The APR Design® Guide for Plastics Recyclability

Supplemental Guidance

The following supplemental information is intended to be used alongside the Circular Packaging Assessment Tool. The information within is consistent with the APR Design® Guide for Plastics Recyclability.

Polyolefin Packaging Articles Sink or Float Evaluation

Document Code – O-S-01

Publication or Revision Date: 01/23/2024

Introduction – Scope, Significance and Use

The float-sink step is an important process step when rigid, flexible or film olefin articles are recycled in a wet wash process. There may be a float-sink step after granulation, and/or a float-sink separation employed after the wash step. Although the films do not always get a wet wash APR recommends the floatability as an important evaluation.

It is generally desirable that other package components such as non-olefin materials sink in water so that they can be cleanly separated from the desired polyolefins.

This document presents a standard laboratory test method to evaluate the ability of a specific package component to float in room temperature water, as well as after exposure to water at 80 °C as occurs during a heated caustic wash of polyolefin flake. Some materials may increase in density above 1.0 g/cm^3 because of exposure to hot water. A comprehensive evaluation of a new material or product requires exposure to the heated water.

There are situations where an investigator can develop useful information from the room temperature evaluation only. Examples might be the impact of fillers in polyolefins on

float/sink behavior. Another is the impact of inks and pigments on the float/sink behavior of rigid articles, labels, flexibles, and films when it is known that heat exposure does not change the density of the article or label.

Test Method Summary

A packaging component of interest is either granulated or cut into pieces before mixing with water and a surfactant. Ability of the component to float in water is observed visually and can be measured gravimetrically. Surfactant is necessary to allow water to fully wet the component and displace air bubbles that might adhere to the component.

Equipment Required

- Weigh scale (± 0.01 grams)
- Thermometer
- Hot plate with magnetic stirrer, or an over-head mixer
- Means to size reduce the test component to about 1 cm pieces – could be a laboratory granulator, hand shears, scissors.

Materials Required

- 250 ml glass beakers
- 10 individual items of component to be tested (for example 10 closures or 10 labels)
- Drying pans
- Triton X100 or McDermid surfactant (common liquid dish wash surfactant can be used if needed)
- Caustic solution or pellets

Test Method Steps

Safety Statement: *APR Test and Practice documents do NOT CLAIM TO ADDRESS ALL OF THE SAFETY ISSUES, IF ANY, ASSOCIATED WITH THEIR USE. These Tests and Practices may require the use of electrically powered equipment, heated equipment and molten polymers, rotating motors and drive assemblies, hydraulic powered equipment, high pressure air, and laboratory chemicals. IT IS THE RESPONSIBILITY OF THE USER TO ESTABLISH AND FOLLOW APPROPRIATE SAFETY AND HEALTH PROCEDURES WHEN UNDERTAKING THESE TESTS AND PRACTICES THAT COMPLY WITH APPLICABLE FEDERAL, STATE AND LOCAL REGULATORY REQUIREMENTS. APR and its members accept no responsibility for any harm or damages arising from the use of or reliance of these Tests and Practice documents by any party.*

Room temperature water evaluation:

1. Size reduce the 10 items of the component to pieces about 1 cm in dimension and mix together to create a single test sample.
2. Weigh the size reduced sample material.
3. Add the size reduced sample to a volume of tap water about 10x the weight of the sample; the volume of water is not critical and can be adjusted to give a good visual separation of floating and sinking material.
4. Add six drops of surfactant to each 100 ml of water volume.
5. Mix the water and plastic component using the stirrer or mixer for 5 minutes at an impeller tip speed of at least 240 meters per minute.
6. Shut-off the mixer and observe whether the material floats or sinks in the water. A visual evaluation is expected to be sufficient to observe pieces that float and pieces that sink. If an overhead mixer was used, remove from beaker to prevent material from collecting around the shaft. If bubbles are observed, as attached to flakes, continue stirring until no attached bubbles are observed.
7. If there is a combination of floating and sinking material, the floating material can be recovered, dried and weighed to report the % that floats. The composition of the floating material can be characterized.
8. The sinking material can also be recovered and characterized.

Heated water evaluation:

1. Size reduce the 10 items of the component to pieces about 1 cm in dimension and mix together to create a single test sample.
2. Weigh the size reduced sample material.
3. Add the size reduced sample to a volume of tap water about 10x the weight of the sample; the volume of water is not critical and can be adjusted to give a good visual separation of floating and sinking material.
4. Add six drops of surfactant and 10 drops of caustic to each 100 ml of water volume.
5. Heat water and chemistry to 80 °C on the hot plate.
6. Add the size reduced items to the hot water and mix for 15 minutes at an impeller tip speed of at least 240 meters per minute to simulate the time employed for hot caustic wash of polyolefin flake.
7. Shut-off the mixer and heat and observe whether the material floats or sinks in the water. A visual evaluation is expected to be sufficient to observe pieces that float and pieces that sink. If an overhead mixer was used, remove from beaker to prevent material from collecting around the shaft. If bubbles are observed, as attached to flakes, continue stirring until no attached bubbles are observed.
8. If there is a combination of floating and sinking material, the floating material can be recovered, dried and weighed to report the % that floats. The composition of the floating material can be characterized.
9. The sinking material can also be recovered and characterized.

Test assessment

In a comprehensive assessment, the desired outcome for polyolefin recycling is that 100 wt% of the size reduced sample floats after exposure to water bath.

For rigid polyolefin articles:

- If ≥ 95 wt% of the polyolefin item floats when tested, then the item is classified as **Preferred**.
- If ≥ 51 wt% to 95 wt% of the polyolefin item floats when tested, then the item is classified as **Detrimental**.

- If < 51 wt% of the polyolefin item floats when tested, then the item is classified as **Non-Recyclable**.

Any sinking material can be characterized for composition and this knowledge used to redesign the packaging component. Sinking materials indicates contaminates in the polyolefin stream. The sinking material is a yield loss and therefore not recycled.

Document Version History

Version	Publication Date	Revision notes
1	10/23/2019	Updated entire document, approved by OTC on 10/2/19
2	1/23/2024	Updated entire document to match sink/float requirements from new density guidance approved by OTC 12/2023.