Types of Plastics & their Recyclability

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Why in news?

Only certain plastics can be recycled because of differences in their polymer structures, additives, and economic viability.

- **Plastics –** It is an ***umbrella term*** for various materials with some similar properties but differ in their ***polymer structures and chemical additives***.
- These differences decide how each type of plastic behaves when it is heated, ground down, and remade, which is why only certain plastics are practically recyclable.
- **Types –** Thermoplastics & Thermosets.

Thermoplastics	Thermosets
Soften on heating and harden on cooling repeatedly.	Harden permanently when heated and cannot be softened again.
Can be **remelted, reshaped, and recycled**.	**Cannot be remelted or reshaped** once set.
Structure - Linear or slightly branched chains.	**Structure - Highly cross-linked 3D network**.
Lower heat resistance.	High heat and thermal resistance.
Generally flexible and less rigid.	Very hard, rigid, and brittle.
Lower mechanical strength.	High mechanical and dimensional strength.
Processed by injection molding, extrusion, blow molding.	Processed by compression molding, casting, resin transfer molding.
Good recyclability.	Poor recyclability (cannot be remelted).
Examples: **PE, PP, PVC, PET, PS**.	Examples: **Bakelite, Epoxy, Melamine, Urea-formaldehyde**.

Used for bottles, bags, toys, pipes, packaging.	Used for electrical switches, sockets, adhesives, cookware, circuit boards.

- **Limitation Factors for recycle–**
  - **Purity of additives & contaminants –** Labels, food residues, dyes, fillers, flame retardants, and plasticisers alter melt flow and weaken the recycled product.
  - **Multilayer Packaging** – Combines different polymers (e.g., PET, polyethylene, aluminum) that are hard to separate.
  - Common in food packaging, but often not recyclable due to complexity.
  - **Recycling is costly** – Steps like collecting, sorting, washing, and remelting require money and infrastructure.
  - **Chemical recycling**– - New methods can break plastics into simpler molecules, but they use a lot of energy and aren't widely adopted yet.

Reference

[The Hindu | Why can we recycle only some kinds of plastics?]

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