SEVERE SERVICE JOURNAL

www.FisherSevereService.com

A Newsletter from Emerson's Severe Service Team

Research Products News Technology

July 2011 **Volume 11, Issue 3**

The Severe Service Journal is published quarterly by the Emerson severe service team and is distributed by email. To subscribe, go to www.FisherSevereService.com. The Emerson severe service team provides global customers with Fisher® severe service control valve solutions. Whether it is severe service applications for the power, hydrocarbon, chemical or pulp and paper industry, these technical experts deliver sound solutions to address critical applications for aerodynamic noise, cavitation and out-gassing issues, as well as particulate erosion. Please visit our website or contact your local Emerson sales office for more information.

Look to Emerson for Control Valve Corrosion Solutions

Corrosion is the deterioration of a material, usually a metal, which results from a chemical or electrochemical reaction with its environment. In this sense, the word "environment" is not only limited to the external environment, but also to the environment in contact with the component in question, such as the process fluid in contact with a valve trim component.

Type 316 stainless steel plug showing severe corrosion

There are many chemicals that can be corrosive to pipelines and valves. Some of the process fluids resulting in severe corrosion are often found in the hydrocarbon industry. These are due to the naturally corrosive nature of the chemicals that are separated out of crude oil and the chemicals needed to further process oil and gas. For example, the most common problematic component encountered in oil and gas production is hydrogen sulfide (H_2S), which can cause corrosion and sulfide stress cracking (SSC) in piping, vessels, and control valves if proper material selection and material processing are not employed.

There are many different forms of corrosion, ranging from general corrosion (which basically affects the entire exposed surface in a primarily uniform manner) to localized corrosion mechanisms such as pitting (formation of small, deep pits) and stress corrosion cracking (SCC).

Some materials are inherently more resistant to corrosion than other materials. Alloys containing chromium get their corrosion resistance from a passive oxide layer on their surface, which acts as a barrier to further oxidation or corrosion. Most stainless steel and nickel alloys rely on this layer for their corrosion resistance.

Type 316 stainless steel exhibits this type of protective film and is commonly used as a trim/body material in Fisher valves. Corrosion resistance can also be enhanced by increasing the amount of nickel. For example nickel alloy C, commonly known by the Haynes International trademark Hastelloy® C, exhibits excellent resistance to sulfuric, hydrochloric, and organic acids as well as ammonia, dry chlorine, and hydrogen sulfide. Nickel alloy 625, commonly known by the Special Metals trademark Inconel® 625, also has high corrosion resistance in a wide range of environments, and is commonly specified in the oil and gas industry for resistance to pitting, crevice corrosion, and SCC caused by high chloride levels, as well as resistance to sulfide stress cracking.

Emerson Process Management offers a vast range of corrosion resistant options for a range of severe service control valve applications. Your local Emerson Sales or Local Business Partner office can help obtain the best solution to your corrosion problems.

Fisher® Cladding Technologies

Cladding is defined as the act or process of bonding one metal to another, usually to protect the inner metal from corrosion. Traditionally this has been a process utilized in the hydrocarbon industry for piping. Recently, it has begun to gain favor in other components such as control valves.

The main driver for utilizing this process on valves and piping is to allow for a less expensive base material, such as carbon steel, to have the corrosion properties of a much more expensive material such as Inconel® 625 at the surface. The benefits are that the wetted surfaces have the corrosion resistance of the clad material with an overall cost closer to that of the base material.

Emerson Process Management is able to offer this option on our Fisher® NPS 8—24 globe style valves and NPS 3 and larger angle valves. All sizes can be offered in both high pressure and low pressure valves. A variety of materials are available including Inconel® 625, Incoloy® 825, Hastelloy™ C, Duplex Stainless Steels, Austenitic Stainless Steels, and Alloy 400 with other materials available upon request.

Thus, if you feel that this technology may be a good fit for your process, contact your local Emerson Process Management sales office today for an application and technology review.

Alloy Solutions

For many years, the 300 series stainless steels (SST) have been the workhorse alloys for corrosive applications. For severe applications, the nickel-base alloys were the next step in corrosion resistance. The cost differential, however, was great (four to ten times, or more). In recent years, Duplex and Super Austenitic SSTs have started to fill this void as cost-effective alternatives.

In an effort to provide customers with a more cost effective solution, Emerson Process Management has standardized on material offerings and suppliers. To provide the optimum properties at the best value, the specific material grades shown below have become the standard offering for higher grade alloy materials. Standardizing on a group of experienced global suppliers has provided shorter lead times due to the ability to forecast these materials.

Using these materials is suggested when selecting higher grade alloy steels for use in corrosive service.

Common Name	Typical Composition	Castings	Forgings	Bar
Duplex	22% chromium, 5% nickel, 3% molybdenum	ASME SA995 Grade CD3MN or 4A	ASME SA182 Grade F51	S31803
Super Duplex	25% chromium, 7% nickel, 3.5% molybdenum, and traces of tungsten and copper	ASME SA351 Grade CD3MWCuN or 6A	ASME SA182 Grade 55	S32760
Super Austenitic	20% chromium, 18% nickel, 6% molybdenum, 1% copper	ASME SA351 Grade CK3MCuN	ASME SA182 Grade F44	S31254
Alloy 625	22% chromium, 9% molybdenum, 2% iron, balance nickel	ASTM A494 Grade CW6MC	ASME SB564 Grade N06625	N06625
Alloy 825	21% chromium, 42% nickel, 3% molybdenum, 2% copper, balance iron	ASME SA494 Grade CU5MCuC	ASME SB564 Grade N08825	N08825

NACE Standards - A Fundamental Overview

The consequences of sudden failures of metallic oil and gas field components, associated with their exposure to production fluids containing hydrogen sulfide (H_2S), led to the preparation of the first edition of NACE MR0175, which was published in 1975 by the National Association of Corrosion Engineers, now known as NACE International.

Sulfide stress cracking (SSC) is actually a form of hydrogen stress cracking (otherwise known as hydrogen embrittlement). The following factors are required for SSC to occur:

1. Presence of H_2S and water (even a trace amount of moisture is sufficient)
2. Susceptible material composition, strength/hardness, heat treatment, and microstructure
3. Tensile stress (residual and/or applied)

From a valve manufacturer standpoint, sulfide stress cracking can be controlled through the use of proper materials in the proper conditions.

The NACE standards establish H_2S limits above which precautions against sulfide stress cracking (SSC) may be necessary. They also provided guidance for the selection and specification of SSC-resistant materials when these H_2S limits are exceeded. The standards do not specify any type of "NACE Test" to certify a valve assembly.

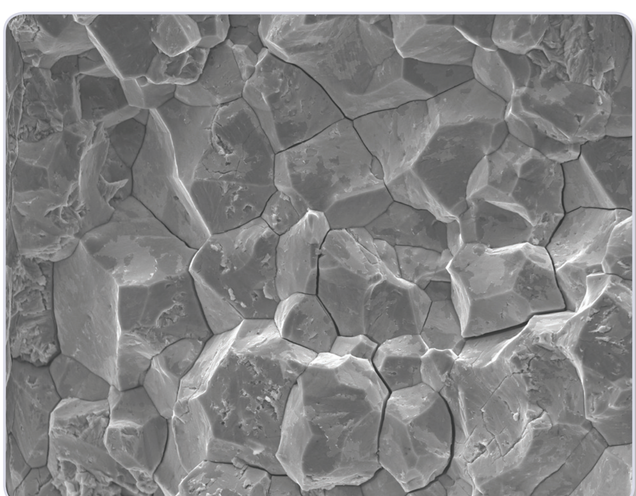
Although the initial revisions of NACE MR0175 were only concerned with sulfide stress cracking, revisions since 2003 address several mechanisms of cracking that can be caused by H_2S and/or chlorides, including chloride stress corrosion cracking, hydrogen-induced cracking and stepwise cracking, stress-oriented hydrogen-induced cracking, soft zone cracking, and galvanically-induced hydrogen stress cracking.

The two current standards that are applicable to control valves are NACE MR0175/ISO 15156 - "Petroleum and Natural Gas Industries - Materials for use in H_2S Containing Environments in **Oil and Gas Production**" and NACE MR0103 - "Materials Resistant to Sulfide Stress Cracking in Corrosive **Petroleum Refining** Environment."

NACE MR0175-2003, the short-lived precursor to NACE MR0175/ISO 15156, is still referenced occasionally and NACE MR0175-2002, which was the last revision of NACE MR0175 prior to the scope expansion, is still specified quite frequently for upstream applications.

NACE MR0175/ISO 15156 includes added environmental restrictions (such as maximum temperature limits) to address chloride stress corrosion cracking, an issue usually associated only with upstream applications. NACE MR0103 places extra emphasis on welding controls in several material groups, as welding is more prevalent in refinery piping and equipment. NACE MR0103 lists certain materials and/or material conditions that are not listed in NACE MR0175/ISO 15156, and vice versa.

It is important to note that it is always the end user's responsibility to request NACE-compliant materials. End users are also responsible for specifying which of the two standards is applicable to their process, and what revision applies. As a manufacturer, Emerson Process Management is responsible for meeting the specified metallurgical requirements.



Scanning electron microscope image of integranular fracture surface caused by sulfide stress cracking

Valve Plug Seizure and Corrosion Eliminated in Hydrogen Recycle Application Using Fisher® Severe Service Control Valve

A hydrogen recycle valve, controlling hydrogen flow to the hydrocracker, was causing frequent disruption to the refinery's operation and impacting plant efficiency due to valve plug seizure and stress corrosion problems.

The hydrocracking process produces lighter hydrocarbon products from heavy feedstocks through reaction with hydrogen in multiple heated catalyst beds. Controlling hydrogen feed into the catalyst bed directly impacts the cracking conversion process and the quality of the light hydrocarbon products. At the same time, piping and valves in this application experience corrosion due to polythionic acid, caustics, and napthenic acid.

The refinery approached Emerson Process Management for a control valve solution to address the problems.

Emerson Process Management engineers evaluated the application and recommended an NPS 6 Fisher® EHZ severe service control valve with a 347 SST body with proper trim material to address the stress corrosion problem that was occurring under the severe operating conditions.

The post-guided Fisher EHZ valve design was selected to minimize the seizure effect of solid particle buildup in the valve. Sufficient actuation force to overcome excessive valve friction, which could result from potential particle deposits, was also incorporated in the design.

Since startup, the Fisher severe service control valve has operated smoothly without any of the valve plug seizure or corrosion problems experienced by the original valve.

For more information on severe service solutions, visit www.FisherSevereService.com.

The Severe Service Journal is published quarterly by the Emerson severe service team and is distributed by email. To subscribe, go to www.FisherSevereService.com.

Emerson Process Management
Marshalltown, Iowa 50158 USA
Sorocaba, 18087 Brazil
Chatham, Kent ME4 4QZ UK
Dubai, United Arab Emirates
Singapore 128461 Singapore
www.EmersonProcess.com/Fisher

FISHER®
Severe Service

EMERSON™
Process Management