Analytical Testing of Pressure Sensitive Adhesive Constructions – What Can It Reveal?

Use of these analytical techniques along with testing peel, tack, shear and release, can often help solve problems. This testing can also be valuable during product development to make sure the product is well defined prior to launch. Chemsultants can perform these tests or work with our partner laboratories to provide results and interpretation.

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When a problem arises with a pressure sensitive adhesive (PSA) label or tape, often the first testing that is done is for physical properties, such as peel, tack, static shear and release. Depending on these results and other factors, the question that often comes up next is, "why?" This can lead to testing that is more chemical and structural in nature.

1. The most common tests that are used for an initial "chemical" look at a PSA are:
2. Fourier Transform Infrared Spectroscopy (FTIR)
3. Differential Scanning Calorimetry (DSC)
4. Gas Chromatography (GC)
5. Liquid Chromatography or High Performance Liquid Chromatography (LC or HPLC)

FTIR involves passing infrared light with a broad frequency range through a sample. Certain frequencies of the incident light are absorbed depending on the molecular functionality of the sample. A spectrum is generated showing where the transmission of the incident beam was diminished (i.e. what frequencies of light were absorbed). Molecules with different functionalities (i.e. different atoms and different bonds to atoms) will possess different IR spectra. A PSA sample can be tested as is by adhering it to an ATR plate. A PSA sample can be dissolved in a solvent to remove it from a carrier, the solvent evaporated and then scanned.

FTIR can be used for the following:

1. Identifying the polymer type (acrylic, rubber, silicone)
2. Determining an approximate rubber-to-resin ratio in tackified systems
3. Pinpointing the presence of significant amounts of contamination such as release coating, migrated components from containers, etc.
4. Diagnosing significant degradation of a PSA

In the scan, PSA layers on two products are compared to see if they are the same formulation. FTIR may not see very small amounts of an additive, and may not see substances that are "masked" by other ingredients with similar absorption peaks. Also, it is not a strict quantitative analysis method, but can be compared to a control or reference scan to gauge differences in amounts of components.

DSC can be used for the following:

1. Determining glass transition points (Tg), melt points, crystallization and other transitions
2. Calculating solvent boiling points and amount of solvent retention
3. Measuring specific heats
4. Identifying the onset of curing and the degree of curing in a reactive system

DSC is performed by heating a sample along with a reference material, and comparing the amount of heat needed to maintain a temperature or temperature increase related to the reference. This is usually done by increasing the temperature of the sample and reference over time, and measuring the amount of energy needed to heat the sample as a function of temperature.

GC is a separation technique that passes a vaporized test material along with a carrier gas through columns packed with liquid or liquid coated absorbent materials that selectively allow different components in a mixture to travel through the column at different rates. This gives different "elution times" to different components, and these peaks can be compared to reference materials to determine the chemical components in a material. GC can be qualitative in its results, or it can be quantitative when coupled with a mass spectrometer (MS).

GC can be used for the following:

- Comparison of two materials to look for different components or contamination
- Solvent retention
- Residual monomer content

GC is limited to looking at components that can be vaporized.

HPLC is similar to GC in that it is a separation technique, but it utilizes a liquid phase rather than a gas phase. A test material along with a carrier solvent is run through a packed solid column at high pressure. Components are separated in the column and are detected based on the elution time or retention time in the column. HPLC can be used to help separate components and detect amounts of components (with a reference standard or if connected to an MS unit) in a mixture that is not easily volatilized.

For more information

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