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TO: Ashland Specialty Chemical Company Drew Marine Personnel Worldwide

FROM: Lois Neil

SUBJECT: METAL PASSIVATION

DATE: February 26, 2001

We have several products that provide metal passivation corrosion inhibition for the various shipboard water systems. The chemistries include nitrite for cooling water systems, silicate for potable water systems, hydrazine and DEHA for steam generating systems.

The following discussion on metal passivation is intended to help understand how these different chemistries provide metal passivation in the various water systems that they are used in.

Regards,

Lois

Lois

LN/hb
attachment:

NTSB 27

Metal Passivation

Passivation Provided by Nitrite and Silicate

Metal surfaces can be passivated (when there is no difference in potential between the anode and cathode areas and corrosion is minimized) by formation of a thin, impervious film that is formed by the addition of corrosion inhibitors such as nitrite (DEWT® NC, LIQUIDEWT™ or MAXIGARD®), and silicate (CIL™). Nitrite and silicate are considered to be anodic inhibitors and provide passivation corrosion protection because they react and bond with the metal at the point of potential metal loss by forming a thin, protective, mono-molecular film, thus minimizing the anodic corrosion reaction and reducing metal loss.

The mono-molecular film formed from nitrites and silicates can form over either clean or rusted surfaces. Applying over clean surfaces minimizes corrosion and applying over rusted surfaces inhibits further corrosion. If applied in insufficient quantities, they do not properly passivate. Therefore, it is important to add sufficient nitrite or silicate for the protective film to remain intact.

Silica found in many shore water supplies does not provide enough protection. Therefore, additional silicate as SiO_2 is needed above the silica level normally found in the shore water supply.

Passivation Provided by Hydrazine and Diethylhydroxylamine (DEHA)

Magnetite (ferrous oxide) and cuprous oxide are well-known protective, mono-molecular metal oxide films that act as a barrier against corrosion, passivating the iron or copper metals and inhibiting further corrosion in steam generating and condensate systems. They are bonded to the metal surfaces when oxygen scavengers such as hydrazine (AMERZINE®) and DEHA (DREWPLEX® OX) are fed in excess over the demand of oxygen scavenging.

Hydrazine and DEHA differ somewhat in their passivation properties from nitrite and silicate in that they have the ability convert common rust (Fe_2O_3) into magnetite (Fe_3O_4) as well as form a magnetite passivation film on a clean metal surface.

Passivation Provided by Nitrite, Silicate, Hydrazine and DEHA

The protective films formed by nitrite, silicate, hydrazine or DEHA are extremely thin films and are not considered to be like thick coatings that foul equipment or impede heat transfer.

Over time, the thin mono-molecular film formed by these passivators becomes self-repairing and the growth of the film is self-limited because corrosion products necessary for the process are unavailable as the corrosion process is inhibited.

Metal surfaces that are passivated must be maintained in that state by the attention to the proper control of the passivating chemical and periodic testing.

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