

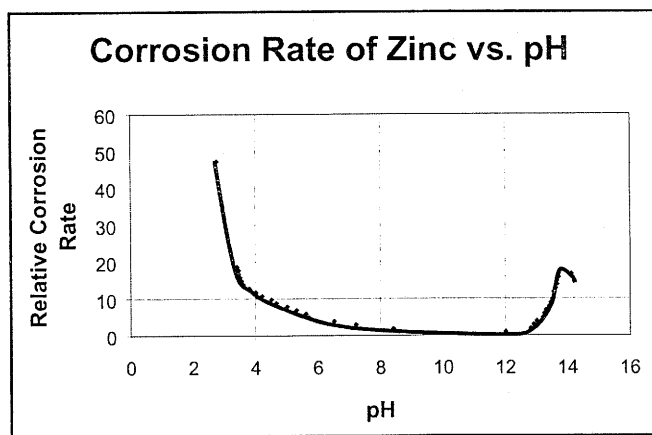
ASK DR. GALV

I KNOW GALVANIZED STRUCTURES HOLD UP WELL IN "NORMAL" ATMOSPHERIC CONDITIONS, BUT HOW DOES GALVANIZED STEEL STAND UP TO THE CORROSION CHALLENGE IN SPECIAL CONDITIONS?

Well now that's a question that the AGA gets quite often. Does galvanized steel hold up well in some special circumstance? "I need to protect my structure from corrosion, but how well and how long will hot-dip galvanized steel protect my structure?" many specifiers ask.

It's impossible to give an exact service length due to the varying atmospheric conditions throughout the world. However, general assumptions can be drawn from case histories and current data.

A major consideration in determining whether galvanized steel will perform well under certain conditions is the pH. The pH of a solution identifies the concentration of hydrogen ions in the fluid. Acids, which have a low pH, have a high concentration of hydrogen ions. Bases or alkaline solutions have a high pH, which relates to low concentrations of hydrogen ions. The pH of a solution will dictate the solubility of other constituents in the solution. Some solids are more soluble in acidic solutions while other solids are more soluble in basic solutions. In certain cases, as with zinc oxide, species may exhibit both acidic and basic solubilities. These species are called amphoteric.



After a newly galvanized part is removed from the kettle, the formation of a protective layer on the zinc metal begins. The outer layer of free zinc reacts with oxygen in the atmosphere to produce zinc oxide. Since zinc oxides are amphoteric, this layer exhibits both acidic and basic solubility. Thus, the stable region in which zinc exhibits the least corrosive behavior is in neutral solutions.

However, the pH curve lies slightly to the basic side and thus zinc is most stable in a pH region of approximately five to 13. Factors such as agitation, aeration, temperature, polarization and the presence of inhibitors may change the effect of pH and the corrosion rate curve. Within the stable pH range the protective film of zinc carbonate, called the patina, is allowed to form and has a significant impact on lowering the rate of corrosion.

Galvanized steel containers are widely used for storing and transporting chemical solutions. Many organic solutions are relatively neutral; thus galvanized steel provides corrosion protection without affecting the integrity of many widely used organic solutions. A list of over 600 chemicals that have been successfully stored in galvanized steel containers is available in *Corrosion Resistance of Zinc and Zinc Alloys* by Frank Porter.

"Great! The technical data looks good, but how about a few examples of some applications where I might not think galvanized steel performs well?"

One application where galvanized steel has performed particularly well is in Sterling Chemicals' petrochemical plant in Texas City, Texas. The galvanized pipe racks in the plant have been in service for 30 years and some of them have retained a coating thickness that exceeds ASTM thickness requirements for newly galvanized steel! The galvanized steel has exhibited excellent durability despite the harsh industrial and coastal environment.

Another application where galvanized steel has been used successfully is in fertilizer plants. Fertilizer plants produce anhydrous ammonia and phosphate-containing compounds. In the absence of excessive heat and moisture, galvanized steel performs very well in the presence of these chemicals. One such ammonia plant, Joffre Nitrogen Operations in Joffre, Alberta, has the majority of its steel structures hot-dip galvanized. Construction was completed in 1987 and the current condition of the galvanized structures is excellent.

There are numerous other applications where galvanized steel works particularly well. However, Dr. Galv does not have enough room to discuss all of them. Also, there are many other factors that affect the corrosion rate of zinc. Entire books have been written on the corrosion of zinc, but Dr. Galv thought that if a few specifics were ironed out, one might increase his or her ability to provide information to customers on specific environments where zinc wins the corrosion battle.