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Technical Bulletin #8

NATIONAL SLATE ASSOCIATION

Technical Bulletin No. 8: Corrosion and Wear of Metal Flashings

Introduction

Slate roofs rely on metal flashings at critical junctures. When leaks develop in slate roofs, it is often due to flashings that have worn out. Understanding what causes the flashings to wear out, and proper detailing to address these problems, can improve the function of slate roofs, and defer the need for costly repairs. Copper is the most common metal flashing installed with slate roofs, due to its long service life and workability. As such, copper will be the primary focus of this Bulletin's examination of corrosion of metal flashings.

Copper flashings on a slate roof can deteriorate for many reasons. Copper can erode due to repeated flow of rainwater coursing over the flashings; the water can carry bits of slate, soot, and dust that can act as abrasives that gradually thin the copper. In addition to physical wear, there are also chemical processes that can cause localized wear of the flashings – these are types of corrosion.

Galvanic Corrosion

Also known as electrolysis, galvanic corrosion is a chemical reaction that occurs between dissimilar metals in the presence of a liquid that can conduct electricity - the same process as a battery. In roofing projects, the dissimilar metals could be fasteners that are different from the flashing metal, and the liquid could be rainwater, dew, or condensation. Near the seashore, spray from salt-water could also provide the liquid, which is much more conductive than rainwater, and would speed the reaction. Some metals are more reactive than others. Metals commonly used in construction are listed in the accompanying chart, in order from most noble (least reactive) to least noble (most reactive). The farther apart metals are on the galvanic chart, the more likely galvanic action will occur between them, resulting in the less noble metal sacrificing itself to the more noble. For more on galvanic corrosion, see NSA's *Slate Roofs – Design and Installation Manual*, 2010 edition, p. 37.

Most Noble → **Least Noble (Sacrificial)**

Stainless Steel 304 & 316 (passive)	Silicon Bronze	Copper	Brass, Bronze	Tin	Lead	Solder	Cast Iron	Mild Steel, Wrought Iron	Galvanized Steel	Aluminum	Zinc

The above photo shows de-icing cables that were fastened to a lead-coated copper expansion joint with steel screws and straps. The "less noble" screws and straps have corroded badly, while leaving the copper intact. This illustrates the process of the less noble metal corroding in the presence of the more noble copper. Corrosion could have been avoided by using copper straps and rivets, or fasteners that are closer to copper in the galvanic series, such as brass, silicon bronze or stainless steel.

Acidic Leachates

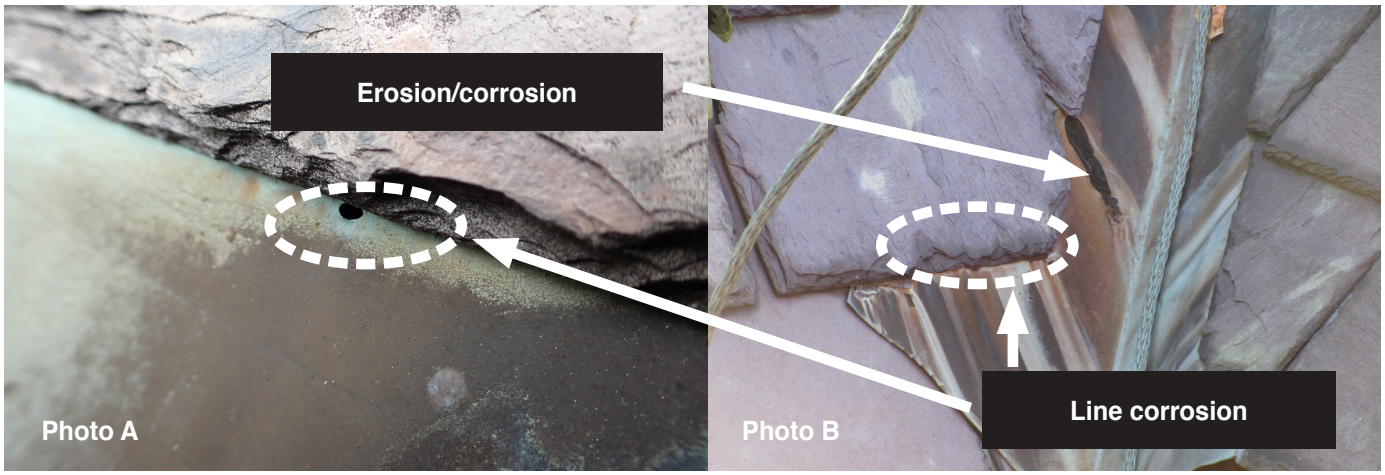
When copper flashings are installed down-slope from various roofing products such as pressure-treated wood, fire-retardant treated wood, or cedar shingles, bright orange discoloration may occur on the copper. This is due to weak acids that leach out of these products. These weak acids prevent the natural process by which copper develops a patina, and can result in uneven weathering of the copper. For more on this topic, see *Copper and Common Sense* by Revere Copper Products.

Line Corrosion

Localized pitting of copper can occur due to a chemical reaction that breaks down the protective patina on the surface of the copper. As stated in *Copper and Common Sense*, "A drop of water on the surface of a metal excludes oxygen from the small area it covers. This results in a flow of electrons from the 'oxygen starved' area under the drop to the 'oxygen rich' areas near the edge of the drop. The resulting flow of electrons causes a pit to form." This type of corrosion occurs where drying takes place slowly, such as along the butt end of the slates where they terminate at valleys or built-in gutters, and is referred to as "line corrosion." See photos A and B.

Erosion/corrosion

Copper's protective patina can be removed by water running off, or dripping off, the butt ends of the slate. The run-off from the slate can contain abrasive particles that continually wear down the copper (see Photo B). Damage to the copper can result not only from water run-off causing physical erosion, but also from a chemical process. When



dew forms on the roof, the drops of water slowly run down the slope; along the way, environmental impurities are dissolved into the water, making the water acidic. As the water trickles down the roof, some water evaporates, making the acid more concentrated. Some of these acids remove the protective patina and gradually corrode the copper.

Recommendations

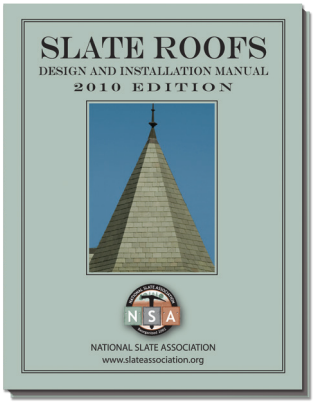
1. When inspecting a slate roof, or investigating leaks, check carefully at the locations where water drips off the slate onto copper flashings. Such locations would be at valleys, built-in gutters, chimney crickets, vent-pipe flashings, etc. The pitting and wear start very small, and can be difficult to see at first. Take note of color differences in the copper; when the copper becomes thin it turns a yellow-orange color. Temporary repairs can be made with a variety of patching materials, but avoid applying these materials to the slates themselves – only patch the copper flashings. The proper repair is to remove slates adjacent to the worn copper, replace the copper flashing, and re-install the slates. Other options may include inserting a replacement flashing below the slate shingles and over the worn areas of copper. There are also many fluid-applied membranes that can be used for localized repairs, but, again, these should not extend onto the slates themselves.

2. When installing a new slate roof, include heavier copper flashings at locations that are most vulnerable to wear. For example, include 20-oz copper at valleys, and other susceptible locations. In addition, sacrificial strips of copper can be included to protect these vulnerable areas (see Photo C).

Photo C

3. The bottom course of slate should be raised slightly by use of an integral copper cant as illustrated in *Slate Roofs: Design and Installation Manual*, a wood cant clad in copper, or a composite wood cant. The resulting separation between the slate and the copper will help limit the conditions that cause line corrosion.

For more information on slate roofing, please see *Slate Roofs: Design and Installation Manual,* 2010 Edition, available at www.slateassociation.org



For more information about The National Slate Association, visit **www.slateassociation.org**

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