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Flash Rust: Color

by Lydia Frenzel

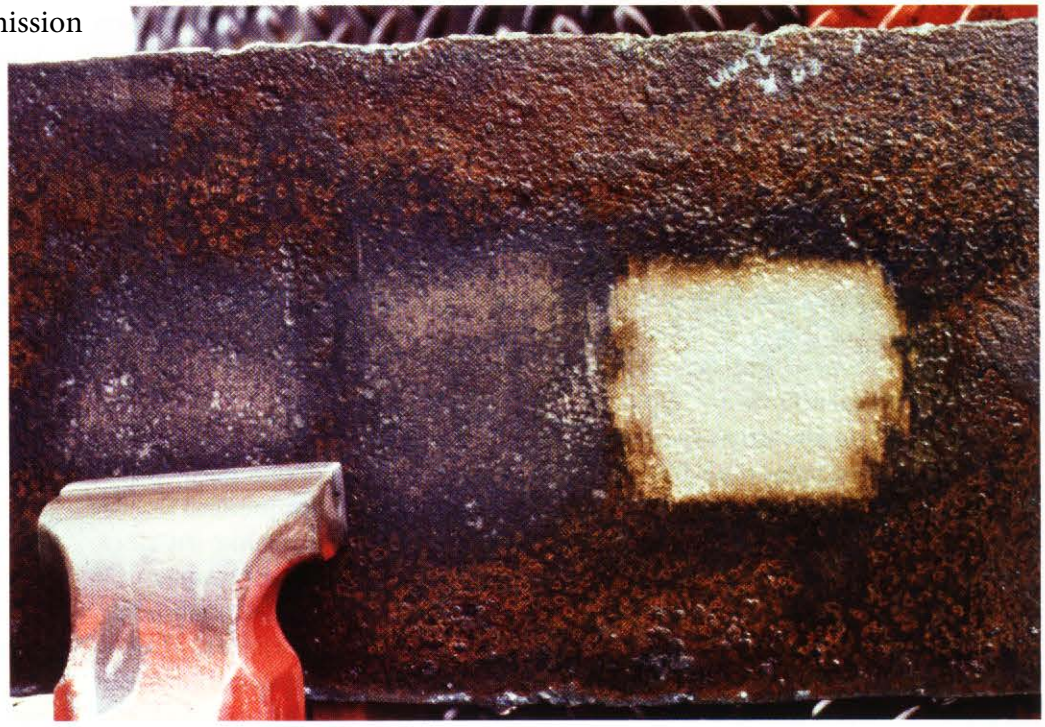

Photo courtesy of Advisory Council

Editor's Note:

Last month, John Tanner, in his article, "Dealing With Flash Rust: A Primer" introduced readers to the skepticism individuals exhibit when told that it is possible to paint over some types of rust and still have excellent results. Prior to 1994, "flash rust" referred to the appearance of rust spots on the surface of newly applied, water-borne film during the drying phase. The term was expanded in the paint industry in 1994, when International Protective Coatings published their "Hydroblasting Standards." Lydia Frenzel will devote her column this month and next to providing further information on the issue of flash rust as related to color and amount.

The "A B C" components of surface preparation for painting structures are visible appearance, profile or anchor pattern, and non-visible contaminants. Unfortunately, however, there is a complicating factor—"flash rust" that results from the drying of water on cleaned steel. The color and the amount characterize the condition. Steel or iron will form rust as water is evaporating during cleaning. If you are planning to paint, coat, or apply a lining to a steel surface, evaluating the presence of newly formed rust might be a problem.

The experienced jetter looks for a uniform coloration that doesn't mark a cloth that is lightly wiped over the surface. John Tanner calls this "tight rust." A dark black splotchy appearance where the rust appears to ooze from the surface indicates that the surface is not clean—it is a danger sign. Further measures should be taken, since the black coloration warns of the presence of chloride or sulfate (ferric chloride is dark brown to black).

The standards committee of SSPC and NACE has spent years trying to define "flash rust." We almost agree on a general description; however, there is "draft" language that still has to meet final approval from SSPC and NACE. This reads: "Flash rust or rust bloom is a light oxidation of the steel that occurs as waterjetted carbon steel dries. With the exception of stainless steel surfaces, any steel surface can show flash rust within 0.5 to 2 hours depending on environmental conditions, after cleaning by water. It quickly changes the appearance. This flash rust may be reduced or eliminated by physical or chemical methods. The color of the flash rust may vary depending on the age and composition of the steel and the time-of-wetness of the substrate prior to drying. With time, the flash rust changes from a yellow-brown, well adherent, light rust to a red-brown, loosely adherent, heavy rust.

"The visual appearance of steel that has heavily flash rusted after initial cleaning and is then re-cleaned by low-pressure water cleaning (up to 5,000 psi) has a different appearance than the original light flash rusted steel. The coating manufacturer should be consulted to ascertain the tolerance of the candidate coatings to the amount of flash rust commensurate with the in-service application. These conditions should be present at the time of recoating."

The terms "rust bloom," "re-rust," and "rust back" already are used to describe rusting in dry and wet abrasive blasting. You can have rust bloom in dry

blasting; you can have flash rust or rust bloom in wet blasting/jetting. However, flash rust does not occur in dry blasting.

I first saw WJ with fanjets at 20,000 psi (1360 Bar) in 1983. The amount of material that could be removed relative to 10,000 psi (680 Bar) was impressive. (Fig. 1). What struck me was the heat buildup on the steel. Within minutes, the surface quickly assumed a light yellow to blue color as the water steamed from the surface. There was a bronze color over the entire surface. This is what I think of as "flash rust."

For months, the steel retained the original color. The panels did not develop microscopic brown corrosion sites as could normally be found on dry blasted surfaces. The color had no effect on subsequent painting tests. This golden color was not like the opaque yellow/brown iron oxide that forms when residual water dries slowly on a surface. I think of the latter as "rust bloom"—discrete iron oxide that can be seen under the microscope. It appears opaque and typically is uniform over large surface areas.

Attenuated total reflectance infrared spectroscopy showed that a thin film was present on the surface of the steel. The color, from yellow (thinnest) to blue (thicker), is just like the transparent color of a soap bubble film. The thin film itself appeared to protect the steel. I postulated that the film is probably a polymeric iron oxide that is formed instantaneously as the water droplet implodes on the surface, but there is no proof for this. While I think of this reaction becoming visible in minutes, research physicists and chemists study sonochemistry reactions occurring in 10–10 seconds for fluid bubbles traveling at 400 Km/h. For comparison, water at 10,000 psi travels at a velocity around 1,200 Km/h (1100 ft/second or 3,900 Kft/hour).

When a jetter is using equipment without vacuum above 20,000 psi to clean steel, I look for that golden hue, "light flash rust," to indicate that the steel is clean. If a vacuum attachment is used, the water is removed so quickly that the golden color doesn't develop.

What then does the experienced jetter look for—a uniform coloration that doesn't mark a cloth that is lightly wiped on the surface. In John Tanner's words—Tight Rust.

For Further Information

- See: http://www.exploratorium.edu/ronh/bubbles/bubble_colors.html for information about thin films and colors formed by interference patterns.
- Standard photographs of flash rust can be found at International Paint web site: http://www.international-pc.com/pc/ Go to Technology R & D and click on hydroblasting for standard photographs of flash rust.

Lydia M. Frenzel, Ph.D., is executive director of the Advisory Council. She is an industry resource and works as a pro-active advocate for emerging technology. She shares her knowledge and experience through custom courses, educational modules and presentations. She writes a monthly column for ***Cleaner Times*** *magazine.*