



Polystyrene Recycling

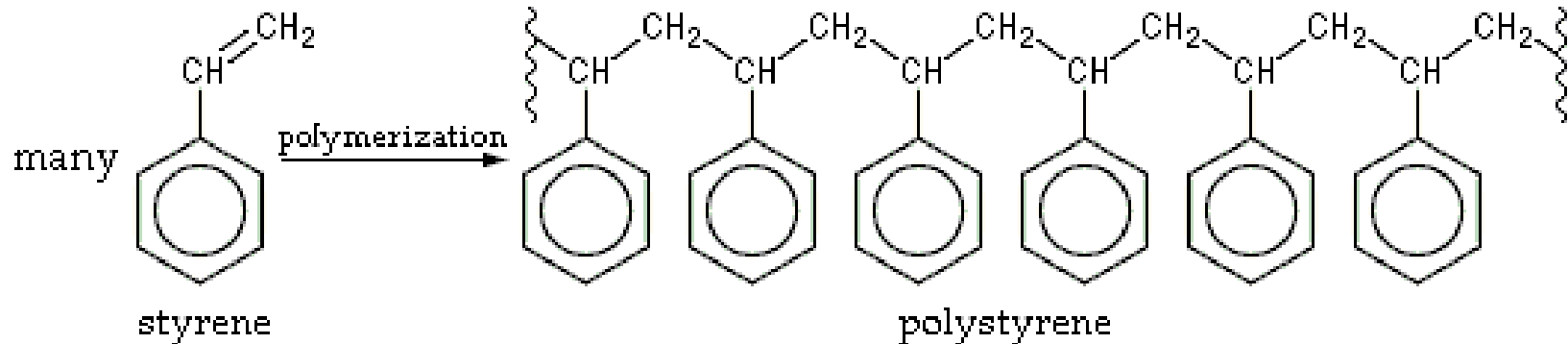
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Polystyrene (PS)

- Aromatic polymer made from styrene monomers
- Cheap relatively easy to manufacture and process
- Thermoplastic commonly extruded or molded



Polystyrene Cont.

- Clear polymer
- Low-cost applications
- Low impact strength
- Rigid (*easy to fracture*)
- Poor Weatherability
- Poor Chem. Resistance
- Processed
 - Sheet
 - Molded
 - Foams

Property	Unit
Density	1.05 g/cm ³
Young's Modulus	3000-3600 Mpa
Tensile Strength	46-600 Mpa
Elongation at Break	3-4%
Electrical Conductivity	10-16 S/m
Thermal Conductivity	0.08 W/(m·K)
Glass Temp.	95°C
Melting Temp.	240°C
Decomposition	50-1000 years

Polystyrene Products

- Sheet or Molded
 - Disposable Cutlery
 - CD “Jewel” Cases
- Foams
 - Insulation (Thermal & Acoustic)
- Extruded Polystyrene Foam(XPS)
 - Packaging
 - Shock Absorption





Do YOU Have a Waste Polystyrene Problem?

Polymer Myth:

Polystyrene can not be recycled

Polystyrene Disposal

- Burial (Landfill)
 - Stable to bury (without contamination)
 - Without UV and oxygen long degradation times
- Incineration
 - Requires high temperatures to combust properly
 - High energy content (good fuel)
- Discarded (*Thrown away into the environment*)
- Reduce / Reuse / Recycle

Environmental Impact

- Hazardous if improperly burnt
 - When burnt below 900°C up to 90 dangerous compounds can be released.
(ex: alkyl benzenes, carbon monoxide, and benzo[ghi]perylene)
- Takes up large volumes and occupies landfills
 - Foams decompose slow taking space longer
- Slow to degrade which poses danger to wildlife
 - Products improperly disposed of can hurt wildlife
(ie: styrofoam cups, disposable cutlery)

Polystyrene Recycling

- Like other polymers it can be recycled
(majority of Polystyrene is not recycled)
- Expanded Polystyrene Scrap (EPS)
 - Chopped into building materials
 - Filler for structures (park benches, lamp posts)
 - Remolded & using in casting industry
(25% of recycled foam)
- PS sheet and molded components
 - Chop filler for non PS materials
 - Reground into PS materials (if near virgin)

PS Recycling Problems

- Bulky Foams take up large amounts of space requiring multiple trips to haul away relatively little waste. (*Increased expenses and costs*)
- Light polymer structure makes regrinding and molding into PS components difficult without degradation.
- Additives and fillers prevent direct recycling
- PS is the most comely contaminated resin (*food contact, toxins and organics*)

Incineration Solution

- Polystyrene can be burned cleanly and efficiently
- Maintain burn temperature over 1000°C
- Burned with excess oxygen to break down chemicals
- Byproducts
 - CO² (*As exhaust gas*)
 - Water Vapor
 - Soot (*Biochar- easily biodegradable*)
 - Heat

Burial Solution

Melting technology to reduce bulk before burial

- EPS is subjected to low heat to release entrapped foaming agents and reduce bulk



Before



After

Reduce/Reuse Solutions

- Make foam packaging components generic shapes which can be used repeatedly.

(No mold to fit components)



Blocks

or



Peanuts

Reduce/Reuse Solutions cont.

- Reuse “disposable” products. PS is nonporous and easy to clean/serialize
(Cutlery and Jewel Cases)
- Redesign disposable products to be used multiple times before being disposed.
 - Add stronger liners
 - Reinforcing fillers*(ex. Cups and Containers)*

Recycle Solutions

- **Sterilizers: Decontaminate straight PS**
 - Allows PS to be reground and used in new PS products. (With use of colorant)
 - Chemicals, UV or Heat is applied to break down or kill off contaminants from PS
- **Pyrolysis: Breaks down PS in the absence of O²**
 - Creates base monomers for reprocessing
 - Light crude oil for fuel or virgin stock reprocessing

Recycling Solutions Cont.

- **Condensers: Compact unusable EPS**
 - Used to allow more PS to be carried away decreasing the costs associated with PS recycle
 - Mechanically applies pressure and some heat to crush foams into a dense block.
 - Works best on open cell foams
 - Allows for 2-5 times the amount of PS foam to be shipped for recycling

(reducing transportation costs)



Any Questions?

