

Question of the Month

Q: What kind of service life can be expected from a painted overhot-dip galvanized coating, and is there a cost savings?

A: The service life of a duplex coating (paint over galvanizing) must be examined from both a theoretical and practical perspective.

Theoretical Answer

If we apply the general rule developed by Jan van Eijnsbergen, author of the book “Duplex Systems”, then a duplex coating will theoretically provide corrosion protection for approximately 1.5 to 2.5 times longer than the sum of the individual coatings. So, for example, in a moderately industrial environment a one-half inch thick structural steel weldment with 3.9 mils of zinc coating will have the following corrosion protection:

Hot-dip galvanized steel	75 years
Three-coat inorganic zinc rich primer/ epoxy intermediate/polyurethane topcoat	21 years
The duplex combination of the two would provide corrosion protection for approximately	139 – 232 years

At the end of life all of the paint barrier protection is long gone and the zinc barrier and cathodic protection is providing corrosion protection to 95% of the substrate steel. That is, 5% of the steel is now exposed and rusting.

Practical Answer

If hot-dip galvanized steel is painted, it is done so for aesthetic, identification, or safety reasons and is likely to be repainted when the paint is either faded or failing to provide barrier protection due to cracks or damage. And, in practical terms, no one expects a paint system to last much longer than 20 years. So, for a duplex coating essentially, the underfilm (under the paint) zinc oxidation is isolated to the areas where paint is no longer thick enough to provide barrier protection or at damaged areas of the paint. There is no zinc oxidation migration under the rest of the remaining paint as there is when ungalvanized steel corrodes under paint. This translates into the paint lasting about 1.5 times longer than if were it applied over bare steel. So for the same duplex system examined above, the paint would not require touchup for about 32 years (1.5 x 21 years) and maintenance repaint for about 59 years (1.5 x 39).

Intuitively we know this means a duplex system delivers maintenance cost savings; there just isn't as much painting required. Let's examine how much money is saved.

Using the Life-Cycle Cost Calculator at www.galvanizingcost.com and the following parameters for a typical project:

- Industrial environment
- 75 year project life
- 10,000 ft² project at 250 ft/per ton



A Duplex System

Paint (Alone or on Bare Steel)	
Initial Cost	\$3.07/ft²
Maintenance Cost Over 75 Years*	\$4.83/ft²
Total Life Cycle Cost in net present value (NPV) dollars	\$7.90/ft²
*Touchup maintenance after 21 years, maintenance repaint in 28 years, full repaint in 39 years and another touchup in year 60.	

Duplex System (HDG & Paint)	
Initial Cost	\$4.35/ft² (\$3.07 + \$1.28)
Maintenance Cost Over 75 Years*	\$2.05/ft²
Total Life Cycle Cost in net present value (NPV) dollars	\$6.40/ft²
*Touchup maintenance in year 32, maintenance repaint in year 59.	

In summary, the direct life cycle cost savings achieved from utilizing a duplex system is the difference between the two, i.e. \$1.50/ft², or in total dollars for this example project \$15,000 NPV. Considering there are two less maintenance cycles, we can correctly conclude there is a lower indirect cost as well. Indirect costs such as lost productivity, traffic delays, safety, and natural resources are estimated to be anywhere from 5-11 times the direct cost. Duplex systems make sense as well as saves dollars.

Other points to consider include the fact touchup painting may not be possible on hard-to-reach areas where corrosion often initiates, and the cost savings of a duplex system are enhanced when the project life is extended beyond 75 years.