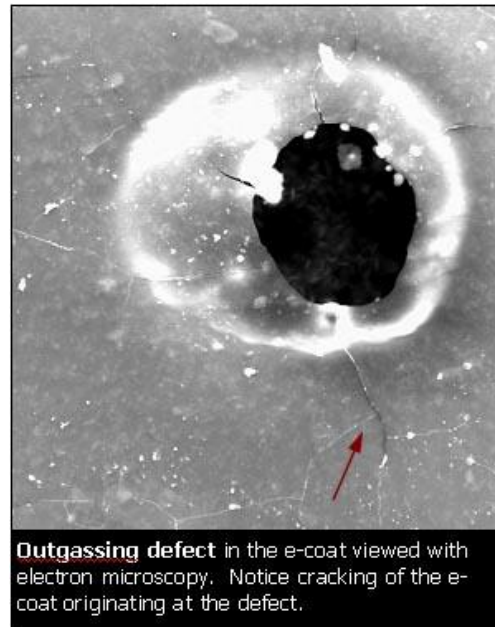
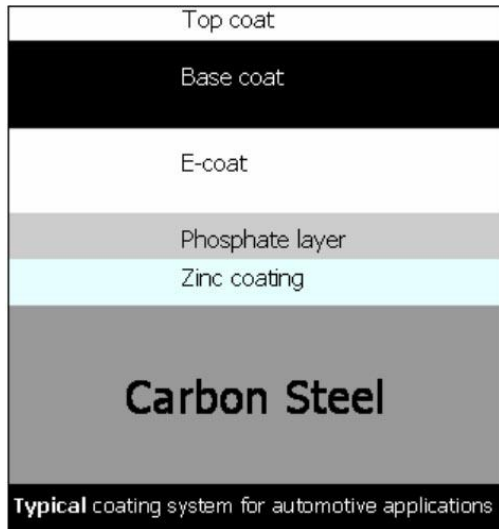


Discovering Outgassing Defects

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Cathodic electrodeposition is commonly used as a coating process for automotive appliances and general industrial coatings. The process employs a modern electrodeposition line with automation, low levels of pollution and high amounts of throwing power. The electrodeposited coating, or e-coat, is mostly applied on electrogalvanized and carbon steel substrates.



Production lines usually involve rolling, electrogalvanizing, phosphating, electrodeposition-coating and baking processes. The cross-section above illustrates these processes. Beginning with rolled carbon steel, layers are added at each step of the process. The zinc layer being formed by electrogalvanizing, the phosphate layer by phosphating, the e-coat by electrodeposition, and the final base coat and topcoat layers by common coating application techniques.

Under certain conditions parts like these can develop blister like or popping defects on the surface of parts that blemish the appearance of the parts and may result in localized corrosion.

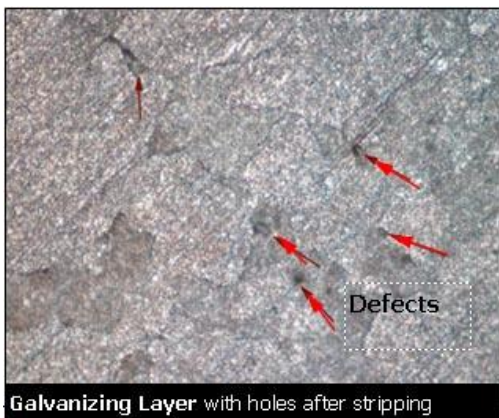
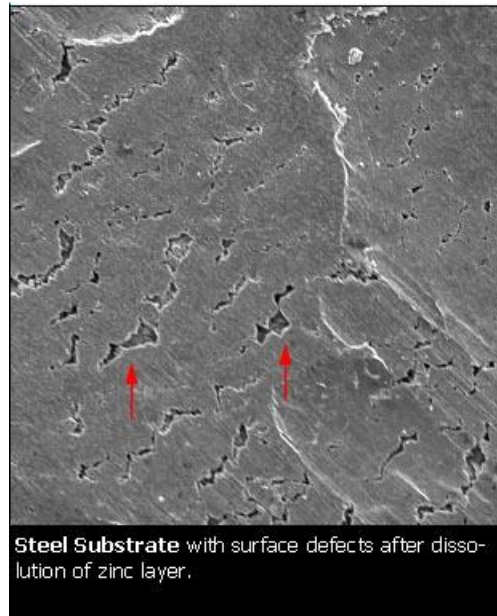
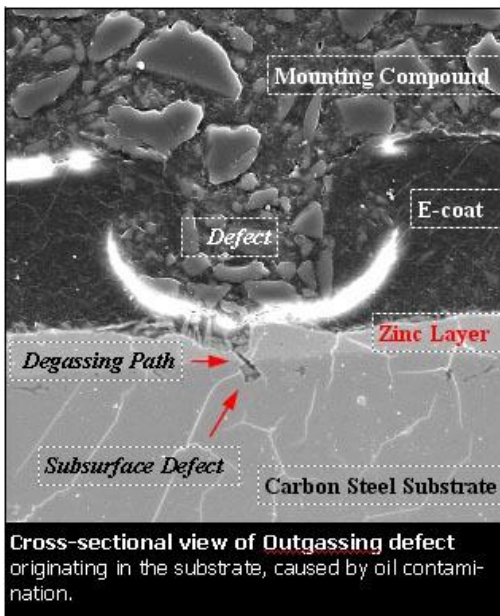
In such cases, oil contamination in either the electrogalvanizing/phosphating process, the e-coat process, or the baking operation becomes a major consideration. This is because oil contamination has been known to cause "outgassing defects".

In a recent case, Matco characterized outgassing defects and resolved the issue with a comprehensive failure analysis involving FTIR, SEM/EDS and somewhat uncommon metallographic techniques. In the investigation it was found that the blister-like defects in the e-coat actually possessed some type of defective site or irregularity beneath, in the substrate. To further examine this irregularity several samples were successively polished.

Metallurgical cross sectioning and successive polishing revealed the minute popping defects to be due to small cavities, cracks, surface protrusions or flaps in the substrate. Anodic stripping of the phosphate layer and electro-galvanized layer further confirmed the metallurgical observations, and revealed the presence of numerous defects on the surface of the substrate.

Additionally an unfinished sample possessing no electrogalvanizing exhibited the same type of defect in the form of extensive surface and subsurface cracking. These sites trap oil during rolling operations. The same sites may also trap hydrogen during electro-galvanizing or pickling operations, although this aspect was not observed at the time of the investigation. Subsequent cleaning is not able to dissolve the oil because the defects are rolled over. Electro-galvanizing and phosphating covers these defective sites with oil trapped in them. The baking operation in the e-coat process releases the trapped oil during the baking stage. The thermal energy results in outgassing and micro-popping during the baking operation, which in turn results in a popping type defects in the final product.

Baking the electrogalvanized samples prior to the e-coat process releases the entrapped oil and subsequently results in an oil free part during e-coat process. This is why e-coating after prebaking does not show a defective structure. This observation further confirms the proposed failure mechanism for defective electrogalvanized e-coat parts.



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