Introduction: Scientific Identification of Plastic Waste

Effective recycling of plastic waste begins with accurate identification of different plastic types. Since plastics are made from a range of polymers with unique physical and chemical properties, scientific identification is essential to ensure proper sorting, recycling efficiency, and environmental safety.

To achieve this, several reliable methods are used:

- **Resin Identification Codes (RIC):** These standardized symbols (♳–♹) printed on plastic products indicate the specific type of polymer used.

- **Visual and Touch Analysis:** Basic characteristics like texture, flexibility, color, and transparency help in quick preliminary identification.

- **Density (Float-Sink) Test:** Plastics are placed in water to observe whether they float or sink, which reveals their density and helps with separation.

- **Burn Test (Laboratory Use Only):** Controlled burning reveals flame color, odor, and residue—useful indicators of polymer type.

- **Spectroscopic Techniques (FTIR/NIR):** Advanced tools such as Fourier-Transform Infrared (FTIR) and Near-Infrared (NIR) spectroscopy provide precise chemical fingerprinting of plastic materials.

Using these scientific techniques enhances the purity of recycled materials, reduces processing costs, and plays a vital role in promoting sustainable waste management.

Plastic Waste Identification

1. Plastic Codes (Resin Identification Code – RIC)

The codes on plastic products indicate their type and recyclability. These are standardized as per ISO 11469 and ASTM D7611.

	Code No.	Type	Common Uses	Identification Features
♳	1	PET/PETE	Bottles, food packaging	Transparent, sweet smell, shrinks when burned
♴	2	HDPE	Milk/oil containers	Taps with a "thak-thak" sound, floats in water
♵	3	PVC	Pipes, cables	Green smoke, pungent smell, not flammable
♶	4	LDPE	Pouches, plastic bags	Soft, wax-like, floats
♷	5	PP	Boxes, straws	Lightweight, waxy smell, floats
♸	6	PS	Thermocol, cups	Brittle, black smoke, styrene smell
♹	7	Other (PC, ABS)	Auto/electronics	Varies in properties; confirm with FTIR/NIR

A. Touch/Visual Identification

Polymer	Features
PET	Transparent, rigid, drips when melted
HDPE	White, crackling sound when bent
LDPE	Soft, wax-like
PP	Lightweight, rigid, crackles
PVC	Heavy, flexible
PS	Brittle, light
Others	ABS = Tough, PC = Rigid and clear

B. Float-Sink Test (Density-Based)

Polymer	Density (g/cm³)	Floats in Water?
LDPE	~0.91−0.94	✓ Yes
HDPE	~0.94−0.96	✓ Yes
PP	~0.90−0.92	✓ Yes
PET	~1.38	✗ No
PVC	~1.38−1.45	✗ No
PS	~1.04−1.06	✗ No

C. Burn Test (Lab Controlled Only)

Polymer	Flame Color	Smell	Residue Characteristics
PE/PP	Yellow-Blue	Wax-like	Drips when burned
PET	Blue-Yellow	Sweet	Shrinks
PVC	Green	Acidic, pungent	Smokes, self-extinguishing
PS	Yellow with soot	Styrene smell	Leaves soot

3. Recyclability & Cautions

Type	Code	Recyclability	Notes
PET ♳	1	Easy	Widely recycled (fiber, strapping)
HDPE ♴	2	Easy	Common for milk, chemical drums
LDPE ♶	4	Moderate	Film-grade recycling; limited infrastructure
PP ♷	5	Moderate	Found in automotive, bottle caps, crates
PVC ♵	3	Difficult	Toxic fumes; limited recycling
PS ♸	6	Difficult	Brittle; emits benzene on burning
Others ♹	7	Complex	Needs FTIR/NIR; high-grade reuse only

- **FTIR/NIR Identification:** Use Fourier-Transform Infrared (FTIR) or Near Infrared (NIR) Spectroscopy for complex or mixed plastics (♳ Others).
- **Melt Flow Index (MFI):** Evaluate HDPE and PP for their melt properties to determine recycling grade.
- **Washing Units:** Containers (like HDPE and PET for oil/milk) must be caustic-washed before pelletizing.
- **Density Separation Tank:** Essential for separating floaters (PE, PP) from sinkers (PET, PVC) in recycling plants.

Conclusion

Scientific identification of plastic waste using coding, burn tests, density checks, and FTIR analysis is crucial for:

- Improving recycling accuracy
- Reducing costs
- Supporting environmental conservation

If you have any other questions or would like to suggest topics for us to write about, please feel free to contact us at info@polymerupdateacademy.com

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