PUBLISHED QUARTERLY FOR THE BENEFIT OF THE WATER TREATMENT CHEMICAL USER

Volume 20 **Spring 2005**

Don't Let White Rust Destroy Your Tower – Or Your Budget

Facility owners and managers have long had to deal with the difficult and costly problems caused by water and the impurities it contains in their cooling towers and related equipment. Each year, millions, perhaps billions of dollars are spent mitigating and preventing such water-related cooling system problems as scale, corrosion, fouling and uncontrolled microbiological growth. In recent years a new phenomenon has appeared that has made life for facilities personnel even more difficult – WHITE RUST.

White rust is a type of corrosion that occurs on wetted surfaces in new galvanized cooling towers. It is characterized by the formation of a white fluffy or waxy non-protective zinc carbonate corrosion product. Under certain conditions, white rust will develop quickly on new unpassivated galvanized steel, and, if left unchecked, can rapidly result in severe corrosion to the exposed steel beneath the galvanized layer. This corrosion can necessitate expensive repair or even replacement of the tower or tower components.

Galvanized steel has been used as the primary material of construction for factory-assembled cooling towers for many years, but white rust began to appear only within the past 10-15 years. So what caused this change? This has been the subject of much debate among galvanized steel makers, cooling tower manufacturers and water treatment professionals.

Years of study and research support the notion that several factors contribute to the formation of white rust. Some evidence suggests that changes in the galvanizing process have produced galvanized steel that is more susceptible to the formation of white rust. The change over the past 15-20 years to operating cooling water systems at higher pH levels has certainly played a part as well. Before USEPA banned the use of chromate as a cooling water corrosion inhibitor, cooling water systems were controlled to a pH range of approximately 6.0 – 7.0. The ban on chromate necessitated increasing the pH control range to 8.0 – 9.0 and higher. This change coincides with the appearance of white rust.

In contact with water, new galvanized steel will naturally form a zinc oxide or zinc carbonate layer or film. If the pH of the water is below 8.0, this film will be a relatively hard, non-porous, protective coating. If, however, the pH of the water contacting the new galvanized surface is greater than 8.0, a soft fluffy or waxy, porous form of zinc carbonate will form – this is white rust. This form of zinc carbonate is non-protective and will promote corrosion of the underlying steel. If left unchecked, the development of white rust on a wetted cooling tower surface (basin, distribution deck, structural members, etc.) can result in severe corrosion and early and expensive repair or replacement.

White rust on a galvanized steel tower basin. The reddish brown color is evidence of corrosion to the steel substrate.

Fortunately, white rust is preventable. The surest way for a building owner or manager to prevent white rust is to purchase new cooling towers that are constructed of materials other than galvanized steel. Stainless steel, plastic and fiberglass are all cooling tower materials of construction (MOS) that will not develop white rust and are very corrosion resistant. Cooling towers constructed of these materials generally have a higher initial cost

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than galvanized towers, but they may prove less expensive over time due to longer service life.

If this alternative is not viable and a facility has a new galvanized tower, it is still possible to prevent the development of white rust on tower surfaces. When a new galvanized tower is put into service, the following procedure should be followed:

1. Prior to start-up, completely clean the tower basin and fill of all loose dirt and debris.
2. If make-up water chemistry allows, operate the system at low cycles of concentration to keep the recirculating water pH below 8.0.
3. If the pH can not be kept below 8.0 with heavy bleed-off, the addition of acid will be required.
4. Using proper acid feed equipment, maintain the cooling water pH between 7.0 and 8.0. Make certain not to over-feed the acid, because damage to the galvanized surface will occur if the pH drops below 5.5.
5. Maintain sufficient levels of the correct corrosion inhibitors during acid feed. Molybdate, phosphate or the new organophosphate inhibitors will provide good protection if controlled properly.
6. Continue operating in this manner for a minimum of 60 days, after which the program can be allowed to return to normal operating conditions. At this point, the wetted galvanized surfaces should be passivated with a protective zinc oxide/zinc carbonate film.
7. If after the initial 60 day passivation period white rust begins to form, go back to the acid feed program. Periodic 60 day re-passivation procedures may be required under certain severe conditions (soft water make-up and very high pH).
8. If the cooling system is operated on softened make-up water, by-pass hard water into the system to maintain at least 50 parts per million (ppm) of total hardness in the circulating water during acid feed.

White rust can cause severe corrosion to your facility's cooling tower, resulting in many thousands of dollars in repair or replacement costs. The smart facility owner or manager will follow the steps outlined here to help assure that doesn't happen.

Are you planning the purchase of a new cooling tower?

Does your existing tower have white rust?

Do you want to assure yourself that white rust doesn't destroy your budget?

If you answered yes to any of these questions, call your Chemtex Water Treatment Representative today for help and answers to your questions.