The importance of removing detrimental weld filler elements from the weld prior to coating

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Formation of the proper pretreatment conversion coating and adhesion of subsequent coatings to welds is influenced by the cleanliness of the weld area. The welding process can create various inorganic soils depending on the welding process utilized.

These inorganic soils must be removed to ensure the success of the pretreatment conversion and subsequent coating operations. This article provides information on the weld filler elements found in the weld that are detrimental to coating adhesion and also presents the recommended method of removal for these soils.

IDENTIFYING WELDING SOILS
The inorganic soils created during the welding process are localized in the area adjacent to the weld and include weld spatter, weld slag, weld scale and various elements that can be found in the weld filler metal. The area that displays the effects of the welding process is referred to as the heat-affected zone (HAZ).

The HAZ is the area of base material that is not melted but that has had its microstructure and mechanical properties altered by welding. The heat from the welding process and subsequent re-cooling causes the changes in the HAZ. The extent of the property changes depends primarily on the base material, the weld filler metal and the amount and concentration of heat input by the welding process. The different areas of the HAZ are shown in Figure 1.

WELD FILLER ELEMENTS
The weld filler metal is the metal added in the creation of a joint through welding. Three types of filler metals are predominantly used: covered electrodes used for SMAW/stick welding, bare electrode wire or rod used for MIG or TIG welding, and tubular electrode wire used for flux-cored arc welding (FCAW). These filler metals are comprised of elements that affect the formation of the weld and provide different finished weld properties.

Common weld filler elements include silicon (Si), manganese (Mn) and copper (Cu). These elements are present to provide excellent wetting action and a highly fluid weld puddle, which improves the quality of the weld. They also provide excellent tolerance for welding through mill scale and rust.
Depending on the welding process, however, these weld filler elements can also have detrimental effects. Increased amperage, temperature and time all lead to the migration of excessive Si and Mn to the outer surface of the weld. The Si can form small “islands” on the surface of the weld caused by the deoxidized product that appears on the surface of the weld during that process. These islands may appear as a glassy surface. The Mn does not fully migrate to the outer surface, but is distributed throughout the surface of the weld. The Cu is also distributed throughout the weld.

Figure 2. Silicon can form small “islands” on the surface of a weld, which are not conducive to the formation of a pretreatment conversion coating or the adherence of subsequent coatings. The islands are caused by the deoxidized product that appears on the surface of the weld.

Depending on the welding process, the weld filler elements can have detrimental effects on the formation of a pretreatment conversion coating or the adherence of subsequent coatings.
Three types of filler metals are predominantly used in welding: covered electrodes used for SMAW/stick welding, bare electrode wire or rod used for MIG or TIG welding, and tubular electrode wire used for flux-cored arc welding.

The weld, but is present in lower concentrations than the Si and Mn.

The inclusion of these elements, notably the Si and Mn, on the outer surface of the weld creates conditions that are not conducive to the formation of a pretreatment conversion coating or the adherence of subsequent coatings. An example of the Si islands are shown in Figure 2 on the previous page.

REMOVING FILLER ELEMENTS

The detrimental weld filler elements, or inorganic soils, must be removed to provide a receptive surface of the weld for pretreatment conversion coating and subsequent coating operations. There are two methods of removal for the various soils: mechanical and chemical. Mechanical methods consist of manual or automatic abrasion. The chemical method typically utilizes an acidic pickle solution, although neutral organic compounds have been used in specialized circumstances.

Removing detrimental weld filler elements from the weld requires the removal of the outer surface of the weld. When dealing with these filler metals, removal is accomplished using mechanical methods. The typical mechanical methods used are grinding, sanding or blasting.

Grinding and sanding can be done using abrasive wheels or belts. Blasting is typically done using abrasive blast cleaning or abrasive media blasting. The Si and Mn that are present in many weld filler metals are difficult, if not impossible, to remove in a conventional surface treatment process using an acid pickle. The types of acid used are not formulated to remove significant amounts of metal from the parts, meaning that they don’t adequately attack or undercut the problem elements enough to remove them from the surface of the weld.