

Plastics Recycling Testing Terminology

Introduction – Scope, Significance and Use

There are a variety of jargon terms that are regularly used in discussions of plastics recycling and evaluation in the laboratory. Many of these terms are listed and defined below. Because there are a wide variety of labels used with plastic packaging, and labels can have an impact on recycling, there is a second section on terms that are specific for labels, inks and adhesives. Terms that are commonly used in package and plastics engineering are not included in the listing.

Plastics Recycling Testing Terms

AIR DRY SAMPLES To allow any samples that are water wet to dry at ambient laboratory conditions, or no greater than 40°C, so that heat does not affect the samples.

ATTACHMENTS Components bonded to plastic packages, for example handles or spouts, after the base item is molded and not during the molding process itself.

CLUMPING An effect that occurs when amorphous or low melting point polymers are mixed with crystallized polymers such as PET. The amorphous or low melting polymers become soft and sticky at elevated PET drying temperatures and act as an adhesive creating clumps of PET flake.

COLOR VALUES Measurements of color for PET that are typically measured by a spectrophotometer using the $L^*a^*b^*$ system where: L^* is a measure of lightness and darkness; b^* is a measure of blueness or yellowness; and a^* is a measure of redness or green. For transparent plastics such as PET, the % haze can also be evaluated by the spectrophotometer.

CONTROL RESIN A resin of known composition used to minimize the effects of variables other than the ones introduced by the innovation being tested. There are resins specified that can be used as control resins. There is also a procedure that can be used to confirm that a resin not on the recommended list is suitable for use as a control resin.

CONTROL PACKAGE The package made using the control resin.

DESICCANT DRYER – A technology that uses a desiccant bed to remove moisture from the air in the dryer used to dry PET prior to molding. This results in lower moisture values in the PET flake or pellets. This is done because PET can react with moisture in an extrusion or injection molding step resulting in a loss of molecular weight.

DIRTY FLAKE The result when a plastic item or package has been granulated, but not washed. This flake will include the residual contents in the packaging, labels and closures on the packaging, and any dirt or contamination from collection and sorting of the packaging.

ELUTRIATION The process of circulating PET flakes through an air separation where flake is passed down with gravity through a process unit that has an up-draft of air. The up-draft is used to remove light pieces of contamination such as fines, label residue, and multi-layer residue.

EXTRUSION Manufacturing process in which a molten polymer is forced through a die and quickly cooled to form a continuous strand or otherwise shaped plastic.

FLAKE (Or BOTTLE FLAKE) The resulting small, flat shaped pieces of material created when plastic bottles are granulated

GRANULATION The reduction in size of large plastic parts for washing and extrusion by machine processing. Typically, rotating cutting knives are used to cut the plastic to a size that falls through a screen resulting in pieces of plastic in the range of 6 to 12 mm. These pieces are referred to as granulate or flake. Alternately referred to as “grinding”.

INNOVATION A general term used in APR Documents to refer to a resin, material, component or package design that is being considered for evaluation for compatibility with recycling.

INTRINSIC VISCOSITY (or IV) A common measure related to the molecular weight of PET resin. A sample of resin is dissolved in a solvent, and the viscosity of the solution is a measure of molecular weight. Some laboratories measure the melt viscosity of a PET resin using a capillary rheometer and use a correlation curve to relate the melt viscosity to the intrinsic viscosity. Some use the comparative terms solution intrinsic viscosity and melt intrinsic viscosity to distinguish the measurements.

MELT FILTRATION The process of melting plastic in an extruder and forcing it through a fine screen to filter the melt. Melt filtration is widely used to remove metals, wood and paper, thermoset materials and other unmelted physical contamination from recycled plastics.

MULTI-LAYER CONTAINERS OR FILM Packages made with layers of polymer. Multi-layer packaging may consist of multiple layers of the same polymer or incorporate different polymers or substances. Two common examples:

- A blow molded PET bottle with a co-injected layer of nylon to provide a container with higher oxygen and CO₂ barrier than can be achieved with PET alone.
- A thermoformed PP container made from a multi-layer co-extruded sheet that has layers of PP, EVOH, adhesive tie layers to bond the EVOH to the PP and perhaps a re-grind layer.

LIBERATE To remove an attached package component through machine processing. As an example, a package employs a tamper evident band secured to the finish of a bottle. The granulation process liberates the tamper evident band from the container finish.

PELLETS A form of plastic created when washed flake is extruded into a strand and chopped into uniformly sized pieces called pellets, for the purpose of achieving higher bulk density than flake with better feeding and conveying performance.

SEPARATE To use machine processes that take advantage of different properties of package components that have been liberated to separate them. An example is a HDPE tamper evident band on a PET bottle which separate in the float sink step. Other separation technologies may include metals removal, size screening, air separation and flake color sortation.

SOLID STATING Heating PET pellets under vacuum or inert atmosphere that contains no moisture. Solid stating promotes removal of water and advances the polyester condensation reaction to build molecular weight.

STRAND CUT PELLETS Pellets of plastic produced by cutting the strands of plastic formed from extrusion of melted material through a die. In the laboratory, as well as commercial practice, it is common to extrude strands of plastic through a die, cool the strands in water, and then pelletize the solid strands to recover plastic pellets.

WASHED FLAKE Flake obtained after dirty flake is washed to remove surface contamination. Washed flake also goes through a variety of other steps to remove contamination and improve uniformity. These steps can include: float/sink tank separation, metals removal, size screening, air separation, and flake color sortation.

WASH WATER The water-based solution used to wash plastic flake. Plastics are washed under different conditions depending upon the plastic and the end use requirements. PET, for example, is commonly washed in heated water that contains a caustic detergent composition. HDPE detergent bottle flake might be washed in water near room temperature that only contains the residual detergent from the bottles.

Terms used with Labels, Inks and Adhesives

Label terms

DE-LABELING The process steps used to remove a label from a container.

DE-SEAMING The process step that removes shrink sleeve labels with adhesive seams from plastic bottles by dissolving the adhesive in hot caustic wash water, thus allowing the label to be liberated from the container.

DIRECT PRINT LABELS Decorations that are printed directly onto the container to create a label. Silk screening is one method used. Another gaining use is digital printing with UV cured inks.

GENERIC LABEL A label prepared for testing specified so as to represent any label construction within the scope of the test. Generic labels are typically printed with three chromatic inks, along with white and black ink in a test pattern.

IN-MOLD LABELS – Labels for plastic packages or items that are applied during the molding process, as opposed to being applied to a finished item. First, a label is printed on a plastic film. Then the label is placed in a mold and the container is molded over the label. The technology can be used in both injection molding and blow molding. The hot melted plastic of the container adheres firmly to the label film.

INTENDED LABEL An actual label that will be used in production; the label is intended for commercial use.

LAMINATED FILM LABELS Labels made by printing on the surface of a film, and then laminating a clear protective layer over the first to sandwich the ink between the two layers.

LAMINATED PAPER AND FILM LABELS Labels made by printing on a paper surface, then laminating a clear plastic film over the printed paper surface to sandwich the ink between the two layers.

MONO-WEB LABELS Plastic film labels made by printing on an exterior surface of a single film layer.

PRESSURE SENSITIVE FILM LABELS Plastic film labels with an adhesive backing that adhere to a package when pressed onto the surface of the package.

PRESSURE SENSITIVE PAPER LABELS Paper labels with an adhesive backing that adhere to a package when pressed onto the surface of the package.

ROLL-ON SHRINK-ON (ROSO) LABELS Labels that are wrapped around a container where the leading film edge is adhesively attached to the container and the trailing edge is adhesively attached to the leading film edge. When the label is heated with hot air or steam, the label shrinks to conform to the shape of the container.

STRETCH LABELS Labels made in the shape of a tube that are stretched to fit over a container.

SHRINK SLEEVE LABELS Labels placed around a package, usually as a preformed tube shape, that shrink to conform to the package when heated.

WET GLUE-ON LABELS Labels using an adhesive layer that is moistened, and then the label and adhesive are adhered to the package.

WRAP AROUND LABELS Labels that are wrapped around a container and fixed in place with an adhesive on the ends, but not fixed with heat like ROSO labels. Wrap around labels are typically polypropylene film or paper.

Ink terms

BLEEDING INK Ink that washes off a label in substantial amounts and becomes dissolved, mixed, or suspended in wash water, to the degree that the printing and graphics are no longer legible.

INCIDENTAL INK The amount of ink released from the exposed cut edges of a label that becomes suspended in the wash water to the degree that it is visible, but the text and the graphics of the label are still clearly legible and visually not affected by the wash process. Some specific pigments used in inks may be slightly soluble in hot caustic wash water and introduce incidental ink color into the wash water. This incidental ink might also be small particles of ink from cut edges.

LAMINATED INK The ink between the layers of a laminated label.

OVER-VARNISH A clear coating applied over a printed label to provide abrasion, moisture and chemical resistance.

SOLVENT BASED INK A type of printing ink where the ink binder is dissolved in an organic solvent; the ink is dried by heating and removing the solvent from the printed surface.

STAINING INK Ink that stains or discolors plastic as a result of the flake wash process; resulting in either discoloration of washed flake, or of a molded part made from the washed flake.

THERMOSET INK A type of printing ink that is cured using UV light or an electron beam to create a cross-linked polymer binder for the ink.

WATER BASED INK A type of printing ink where the ink binder is dispersed primarily in water, and the ink dries as the water evaporates from the printed surface.

Adhesive terms

ADHESIVE ADHERED TO LABEL Adhesive that separates from the plastic container and remains adhered to the label film after flake washing.

ADHESIVE ADHERED TO PLASTIC Adhesive that remains adhered to the original plastic container surface and is not removed by the washing process.

FREE ADHESIVE Adhesive that separates from the plastic surface as well as the label and becomes dispersed in the wash water. Typically acrylic and hot melt adhesives are dispersed as a second non-aqueous phase in wash water. Some wet glue adhesives might be soluble in wash water.

HOT MELT ADHESIVE A polymer composition that is fluid or viscous when heated, and then cools to provide an adhesive bonding agent.

PRESSURE SENSITIVE ACRYLIC ADHESIVE A common adhesive used for pressure sensitive labels.

PRESSURE SENSITIVE HOT MELT ADHESIVE A second adhesive type used on pressure sensitive labels.

WET GLUE ADHESIVE A water sensitive glue that provides an adhesive bond upon drying.

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