Corrosion protection of road bridges with a 100 years lifetime

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In Norway there are about 2200 steel bridges. They typically have a design life of 100 years, and most of them are located in coastal areas, crossing fjords and straits. Depending on elevation over the sea and climatic conditions at the site, the corrosivity varies. Corrosion class C5 according to ISO 12944 must be assumed for many bridges. Some floating bridges are even entirely located in what must be defined as the splash zone. Hence, corrosion is a considerable threat to these bridges. Due to the very long lifetime of the bridges, a long life coating system is also desired in order to keep the life cycle costs as low as possible.

Since 1965 the coating specification for Norwegian road bridges has been to apply 100 µm thermally sprayed zinc (TSZ) with a paint system on top, a so called duplex coating system. The paint system has changed over the years, depending on environmental legislation and paint technology development in general. Before about 2000 a coating system consisting of a wash primer and four layers of alkyd/chlorinated rubber was mainly used, and after that a system consisting of an epoxy sealer, epoxy barrier coat and a polyurethane topcoat has been used.

The experiences with these duplex coating systems have mainly been good. There are examples of bridges in coastal areas with more than 40 years maintenance free coating lifetime. The aim is to have at least 35 years coating lifetime, and that only the topcoat has to be refreshed at that time. However, there are also examples of bridges where the coating has failed after only 20 years, so that blast cleaning and application of a new duplex coating has been required.

Inspections of failed coatings have shown that the coating failures are due to paint application errors. Two types of errors are particularly frequent:

- Pinholes in the sealer. The sealer is not sufficiently diluted and is unable to penetrate the pores in the TSZ.
- The paint system is applied too thin. The applicator/inspector usually only measures total coating film thickness, including the TSZ, so that high TSZ film thickness masks low paint film thickness. Hence, low paint film thickness is not discovered.

A laboratory investigation of the corrosion of painted TSZ was started, studying the formation of pores at the TSZ-paint interface and the corrosion mechanism of the zinc in the pores. Pore formation was studied as function of sealer viscosity. Corrosion initiation in pores was investigated as function of humidity, salinity and TSZ alloy composition.