanced solution can reach a pH as high as 11. Whether or not the pH will actually increase in the field is highly dependent on the natural buffering capacity of the aquifer and dilution effects. Iron corrosion rates drop at high pH (10-12), so a high pH may actually inhibit iron corrosion. However, as pH increases, corrosion rates increase for aluminum and zinc. If the pH remains high for an extended period of time, this may have implications for buried electrical conduit which are frequently zinc coated iron or aluminum.

In order to summarize all the factors that may lead to metal corrosion, it is customary to use a grading system as an overall guide. In a corrosion index (Table 28-2) in the Chemical Engineer's Handbook (edited by Perry and Green), one category applies to ORC Advanced: alkaline solutions. This index is graded from 0-6 with a rating of 4-6 being good to excellent in terms of compatibility. A summary of the relevant information from this table is shown in Table 1 below. Materials rated a 4 or higher with alkaline solutions include cast iron, ductile iron, mild steel, stainless steel, Incoloy 825 nickel-iron-chromium alloy, hastelloy alloy C-276 and Inconel 600. Caustic conditions may cause problems with silicon iron, aluminum, aluminum brass, nickel-aluminum bronze, lead, titanium and zirconium.

Table 1. General Corrosion Properties of Some Metals and Alloys *(from Perry's Chemical Engineers Handbook, Table 28-2)*

Materials	*Alkaline Solutions* *Caustic and mild alkalies*
Cast iron	4
Ductile iron	4
Mild Steel	4
Ni-Resist corrosion cast iron	5
Stainless steel	4 – 5
14% Silicon iron	2
Incoloy 825 nickel-iron-chromium alloy	5
Hastelloy alloy C-276	5
Hastelloy alloy B-2	4
Inconel 600	6
Copper-nickel alloys up to 30% nickel	5
Monel 400 nickel-copper alloy	6
Nickel	6
Copper and silicon bronze	4
Aluminum brass	2
Nickel-aluminum bronze	2
Bronze	4
Aluminum and its alloys	0
Lead	2
Silver	6
Titanium	2
Zirconium	2

Plastics

A wide range of plastics and pipes or Fiberglass Reinforced Plastics (FRPs) may be used in underground service. Each type of plastic will have its own characteristic definition profile. These tanks and pipes are replacing metals due to their greater chemical resistance to corrosion. In many cases plastics can withstand significant concentrations of caustic chemicals. Overall, FRPs withstand a variety of harsh outdoor conditions where they are subjected to high temperatures, ozone and UV over long periods of time.

Reference

Perry's Chemical Engineer's Handbook, Seventh Edition. 1997. Editors: Perry, R. H.; D.W. Green, J.O. Maloney. McGraw-Hill Publishing.