

## IMS Associates Program: Representative Projects

**Particulate Contamination** – An extruded polyurethane tubing contained white particles at a low, but unacceptable, frequency. Samples of the tubing were provided for analysis. Micro-infrared spectroscopy and Scanning Electron Microscopy/Energy Dispersive x-ray Spectroscopy showed the particles are agglomerates of two compounds in the starting formulation. The current compounding process was changed to provide a more thorough mixing of the starting ingredients.

**Adhesion Variation** – a purchased part was not adhering in as well as in the past. Contact angle measurement confirmed the new part had a lower surface energy than the older part. X-ray photoelectron spectroscopy and thermal desorption gas chromatography mass spectrometry both confirmed the presence of a low surface energy substance not previously on the surface due to a manufacturing process change.

**Problems with Smeared Printing** - Printing on a plastic product was found to smear at some locations but not others. Microscopic analysis showed smearing was associated with much higher ink film thickness. The problem was subsequently traced to ink build-up on certain print pads in the process and was eliminated by establishing a pad cleaning and replacement protocol.

**Optical Device Failure**– An optical device incorporating a diffraction grating was performing inconsistently. Optical and electron microscopic examination revealed large unexpected inconsistencies in the period and amplitude of the grating in localized regions. Once this was understood the manufacturer was able to address process variations.

**Wrong Resin** - A prototype part was machined from a block of acetal homopolymer. The prototype's performance in trial service runs was far below expectations and the R&D team was considering redesign and/or alternate resins. A sample of the material was submitted for identification. Differential Scanning Calorimetry and Infrared spectroscopy showed the resin used for the prototype was high density polyethylene not acetal.

**Alumina Particle Distribution near the Surface of Aluminum** – for optimum operation of an optical device a uniform distribution of small alumina particles was required near the surface of a sheet of aluminum. The particles could not be detected optically, by scanning electron microscopy or Auger electron microscopy. It was determined that the particle distribution could be monitored by Raman spectroscopy. With this knowledge IMS and the company worked together to optimize the distribution of the alumina particles.

**Customer Return** - A company's customer complained of incomplete hardening of a two part epoxy resin and supplied failed processed parts as an example. Thermal desorption Gas Chromatography Mass Spectroscopy analysis showed that the hardener had been omitted. Proper product usage was subsequently reviewed with the customer so that their process could be adjusted.

**Welding of a Stainless Steel Tube** – An electronic device was housed within a stainless steel tube through which it needed to sense the outside world. Current welds were inconsistent and often leaked. With the advice and guidance of IMS faculty the company was able to produce a more consistent non-leaking weld with a ten times faster device response time.

**Sticky Seal** – A freely moving polycarbonate part was found to stick to the adjacent polyvinylchloride seal once pressure was removed. Thermal desorption Gas Chromatography Mass Spectroscopy showed the seal was highly plasticized with a plasticizer known to be compatible with polycarbonate and somewhat incompatible with polyvinylchloride. During compression, plasticizer was being squeezed out of the seal diffusing into the polycarbonate causing a "sticky" surface.

**Fatigue Life of a Flexible Metal Part** – A metal part used in a product where continual flexing was required was fracturing prematurely for unknown reasons. Investigation revealed that under the existing loads and cycling the part should have had a lifetime at least two orders of magnitude longer. Examination of the part and process revealed an inadequate preparation of the surface leading to high localized stress levels. Modification of the surface processing produced greatly improved life.