Endurance Technologies

Providing Abrasion and Corrosion Resistant Solutions Worldwide

EndurAlon™ (Alonizing™)

Corrosion Resistant Solutions

When Stainless Steel Fails

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Stainless Steel Failure

EndurAlonized™ steel performs well in high-temperature environments where even stainless steel fails. Stainless steels are often considered the final answer to every kind of corrosion problem. But there are those situations in which stainless steel, because of its metallurgical or chemical properties, is almost certain to fail (e.g. catastrophic sulphidation of highnickel stainless materials).

Austenitic grades of stainless steel are used because of their excellent resistance to high-temperature oxidation. Generally, the higher the temperature to which the metal will be exposed, the higher the nickel content of the alloy must be. For example, a type 201 stainless (16/18% nickel) can withstand a continuous operating temperature of 1550°F while a type 310 stainless (19/22% nickel) can withstand continuous service temperatures as high as 2100°F.

Alloys with greater nickel contents can withstand even higher working temperatures. There is a limit, however, to the maximum amount of nickel that can be used in an alloy exposed to high-temperatures sulfidation.

With nickel contents of 25% or more, the nickel will preferentially combine with sulphur to create a lowmelting temperature nickel sulfide eutectic. The nickel sulfide eutectic has a melting temperature of 645°C. However, at temperatures as low as 550°C, sulphur will begin to penetrate the nickel alloy, causing rapid embrittlement. Once the eutectic forms, the nickel is preferentially melted out of the alloy, leading in many cases to catastrophic corrosion and failure.

Alonizing stainless steel will passivate the surface of the material, tying the nickel into an iron-aluminum alloy and preventing the formation of the eutectic. In an experimental plan in South America in which a technique for direct reduction of iron ore was being studied, one of the components was a 1” IPS schedule 160 pipe made of a high nickel proprietary alloy. During a 17-hour period in which this piece was exposed to high-temperature sulphur bearing gases, the pipe wall was completely penetrated in a number of places.

The replacement piece was Alonized™ and the pipe remained sound and unaffected after many subsequent exposures to the same reagents at the same temperatures.

NOTE: The heat of the Alonizing™ process may cause a slight change in tube length. For this reason tubes or pipes with a finish length of longer than about 16’ (4,900mm) are typically ordered 1% over length and then trim cut to final length after Alonizing. Alonized tubing is specified in a number of gas plants to protect the tubes in the waste heat boilers and condensers. A wide variety of metallurgies and configurations are Alonized for use in many types of gas-processing plants.

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