Identifying Common Plastics Used in Agriculture

Lois Levitan, Ph.D.—Cornell University, Department of Communication

Plastics recyclers are usually quite particular about the kinds of plastic (i.e., which plastic resins) they will accept for processing.

Why? One reason is that the “recipes” for finished products call for the specific characteristics of certain plastics. Limitations and capabilities of equipment are another factor, as is cost. And most recycling plants are not set up to handle the toxic emissions from PVC, so recyclers are adamant that PVC not be in the mix.

It’s a plus for farmers and those involved with recycling programs to be able to differentiate among the common plastic resins used in agriculture so that sorting and separating can happen at the point of collection. This paper describes and interprets sink-float and burn tests used to identify common plastic resins and describes characteristics of the resins such as density, feel, color, strength and stretchability. These tests and observations can be carried out with minimal supplies—even in the field.

**SINK-FLOAT TESTS:** Simple sink-float tests can be carried out in the field to identify the common plastics used in agriculture: Place a small sample of plastic flake or chips (about 0.25”–1” sq.) in a jar of water. Shake and then wait a moment for the pieces to settle out or float. Plastics that are less dense than water will float while more dense plastics sink.

*Polyethylenes* and *polypropylene* are the only plastic resins commonly used in agriculture that float in water. Together they form the resin group called *polyolefins*.

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1 eCommons Cornell Archive: [http://hdl.handle.net/1813/42332](http://hdl.handle.net/1813/42332) (Levitan-IdentifyingPlasticResinsRev2016Jan29.pdf. 2pages)

2 *Olefins*, from a French word meaning ‘oil-forming’, are also called alkenes. They are unsaturated hydrocarbons containing a double bond between carbon and hydrogen, with the general formula CnH2n. (source: *New Oxford American Dictionary*)
Most agricultural plastics—including greenhouse and tunnel covers, mulch films, bags from supplements, bale wrap and silage covers, pesticide containers, etc.—are polyolefins.

Other plastics sink in water. So the sink-float test can be used to flag plastics that cannot be recycled with polyolefins. *E.g.*, 

- Adhesives used to bind smaller pieces of film into the large sheets needed to cover greenhouses may have an incompatible chemistry and need to be cut away in order to recycle the film.

- Most recyclers do not accept polyvinyl chloride (PVC), but old maple tubing, some brands of irrigation drip tape, and drainage pipes were (or still are) made with PVC resin and must be separated out.

- Collections of nursery pots and trays typically include a mix of products made from polystyrene, polyethylene and polypropylene. Only the polystyrene planters sink in water.

- Horticultural row covers are made from both spun polyester and polypropylene. The products can be difficult to differentiate just by looking at them, but the covers made from polyester will sink in water.

To **differentiate polyolefins from one another**, conduct sink-float tests with fluids less dense than water, *e.g.*, alcohol and oil. As its name suggests, high-density polyethylene (HDPE #2) is more dense than low-density polyethylene (LDPE #4). It is also more dense than alcohol, so flakes of HDPE sink in alcohol while pieces of low-density polyethylene (LDPE #4) and polypropylene (PP #5) float in alcohol. Polypropylene—the least dense of the polyolefins—floats even in oil, while LDPE sinks. *Try it!*

**BURN TEST**: Resins can be differentiated by the color of their flame, the odor produced, whether they drip, and whether they continue to burn after the flame source is removed.

Polyethylenes and polypropylene (the **polyolefins**) continue to burn after the flame source is removed. They burn slowly, produce a blue flame tipped with yellow, and will drip. Polypropylene smells sweet while burning whereas the polyethylenes smell like paraffin wax. **Polystyrene** also continues to burn after the flame source is removed, but it burns rapidly with a yellow flame and leaves a dense black sooty smoke.

**Nylons, polycarbonate** and PVC also burn, but their flame extinguishes when the flame source is removed. Nylon burns with a blue flame tipped with yellow, will drip, and has the odor of burned wool. Polycarbonate burns with an orange flame, will drip, leaves a black sooty smoke, and has a faint sweetly aromatic odor. Most PVCs burn with a yellow flame, do not drip and smell acidic, acrid or (in the case of PVC/Acrylic) fruity.

**Polyesters** burn quickly with a yellow flame, shrinking away from the flame source and forming hard, dark, round beads. Polyester may continue burning slowly after the flame sources is removed. While burning, polyester emits a slightly sweet chemical odor and black smoke, but does not drip.

**FEEL, FLEXIBILITY & OTHER CHARACTERISTICS**: With experience, resins can often be differentiated by feel and by observation (*e.g.*, polypropylene is harder to scratch than the polyethylenes, and polystyrene is hard and brittle). However, these cues can be tricky because many products are made
with blends or multiple layers of different resins so as to optimize for desired characteristics such as flexibility, strength and puncture resistance.

**COLOR & TRANSLUCENCE/OPACITY:** Without added colorants, low-density polyethylene (LDPE) and linear low- density (LLDPE, which is also classified as #4) are translucent, with a milky hue. Of the two, LDPE is the more transparent. And it has a glossy appearance. In contrast, high-density polyethylene (HDPE) is a semi- translucent milky white, and polypropylene (PP) is opaque. Polyester is clear. Polyvinyl chloride (PVC) is transparent to yellowish in color, as is ethylene vinyl alcohol (EVOH), which is used as a barrier film.

**FLEXIBILITY & STRENGTH:** LDPE is slightly more flexible than LLDPE, but both will stretch rather than tear. Of the two, LLDPE has greater tensile strength and is more resistant to punctures and cracking. Thus LLDPE films alone or in blends with LDPE are typically thinner than a comparable LDPE-only product. But used alone, LLDPE film tends to be sticky and thus can be difficult to handle.

Of the polyethylenes, HDPE is the strongest, least flexible (more brittle and stiff), and most resistant to chemicals, cracks and UV. HDPE bags can hold 2000 times their weight, but eventually will tear rather than stretch. Since HDPE bags are stronger at a thinner gauge, HDPE film is typically thinner than (L)LDPE films.


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