U.S. Navy - Use of Vapor Corrosion Inhibitors

Vasanth published a limited literature review on the use of corrosion inhibitors in naval vessels [1] where he cited a Navy Research Laboratory (NRL) review of vapor corrosion inhibitors (VCIs) during World War II. It found that equipment losses were appalling in the early war years, primarily due to poor packaging for overseas shipment. Ammonium nitrite-based VCIs and new materials and packaging techniques were introduced to address the problem. Early use of VCI exposed the challenge of finding the correct inhibitors that did not attack non-ferrous metals while protecting steels. It should be noted that the U.S. Department of Defense includes VCIs in a military standard for packaging materials [2].

Vasanth also cited personal research conducted at NSWC Silver Springs. The mechanism and effectiveness of two VCI emitters and one VCI aerosol spray, both non-toxic, were examined. It was found that VCI vapors deposit on the metal surface wherever moisture is present and form a monomolecular film, which protects the asset from corroding. Furthermore, VCI vapors will quickly replenish and provide continuous protection when additional moisture enters the test enclosure. Vasanth was concerned about the corrosion of diodes in an electronic cabinet. The test results were positive after nearly two years, and the VCIs employed were recommended for similar onboard applications.

Vasanth concluded that corrosion inhibition is an economical solution to overcome some corrosion problems, and at the time of writing in the mid-1990s, that non-toxic and environmentally friendly asset protecting corrosion inhibitors are the goal.

In 1996 the Ship Structures Committee (SSC) published a study on corrosion control of inter-hull spaces, stimulated by the advent of double-hull, split-resistant tankers [3]. The committee recognized the benefits of VCIs to protect enclosures and noted the success in protecting sensitive electronics. The report recommended that large-scale evaluations are needed to assess the effectiveness of VCIs in voids and inter-hulls spaces which may be several hundred or thousand square meters in area. It also noted a concern for inspection periodicity and its effect on VCIs effectiveness. The SSC did *not* recommend the use of VCIs in inter-hull spaces that would or could be used as ballast tanks, primarily because it might result in the pumping of chromate- and phosphate- contaminated water overboard. The report also cited that in a dry, infrequently opened inter-hull space VCIs in conjunction with a coating system could provide protection lasting in excess of 10 years. It should be noted that 20 years later VCI chemistries are environmentally friendly and provide longer corrosion protection than the two years cited in the SCC report. Perhaps it is time to revisit the contaminated water concerns to determine whether they are still valid.

A 2009 memo from the Office of the Secretary of Defense, cited restrictions on both hexavalent chromium and cadmium. Both are effective corrosion inhibitors but unfortunately are carcinogens [4]. Hexavalent chromium and cadmium are restricted unless a no cost effective alternative with satisfactory performance is available." The article cites four projects seeking alternatives to hexavalent chromium and cadmium.

In 2013 NAVSEA approved the next generation of advanced protective cover with vapor corrosion inhibitor technology developed by Transhield. Made from ArmorDillo®, these second generation covers provided a lighter, more form-fitted cover. Growing demand for covers to protect an array of different assets throughout the fleet confirms the cover's efficacy.

It is evident that corrosion inhibitors have been successfully used in naval applications for over seven decades [5].

References

[1] Vasanth, K. L., Corrosion Inhibition in Naval Vessels, Paper #233, Corrosion 96

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[3] SSC-390, Corrosion Control of Inter-Hull Spaces, Ship Structure Committee, 1996

[4] Webber, C., NAVAIR Discovering Alternatives to Hexavalent Chromium and Cadmium, Currents, Fall 2014, pp. 58-62

[5] Sharman, D. J. Washburn, M., Ozol, S., The Wide-Ranging Benefits of Corrosion Inhibitors, The Society for Protective Coatings (SSPC) Department of Defense Allied Nations Technical Corrosion Conference, August 2017

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