MacDermid Printing Solutions

Tech Tip 15

Physical Properties

Physical Properties of Printing Plate Materials

Careful evaluation of the physical properties of plate materials can help you identify the rubber or photopolymer plate material(s) best suited for a particular application. Properties such as *solvent resistance* and *abrasion resistance* are important to the printer as they affect on-press performance, while *cure rate* and *plasticity* affect platemaking. Some properties are important to rubber plate molders, others to photopolymer platemakers, while some are primarily the concern of materials' manufacturers.

This Tech Tip defines the most commonly tested physical properties and relates them to platemaking and printing performance.

Important To Platemaking

Cure Time
Plasticity
Shelf Life
Shrinkage
Specific Gravity
Tear Strength

Important To Printing

Abrasion Resistance
Durometer
Resilience
Solvent Resistance

Abrasion Resistance

Abrasion resistance directly relates to plate wear on press. It is measured by the amount of material worn away by a standard abrasive wheel loaded with a given weight and tested for a standard period of time. The test instrument is the Tabor Abrader, so the test is often called Tabor Abrasion. Results are usually expressed as eight (in grains) lost over the testing cycle.

Among rubber plate compounds, vinyl gums are usually selected for pigment. With this one exception, the color of the flexo plate material has negligible effect on molding or printing performance. Photopolymer plates are colored by the addition of dyes or pigments. Color is

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largely a matter of customer preference.

Compression Set

Compression set is the measure of compound failure to return to original thickness after being compressed by a given weight for a standard period of time (usually 22 hours). It has little or no application in selection of printing plate materials.

Cure Time (Rate of Cure)

Rate of cure is important to the rubber platemaker and the material manufacturer.

For rubber plate compounds, most manufacturers recommend a preheat and cure time for molding fresh stock at 307°F (153°C). As gum ages, the optimum preheat time decreases. Also, platemakers must adjust the manufacturer's recommendations for the peculiarities of a particular vulcanizer. Compounds with very short cure times may also have short shelf life. For photopolymer plates, "cure time" is called "exposure time" and is established for each lot of material by the platemaker.

Durometer Hardness

Durometer is a measure of the hardness of the plate material after curing, as determined by its resistance to indentation by a standard test instrument. Durometer measurements are subject to considerable variation unless the test is conducted EXACTLY as prescribed.

The most commonly used measure for flexo printing plates is the *Shore "A"* scale. The useful range of durometer hardness is 20 to 70 Shore A range. For general printing of paper or plastic, plate durometers should be in the 45-55 Shore A range. Experience has shown that photopolymer plates can be 5-10 points higher in durometer than commonly used rubber compounds and still produce excellent results.

Elongation (Percent)

Elongation is a measure of the ability of a rubber compound to stretch before breaking. It is measured along with tensile strength, and is a manufacturing test with no practical use to the flexo platemaker or printer.

Plasticity

Plasticity, also called viscosity or "Mooney" viscosity, is a measure of the flow of an uncured material under heat and pressure prior to the start of cure.

It is important to rubber platemakers as it relates to filling the mold cavity and to gauge uniformity in large molded plates. Plasticity is monitored by rubber compound manufacturers as an important physical property of their materials.

Plasticity is not relevant to photopolymers as they cure by UV light rather than heat.

Resilience

Resilience is a measure of the recovery (rebound) of a cured material to its original thickness after impact. The standard test for resilience measures the percent rebound of a steel ball dropped from a standard height on to a cured rubber sample. It is commonly called “Bashore” resilience. Flexo plate compounds generally have a Bashore resilience in the range of 10% to 60%. Natural rubber compounds have the highest resilience, while vinyl/nitrile blends have the lowest.

Resilience can affect printing performance on high speed presses. Very resilient compounds may aggravate press bounce, while compounds with very low resilience may cause “skips” and inconsistent ink coverage. Manufacturers formulate to produce compounds with resilience in the mid-range.

Rheometer

Rheometer is a *complete* measure of the flow and curing properties of a rubber compound during the curing cycle. The data provides measures of plasticity, flow time and cure rate. The most common rheometer test instrument is the Monsanto rheometer. A rheometer curve can provide the development chemist and process technician with a valuable tool in predicting the molding performance of printing plate compounds.

Scorch

Scorch is a measure of the time required to begin vulcanization of a rubber compound. Scorch is measured at molding temperature or similar elevated temperatures. Scorch time, in minutes, is related to shelf life of a raw compound. It is not a good indicator of molding time since it involves only the onset of vulcanization and not the complete cure cycle.

Shelf Life

Shelf life indicates the expected useful life of unprocessed (before before curing) plate material. It is important to both rubber and photopolymer platemakers.

Shelf life is fairly standard for most rubber compounds, although some “fast cure” compounds will show shorter shelf life. Refrigerated rubber storage, inventory control and stock rotation will ensure consistent molding performance. Shelf life of MacDermid photopolymers is not affected by normal temperature variations, but is affected by exposure to ultraviolet radiation, which is present to some extent in all visible light. When stored in the dark, MacDermid materials have a shelf life of 12 months or longer.

Shrinkage

All rubber compounds shrink during vulcanization. Shrinkage is measured as a percent

decrease in length and width of the cured plate from the mold. Shrinkage will be consistent for a compound, but will vary somewhat from compound to compound. Shrinkage is important to the engraver and platemaker for accurate final size and registration. Molding shrinkage is typically about 2%. Most plate gums have slightly higher shrinkage in the cross-roll direction.

Photopolymer plates with polyester or metal backs are dimensionally stable and do not shrink during cure.

Solvent Resistance

Ink and solvent compatibilities are important to both rubber and photopolymer materials.

For rubber plates, compatibilities are usually specific for classes of solvents with classes of rubber compounds. For example, natural rubber is recommended for water or alcohol inks, and Buna-N for oil or cosolvent inks. Some manufacturers offer compounds specifically compatible with selected inks and coatings.

Photopolymer materials are available in solvent compatible “classes” similar to, but not as extensive as, rubber compounds.

Specific Gravity

Specific gravity is a measure of density (weight) per unit volume. It is expressed as “grams per cubic centimeter.”

Specific gravity can be important when making rubber plates. Rubber plate gums vary in specific gravity from 1.10 to 1.65 gm/cc. Low specific gravity gums offer more square inches per pound of stock while high specific gravity gums have advantages in molding consistency. To determine the best value, rubber plate users must evaluate compounds for both cost and finished plate yield.

Specific gravity is not important in photopolymer plates.

Tear Strength

Tear strength is a measure of the force required to tear a standard “nicked” sample.

It can be important to rubber platemakers. When tear strength is determined on a hot sample, it relates to the ease with which a plate can be removed from a mold without tearing. Most rubber compounds are formulated for high hot tear strength.

Tear strength is less important in photopolymer plates as most of the plate’s tear strength is contributed by a standard polyester backing.

Tensile Modulus

Tensile modulus is an expression relating to the force required to stretch a standard sample a given amount (i.e., 100%, 200%, 300%). Determined with tensile strength, it is primarily a manufacturing control test with minor application in rubber compound selection.

Tensile modulus is not relevant in evaluating dimensionally stable photopolymer plates.

Tensile Strength

Tensile strength is a measure of the force required to rupture a standard test sample. Although important as a manufacturing process control test, it is of no practical use to platemaker or printer.

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