



Failure Analysis of Injection Molded Plastic Frame

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Executive Summary

The fracture surfaces of a broken plastic frame were examined using optical microscopy, FTIR, and DSC to determine the failure mode and the root cause of failure. The results of these tests revealed that the failure mode was tensile overload and that the root cause of failure was due to contamination of the HIPS resin with ABS. Since HIPS and ABS are not compatible with each other, the ABS and HIPS phases are not bonded resulting in weak interface regions resulting in a significant decrease in mechanical strength of the composite material. The lower tensile strength of the composite material caused failure by tensile overload when force was applied. It is well known that ABS and HIPS are not miscible or compatible with each other and that blends of the two materials are much weaker compared to the pure materials.

Purpose of the Investigation

The client contracts an injection molding company to manufacture a plastic frame for them. The specifications call for HIPS to be used as the raw material. Occasionally the clips on the frame break off easily from the rest of the frame and show signs of layering or orange peel at the fracture area suggesting that the HIPS is contaminated with an incompatible material. The client suspected polypropylene (PP) may be contaminating the HIPS. The client requested that Plastic Failure Labs perform forensic analyses of a failed part to determine the root cause of failure of a broken frame and, if contamination is indicated as the root cause of failure, to determine the nature and level of the contaminant.

Results and Discussion

A photograph showing the frame in its as received condition is shown in Figure 1. It was noted that one of the fracture surfaces displayed severe delamination of the material (Figure 2). The clips that still remained intact were bent by hand to get a feel for their strength. The clips easily broke away from the rest of the frame with only slight force indicating extreme weakness of the material.

Microscopy

The fracture surfaces of a broken frame were examined using optical microscopy. Microscopic views of the fracture surfaces and outside surfaces of the frame in the vicinity of the fractures revealed the presence of black specs (Figures 3 – 4). HIPS does not contain black specs. However ABS often contains black specs which form as ABS thermally degrades during...

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