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Standard
Recommended Practice

Pilot-Scale Evaluation of Corrosion and Fouling Control Additives for Open Recirculating Cooling Water Systems

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Foreword

Environmental requirements, water shortages, and business pressures have forced industrial plants and power stations to operate with longer production runs, reduced maintenance outages, fewer operating personnel, and increased stress on cooling water systems. Similarly, commercial refrigeration (heating, ventilating, and air conditioning [HVAC]) systems have experienced increased heat loads and requirements for long-term continuous cooling water supply to data management facilities, large retail establishments, campuses, and office complexes.

Under these increasingly severe conditions, cooling water chemical treatment programs are expected to maintain optimum operating efficiency and, at the same time, protect the economic life of the equipment by inhibiting corrosion, mineral scaling, microbiological fouling, and miscellaneous deposition on heat-transfer surfaces.

Cooling system design and operating characteristics vary widely, within individual plants, from site to site, and worldwide. Thus, selection and optimization of water treatment programs must be a site-specific process. In most systems, optimized cooling water chemical treatment is the key to successful long-term operations. The subject of this standard is, therefore, the establishment of criteria for the pilot-scale evaluation of the performance of cooling water additives under field-specific operating conditions.

This standard is intended for use by cooling system owners/operators, water treatment companies, and others who must evaluate the performance of cooling water additives under field-specific operating conditions.

This standard was originally published in 2000 by Task Group T-7A-22, a component of Unit Committee T-7A on Cooling Water. It was revised in 2003 by Task Group (TG) 153 on Pilot-Scale Evaluation of Cooling Water Products, which is administered by Specific Technology Group (STG) 11 on Water Treatment. It is published by NACE under the auspices of STG 11.

In NACE standards, the terms *shall*, *must*, *should*, and *may* are used in accordance with the definitions of these terms in the *NACE Publications Style Manual*, 4th ed., Paragraph 7.4.1.9. *Shall* and *must* are used to state mandatory requirements. The term *should* is used to state something good and is recommended but is not mandatory. The term *may* is used to state something considered optional.

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Section 1: General

1.1 This standard covers the criteria that must be defined and implemented in a pilot-scale testing program to select water treatment programs for use in specific recirculating cooling water systems.

1.2 This standard covers only open recirculating cooling water systems. Closed cooling systems and once-through cooling water systems are specifically excluded.

1.3 This standard applies only to systems incorporating shell-and-tube heat exchangers with standard uncoated smooth tubes and cooling water on the tube side. Heat exchangers with shell-side water, plate and frame and or spiral heat exchangers, and other heat-exchange devices are specifically excluded. However, when the test conditions are properly set up to model the surface temperature and shear stress in more complex heat-transfer devices, the test results may predict what may occur in an operating heat exchanger of that design.

1.4 The test criteria established in this standard are not intended to govern the type of bench and pilot-scale testing normally done by water treatment companies as part of their proprietary product-development programs. However, water treatment companies may choose to use the criteria in this standard as guidelines in the development of their own product-development test procedures.

1.5 On-Site Versus Off-Site Testing

1.5.1 Laboratory and off-site testing

1.5.1.1 Laboratory testing, or testing at alternative off-site locations, may in some cases be necessary for selecting cooling water chemical treatment programs. This type of testing could be used for new construction startup programs, when operating systems are not available, or for evaluating alternate treatment programs. In such cases, the evaluation should include site-specific design criteria and environmental regulations that affect the cooling water system. Site-specific water supplies should be used whenever possible. All criteria in this standard relating to water compositions, test unit configuration, heat-exchanger design, and operating conditions should be followed insofar as possible.

1.5.1.2 No laboratory or off-site testing program can completely duplicate plant conditions. Site-specific factors such as process leaks, microbiological growth, corrosion products, airborne contamination, etc., may affect the operation of cooling water systems and the performance of chemical treatment programs in ways that override the results of laboratory or off-site testing programs.

1.5.2 On-site testing

1.5.2.1 Whenever possible, water treatment programs should be evaluated on site, using plant water supplies and actual design and operating conditions, particularly those that cannot be duplicated in the laboratory. Criteria for these effects are discussed later in this standard.

1.5.2.2 Specific attention must be given to site-specific rules and environmental regulations that may affect the types of chemical products that can be used, the allowable amount and composition of blowdown water, and air quality regulations affecting cooling tower discharge.

1.5.3 On-line testing

1.5.3.1 Whenever possible, all off-site, laboratory, and on-site pilot-scale testing should be validated by monitoring actual performance results on-line. Pilot units can be adapted for on-line work by using a sidestream from the plant circulating cooling water as feedwater, bypassing the pilot unit cooling tower. Such on-line testing serves to validate the off-line/laboratory tests. Cooling systems may be evaluated on-line; however, the data collected will be the result of the combination of any existing treatment and all additional chemicals that were added for the evaluation period. On-line testing in this way can be useful for optimizing the treatment program to meet specific plant requirements. For example, small quantities of a treatment chemical may be added just ahead of the test heat exchanger to measure the effects of increasing additive dosage, or the possible synergistic effects of a new chemical added to the existing treatment program.

Section 2: Test Unit Design Parameters

2.1 Careful evaluation of the mechanical design and operation of each cooling water system is a necessary prerequisite for designing a pilot-scale water treatment product evaluation program. It may not be practical to simulate a specific critical plant heat load or water-flow pattern exactly. Contamination in a pilot cooling tower may