A critical comparison of epoxy phenolic and alkylated amine epoxy technology in uninsulated conditions

Darren Ward - Technical Manager, Oil & Gas

For many years, Epoxy Phenolic technology has been a common solution specified to protect pipework operating at high temperatures. These coatings evolved from linings used for the internals of storage tanks, where a highly crosslinked film was advantageous to resist the damaging effects of strong chemicals or high temperature service. Over time, it was realized that the high crosslink density also provided an effective barrier to mitigate the damaging effects of Corrosion Under Insulation (CUI). Recent testing demonstrates that Alkylated Amine Epoxy technology is a next-generation alternative, with greatly enhanced application properties and improved UV resistance.

There are many generic specifications utilized in the protective coatings industry for the protection of piping which operates through a range of temperatures, and these are often driven by specific client requirements. Variables include:

- Operating Conditions i.e. cyclic or static temperature
- Design parameters i.e. insulated or uninsulated
- Substrate material i.e. carbon or stainless steel
- Specification i.e. 2 x 100µm, 2 x 125µm, 3 x 90µm (2 x 4 mils, 2 x 5 mils, 3 x 3 mils)

Assuming application and surface preparation is carried out in accordance with the coating manufacturer's recommendations, Epoxy Phenolic technology generally shows good 'real world' resistance to the aggressive CUI conditions found on high temperature piping, valves and vessels. UV radiation causes chalking and discoloration of Epoxy Phenolic coatings over time, which makes it important to consider the environmental conditions that the coated steel will experience not only during operation, but also during transit and on-site storage prior to the installation of any insulation materials. Premature coating failure may result where environmental conditions are not fully known, understood and/or taken into account, in both the selection of the coating technology and during application/installation.

A next generation high temperature coating from AkzoNobel, based on novel Alkylated Amine Epoxy (AAE) technology and pigmented with aluminium flakes, has demonstrated significantly improved resistance to the erosive effects of UV and rainfall in both natural weathering and accelerated tests. Temperature resistant from -196°C (-321°F) to 230°C (446°F), Interbond 2340UPC is a combination of an alkylated epoxy resin with aluminium pigmentation, resulting in a coating with excellent CUI resistance alongside very low erosion rates when compared with typical Epoxy Phenolics found on the market. This significantly reduces DFT loss, even in high UV/high rainfall environments.

Picture 1: Insulated high temperature piping

Picture 2: Uninsulated high temperature piping

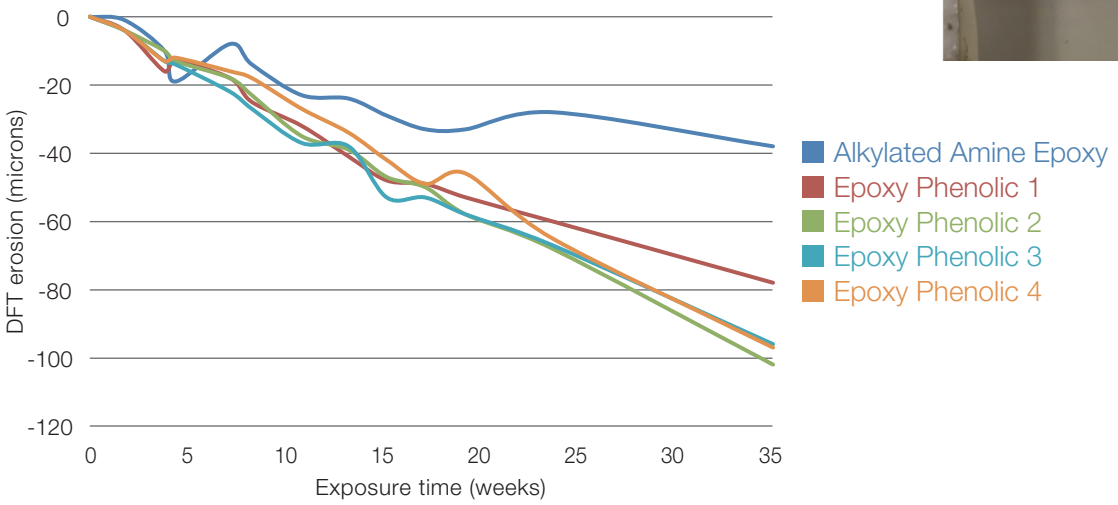
Fig 1: UV Erosion test procedure

Accelerated erosion test
Coatings are evaluated for DFT loss after exposure to a highly erosive combination of UV, water spray and condensation. The test is designed to simulate ~2 years in an extreme climate which constantly cycles between high UV and heavy rainfall.

Exposure Cycle – 7 day cycle repeated 30 times.

Test Element	Duration
- 2.5 hours UV-A - 0.5 hours water spray (repeated 8 times over a 24 hour period)	6 days
- 24 hours condensation at 40ºC (104ºF)	1 day

Loss of DFT versus time when exposed to accelerated erosion test



Picture 3: Example test panel, system DFT: 2 x 100µm (4 mils) of Epoxy Phenolic. The topcoat has been eroded to show the primer coat below.

The challenge faced by many process piping and material design engineers is to understand the erosive/corrosive environment for the coating during:

- Storage and erection stage (up to 2 to 3 years on large projects)
- Designed operation
- Design changes later in asset lifecycle (such as removal of insulation)

The above testing demonstrates the improved erosion resistance of the AAE technology, thus providing long term performance in comparison to typically specified Epoxy Phenolics.

Interbond 2340UPC provides a single effective coating solution, delivering long term protection during operation and project build, whilst ensuring operational flexibility if insulation is removed later in the asset lifetime.

October 2018