What is Fusing of Coatings?

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The enameling process involves the thermal, physical and chemical bonding of frit (finely ground compound with glass) and other materials to a base metal by fusing the two materials together. The result of the fusing process is the mechanical bonding of the glass layer to the metal substrate at a molecular level. Enameling temperatures range from 1,000 °F for aluminum to 1,800 °F for cast iron. Enameling of high-strength steel panels for tanks is typically conducted between 1,350 °F and 1,600 °F.

Applying the glass to the steel can be generally referred to as a coating process only in the sense that the material is layered on the metal substrate prior to entry into the enameling oven. Fusing glass to the steel is unlike traditional coatings such as paints and epoxy that are superficial. The extremely high fusing temperatures of 1,350 °F and 1,600 °F are 3-6 times higher than the simple 200 °F - 500 °F, curing or thermal setting temperatures used with epoxy and paint coatings. These lower temperature processes should not be confused with a true fusing processes and do not involve the actual fusing or thermal, chemical or bonding of the materials on a molecular level.

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Unfortunately some epoxy coated product manufacturers use the term "fusing" when referring to epoxy coatings, which can be misleading. At best, the term "fusing" as it relates to epoxy coatings can only refer to the fusing of the epoxy coatings to themselves and not the fusing of the coating to the actual steel substrate. The portion of the process relating to the bond between the epoxy and the steel is still just thermal curing.

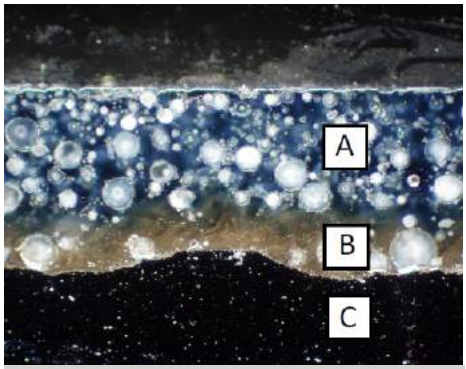

Figure 1 - Cross section of glass-fused-to-steel (enameled) tank panel. Layer A is glass frit layer, Layer B is the molecularly fused layer and layer C is the steel panel substrate.

Figure 1 shows a typical cross section of an enameled steel tank panel. The bubble structure is important to add flexibility and capture off-gassing. Note the discoloration and fading of layer B. This middle layer shows the fusing or molecular interaction between the black colored steel substrate (C) and the blue glass frit (A).

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By comparison, Figure 2 is a cross section of a typical 2-layer epoxy coating on steel substrate. The interface between the substrate and coating layers is very defined indicating no molecular interaction or fusing of the epoxy layers to the steel substrate. In contrast, the layers of the two epoxy coatings, A1 and A2, is indistinguishable showing that the two layers of epoxy have "fused" to themselves. Note also the cleanliness or how clean the layer is between the epoxy and the steel reflective of the mechanical preparation of the steel surface to clean bright finish and the lack of contamination of this layer.

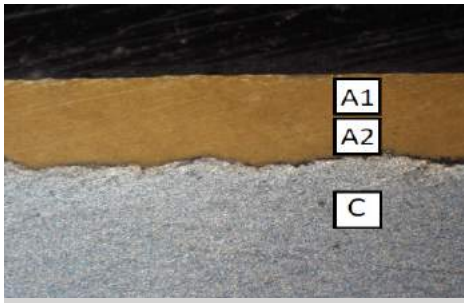

Figure 2 - Cross section of 2-coat epoxy coating on steel tank panel. Layers A1 and A2 are the two epoxy layers and layer C is the steel substrate panel.