Dr. Galv

PREDICT HOT-DIP GALVANIZED STEEL’S SERVICE LIFE

How can I predict the service life of galvanized steel in a specific environment?

For the past 80 years, galvanized steel samples have been tested in a variety of environments around the world to determine the corrosion rate of zinc. These known rates were used to develop a performance chart that was linear to the zinc coating thickness of the galvanized steel. Although an accurate method of determining field performance at particular sites, the service-life chart the American Galvanizers Association has been using for the past 20 years has changed - for the better!

Strict environmental regulations imposed over the past 10 to 15 years have improved the quality of air to the point where galvanized steel lasts much longer. So, in order to have a contemporary method of predicting the zinc corrosion rate (hot-dip galvanized steel’s performance) for any project throughout the world, the Zinc Coating Life Predictor software was developed.

Funded by the International Lead & Zinc Research Organization, designed and built primarily by Gregory Zhang of Teck Cominco Metals, Ltd., the Predictor performs calculations based on models that were developed using statistical methods, neural network technology, and an extensive worldwide corrosion database.

The environmental data input required to estimate a corrosion rate for any location includes: temperature, annual precipitation, relative humidity, sulfur dioxide concentration, and airborne salinity. Once these values are input, the software calculates and reports a corrosion rate, and gives the option to either calculate the predicted life given the zinc coating thickness, or the coating thickness required to achieve a specified life. (Note: zinc coating thickness can only be specified for continuously galvanized steel [sheet], not after-fabrication hot-dip galvanized steel.)

This software was used to develop a chart that predicts the service life of hot-dip galvanized steel of varying coating thicknesses in a wide variety of environments. This chart provides a general idea of the performance expected from galvanized steel in any of five environments as defined by the American Society of Testing and Materials. (The new service-life chart is on page 4 of this newsletter.)

To predict the performance of galvanized steel in your location, visit the American Galvanizers Association’s Web site at www.galvanizeit.org and click on “Service Life” to access the Zinc Coating Life Predictor. Following are explanations of how to collect the open atmosphere data for the five environmental parameters for your particular location:

1) Temperatures and annual precipitation (or rainfall) information can be gathered from www.weather.com, The Weather Channel’s site.

2) Relative humidity data can be gathered from the National Weather Service at www.nws.mlbay.net/rh.html.

3) Sulfur dioxide concentrations can be obtained from an EPA report that lists the peak air quality statistics for major pollutants. This file can be found at www.epa.gov/oaqtrnd00/pdffiles/factbook.pdf. Some cities, particularly rural, do not monitor their levels of sulfur dioxide due to their low concentration. These areas can be estimated to have the lowest of all the concentrations.

4) Air salinity data for numerous environments does not readily exist. Some data exists for areas close to the sea; therefore, for inland areas, these values can be estimated from any other known data and their distance from the ocean. Some examples of airborne salinity data can be found in the Zinc Coating Life Predictor, as can examples of the other four environmental parameters.

Questions about the Zinc Coating Life Predictor may be directed to AGA: aga@galvanizeit.org or 800-468-7732.
New Software Improves Service Life Prediction for Zinc Coatings

Since the 1960s, the service life chart for hot-dip galvanized steel has been a staple of AGA publications. The ultimate factor in choosing a corrosion protection system is always "how long will it protect?" This is the question on the minds of every specifier, engineer, and architect. The ability to provide these people with an accurate tool to predict the corrosion rate of galvanized steel is essential in marketing galvanized steel products. However, the curve that is currently distributed to the public (Figure 1) was developed some time ago. The changing atmospheric conditions warrant a new tool that will improve the prediction of the service life of hot-dip galvanized steel.

The International Lead/Zinc Research Organization (ILZRO) has recently developed internet-based software to predict the service life of zinc coatings. This software, developed by Gregory Zhang of TeckCominco Metals Ltd., allows users to input environmental parameters, which affect the corrosion rate of zinc, and then calculates an anticipated corrosion rate based on the particular environment. The program performs calculations based on models that were developed using statistical methods, neural network technology and an extensive worldwide corrosion database.

The environmental input data required to estimate a corrosion rate for zinc includes temperature, airborne salinity, sulfur dioxide concentration, relative humidity, rainfall, and sheltering condition (indoor, rain-sheltered, or outdoor). Once these values are known, the program calculates and reports a corrosion rate and also gives the option to either calculate the predicted life, given the coating thickness, or the coating thickness required to achieve a specified life. The AGA Technical Department used this program to produce a current anticipated service life chart for hot-dip galvanized steel (Figure 2).

The original curve was developed from corrosion data from 1900 to 1960. The atmospheric conditions of those years were at an all-time low in terms of pollution. In this time period the birth of environmental policies and industrial improvements occurred resulting in a cleaner environment. Restrictions on the exhaustion of harmful chemicals and improvements in fume capture and exhaust air controls as well as fuel changes have significantly improved the air quality and reduced the pollution levels. By reducing the pollution level, or corrosive elements, in the air the corrosion rate of metals, particularly zinc, also decreased.

The recent advent of the Internet has made a vast informational resource available to anybody who owns a computer and has access to a phone line. Almost every major company, agency, and government has a web site that users can access to obtain information. Through the use of the World Wide Web, one can obtain environmental data for a variety of locations and regions. The easy accessibility to this information allows anyone find the correct parameters to use the Zinc Coating Life Predictor.
The resources used to construct the latest service life chart were taken from a variety of websites. The temperatures and annual precipitation (or rainfall) were gathered from www.weather.com, which is the Weather Channel's site. The relative humidity data was gathered from the National Weather Service (www.nws.msbay.net/rh.html), which had annual relative humidity data for numerous cities throughout the U.S. The sulfur dioxide concentrations were determined from a report produced by EPA that lists the peak air quality statistics for the major pollutants. This file can be found online at www.epa.gov/oar/aqtrnd00/pdf/factbook.pdf. Some cities, particularly rural, do not monitor their levels of sulfur dioxide due to their low concentration. The input values for rural cities were estimated to be the low end of the sulfur dioxide concentrations. Air salinity data for numerous environments does not readily exist. Some data exists for areas close to the sea; therefore, for inland areas, these values were estimated based on their distance from the ocean and from any other known data. Some examples of airborne salinity data can be found on the Zinc Coating Life Predictor Web site (fortjava.com:8080/zclp/index.html), as can worldwide examples of the other four environmental parameters.

The Zinc Coating Life predictor is slated to become a part of the AGA's web site (www.galvanizeit.org) in the near future. Directing potential customers to this site will allow them to find out for themselves that hot-dip galvanized steel provides the best corrosion protection system for their project.
Service Life Chart for Hot-Dip Galvanized Coatings

Derived from The Zinc Coating Life Predictor

Average Thickness of Zinc (microns top line, mils bottom line)

*Service Life is defined as the time to 5% rusting of the steel surface

Note: 1 oz./ft² ~ 1.8 mils