Plastic Failure LABS

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Root Cause of Failure of a Chemical Transfer Hose

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Executive Summary

A photo of the failed section of hose is shown in Figure 1.

Figure 1. Photograph of the failed hose showing the location and appearance of the break.

The hose has a laminar construction with multiple layers of synthetic materials including synthetic rubber layers with helical embedded metal reinforcement. The innermost layer is a thin membrane of ultrahigh molecular weight polyethylene (UHMWPE). UHMWPE is an extremely chemically resistant and ductile material.

The failed hose was forensically analyzed using optical microscopy, scanning electron microscopy (SEM), electron dispersive spectroscopy (EDS), Fourier Transform Infrared Spectroscopy (FTIR), and differential scanning calorimetry (DSC). These test revealed that the UHMWPE inner layer failed in a ductile manner by fatigue and did not fail by chemical attack or by chemical degradation. Bending stresses on the hose were concentrated in an area close to the stainless steel coupling. Repetitive bending stresses at the same point in the hose over an extended period of time ultimately caused the hose material to locally fatigue.

Results and Discussion

The failed section of the hose was received for forensic root cause failure analysis. The as received condition of the sample is shown in Figure 2. Other photographs of the hose sample are shown in Figures 3 – 5.