

# CLEANING WET STORAGE STAIN FROM GALVANIZED SURFACES

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## BACKGROUND

Wet storage stain (also called white rust) is most commonly found on tightly stacked or bundled items with zinc on the surface, such as galvanized sheets, bars, guardrail, and plates.

When condensation or rainwater is trapped between galvanized surfaces, or between a galvanized surface and the ground, the zinc coating reacts with the water and creates zinc corrosion products that can form wet storage stain.

Since rain, dew, and condensation contain little or no dissolved salts or minerals, the fresh zinc in the coating quickly reacts with the moisture to form the zinc corrosion products zinc hydroxide and zinc oxide. Water, when in a tightly packed environment, will continue to react with and progressively consume the zinc coating until the part is removed from this environment or the moisture is removed.

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If zinc hydroxide or zinc oxide compounds have formed, the appearance of the galvanized coating changes from a gray, smooth finish to a surface with white or gray powdery deposits known as wet storage stain. If the wet storage stain is thick, it is desirable to remove the zinc corrosion products from the surface. However, it is nearly impossible to restore the original appearance of the galvanized coating.

The appearance of wet storage stain does not indicate an inferior or poor quality zinc coating. It is the result of exposure to environmental conditions during storage of the hot-dip galvanized steel. In the vast majority of cases, wet storage stain does not indicate serious degradation of the zinc coating, nor does it necessarily imply any reduction in the expected service-life.

Wet storage stain is often superficial, despite the possible presence of a bulky, white product. Light or thin wet storage stain will appear as a light white powder on the surface of the galvanized steel. When the galvanized steel is removed from the high moisture environment, the wet storage stain will eventually blend in

with the naturally weathering zinc surface around it and does not need to be removed. However, medium or heavy buildup of wet storage stain, as seen in *Figure 1*, must be immediately removed in order to avoid severe damage to the underlying zinc coating or the base steel. After removing wet storage stain, coating thickness measurements should be taken in the cleaned areas to ensure the coating thickness is still within ASTM specification requirements for the galvanized product.

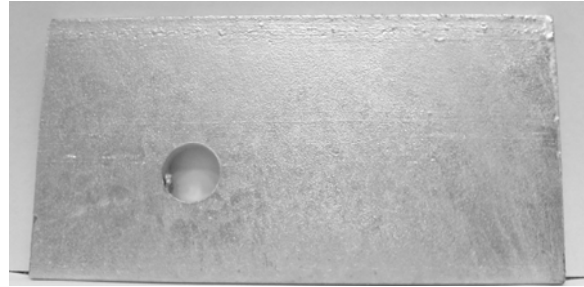


**Figure 1: Heavy Wet Storage Stain**

## INTRODUCTION

An American Galvanizers Association (AGA) study examined the formation of wet storage stain on hot-dip galvanized steel, and tested different, commercially available cleaning products and other

commonly-used wet storage stain removal techniques. The goal was to find commercially available products and/or techniques that remove wet storage stain without dulling the galvanized surface.



**Figure 2: Test Sample**

This study is important because wet storage stain is a common problem among galvanizers and their customers. If left untreated in a heavy stain situation, there is a potential for complete deterioration of the zinc coating and underlying steel.

#### **TEST PROCEDURE**

In the AGA study, forty 3" x 6" steel panels were hot-dip galvanized at the same time. Then, the samples were wrapped in damp paper towels and sealed in airtight plastic bags, where they remained for up to 10 days for the first test and 24 days for the second test.

*Figure 2* shows a sample 3" x 6" panel. Notice the new, shiny zinc surface. The surface has an even texture and color. (Note: Color also depends on steel chemistry.)

The following is the step-by-step test procedure used to evaluate cleaning products or methods in this study.

1. Measure coating thickness on the galvanized sample
2. Wrap damp paper towel around sample
3. Place wrapped sample into an airtight plastic bag
4. Allow sample to remain in the airtight bag for 10 days (Test 1) or 24 days (Test 2)
5. Remove sample from the airtight bag, unwrap the damp paper towel, and let dry
6. Photograph sample on both sides to document extent of wet storage stain
7. Choose the cleaning product or method
8. Attempt to remove the wet storage stain from the galvanized surface with the chosen cleaning product or method

9. Rinse with water and completely dry surface of sample
10. Photograph both sides of the clean sample
11. Measure the coating thickness after cleaning.

The cleaning products were chosen in two ways. First, the AGA contacted member galvanizers to identify all methods currently used to remove wet storage stain. Second, the AGA searched local hardware stores for products that remove various types of metal corrosion.

## TEST 1

### SAMPLE TESTING

After 10 days sealed in plastic bags with damp paper towels wrapped around them, the galvanized samples exhibited light wet storage stain. One cleaning product or removal technique was applied to each sample in an attempt to remove the wet storage stain from the surface. Then, each sample was examined to determine if the cleaning product or method was successful and if it restored the bright zinc surface successfully. *Figure 3* shows one of the galvanized samples covered with wet

storage stain. Compared to the newly galvanized finish in *Figure 2* (previous page), the sample with wet storage stain in *Figure 3* is duller and has many white and gray deposits on its surface.



**Figure 3: Sample with Wet Storage Stain**

A total of ten different cleaning products or removal techniques were examined during this study. They are:

- Bleach<sup>1</sup>
- CLR<sup>®</sup>
- Limejuice
- Must for Rust<sup>®</sup>
- Naval Jelly<sup>®</sup> Rust Dissolver
- Nylon Brush
- Picklex<sup>™</sup> 10G
- Stainless Steel Cleaner
- Tire Foam
- White Vinegar

<sup>1</sup> Bleach was added as a secondary product to help remove the black staining that occurred on the plates.

### TEST 1 RESULTS

CLR<sup>®</sup>, limejuice, Naval Jelly<sup>®</sup> Rust Dissolver, nylon brush, Picklex<sup>™</sup> 10G, and white vinegar all successfully removed the wet storage stain from the galvanized steel surface without causing any additional damage to the zinc coating. The nylon brush was used by itself as a removal method and also to apply all cleaning products. The other products or removal techniques (bleach, Must for Rust<sup>®</sup>, stainless steel cleaner, and tire foam) excessively dulled or scratched the galvanized surface. Some did not completely remove the wet storage stain.

### TEST 2

#### SAMPLE TESTING

The samples were wrapped in damp paper towels and sealed in airtight plastic bags for 24 days. Then, the top five cleaning products from Test 1 were applied. A nylon brush was used to apply each of the cleaning products and to scrub the wet storage stain. However, a nylon brush, by itself, was not used in this test because of the heavier wet storage stain. The cleaning products tested were:

- CLR<sup>®</sup>
- Limejuice
- Naval Jelly<sup>®</sup> Rust Dissolver
- Picklex<sup>™</sup> 10G
- White Vinegar

### TEST 2 RESULTS

Because of the increased exposure time, the galvanized samples accumulated heavier wet storage stain during this phase of the study. Four of the five cleaning products were able to remove the additional wet storage stain.

Limejuice and white vinegar, the two most common cleaning products recommended by galvanizers, successfully removed the wet storage stain without damaging or dulling the surface. Both products, as seen in *Figure 4* (next page), are readily available at local grocery stores.



**Figure 4: Limejuice & Vinegar**

*Figure 5* shows the sample cleaned with limejuice, and *Figure 6* shows the sample cleaned with white vinegar.



**Figure 5: Sample Cleaned with Limejuice**



**Figure 6: Sample Cleaned with White Vinegar**

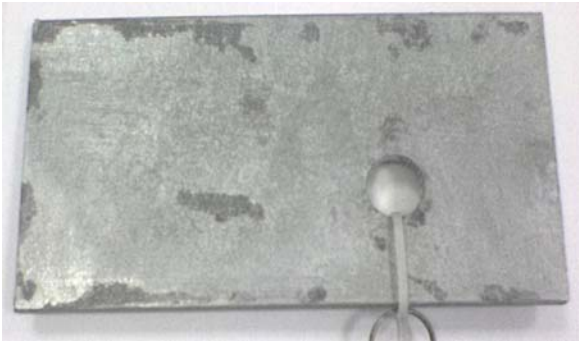
The AGA study found the three other commercially available cleaning products CLR, Naval Jelly® Rust Dissolver and Picklex™ 10G, as seen in *Figure 7*, did not cause damage to the zinc coating.



**Figure 7: CLR®, Naval Jelly® Rust Dissolver and Picklex™ 10G**



CLR® and Naval Jelly® Rust Dissolver are both readily available at local hardware stores. *Figure 8* and *Figure 9* show the samples cleaned with CLR® and Naval Jelly® Rust Dissolver, respectively.

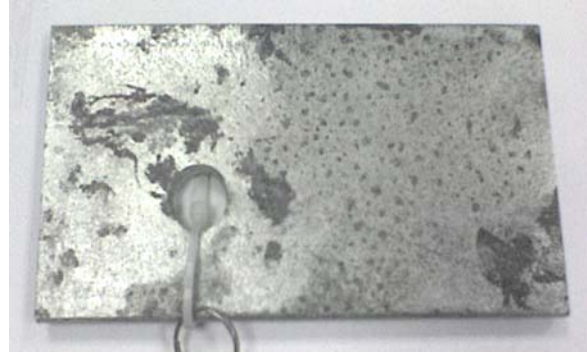


**Figure 8: Sample Cleaned with CLR®**



**Figure 9: Sample Cleaned with Naval Jelly® Rust Dissolver**

*Figure 10* shows the sample cleaned with Picklex™ 10G. Picklex™ 10G must be ordered directly from the manufacturer.



**Figure 10: Sample Cleaned with Picklex™ 10G**

Picklex™ 10G was the best of the three newly discovered, commercially available cleaning products. It removed the wet storage stain very easily, with the cleaning process only taking ten to fifteen seconds. CLR® was the second best newly found commercially available cleaning product for removing wet storage stain. Naval Jelly® Rust Dissolver worked well on light and medium wet storage stain, but would not be recommended on heavy wet storage stain. It also left a light pink coating on the surface of the galvanized steel that may need to be removed before the product is delivered to a customer.

## CONCLUSION

In treating wet storage stain the best cure is prevention. Preventing wet storage stain includes two steps:

1. providing adequate air flow to newly galvanized surfaces
2. removing standing water from newly galvanized surfaces.

If wet storage stain does form, the affected objects should be removed from the high moisture environment and arranged so the zinc coating can dry rapidly. Once dry, most stains can be easily removed by brushing with a stiff nylon brush.

If using a nylon brush does not remove wet storage stain, a cleaning product should be used.

The goal of this study was to find commercially available cleaning products and/or techniques to remove wet storage stain from galvanized steel without dulling the galvanized surface. Applied with a nylon brush, these five products proved effective:

- CLR<sup>®</sup>
- Limejuice
- Naval Jelly<sup>®</sup> Rust Dissolver (light and medium wet storage stain only)
- Picklex<sup>™</sup> 10G
- White Vinegar

CLR, Naval Jelly<sup>®</sup> Rust Dissolver, and Picklex<sup>™</sup> 10G may require the use of personal protective equipment, such as chemical resistant gloves and safety glasses, and are for outdoor use only. Any other health and safety recommendations detailed in the materials safety data sheets (MSDS) from the manufacturer must be followed. In addition, disposal of these products should be made in accordance with federal, state, and local regulations, which can be found in each product's MSDS.



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