

Exp. No. (5)

Primary Identification of Polymers

Introduction

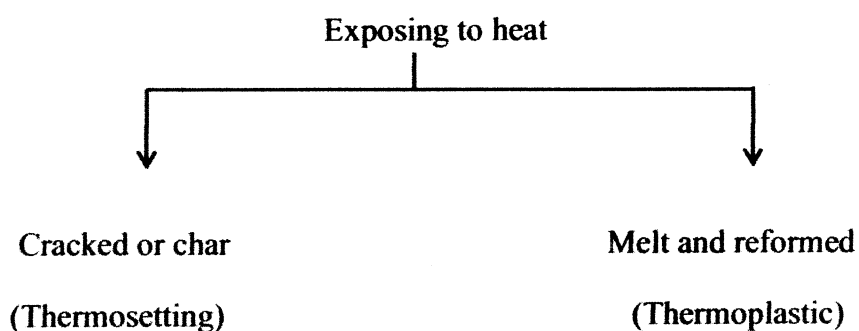
The reaction of various tests are directly related to the structure of the polymeric materials.

A useful link can be made in this way between structure and behaviors.

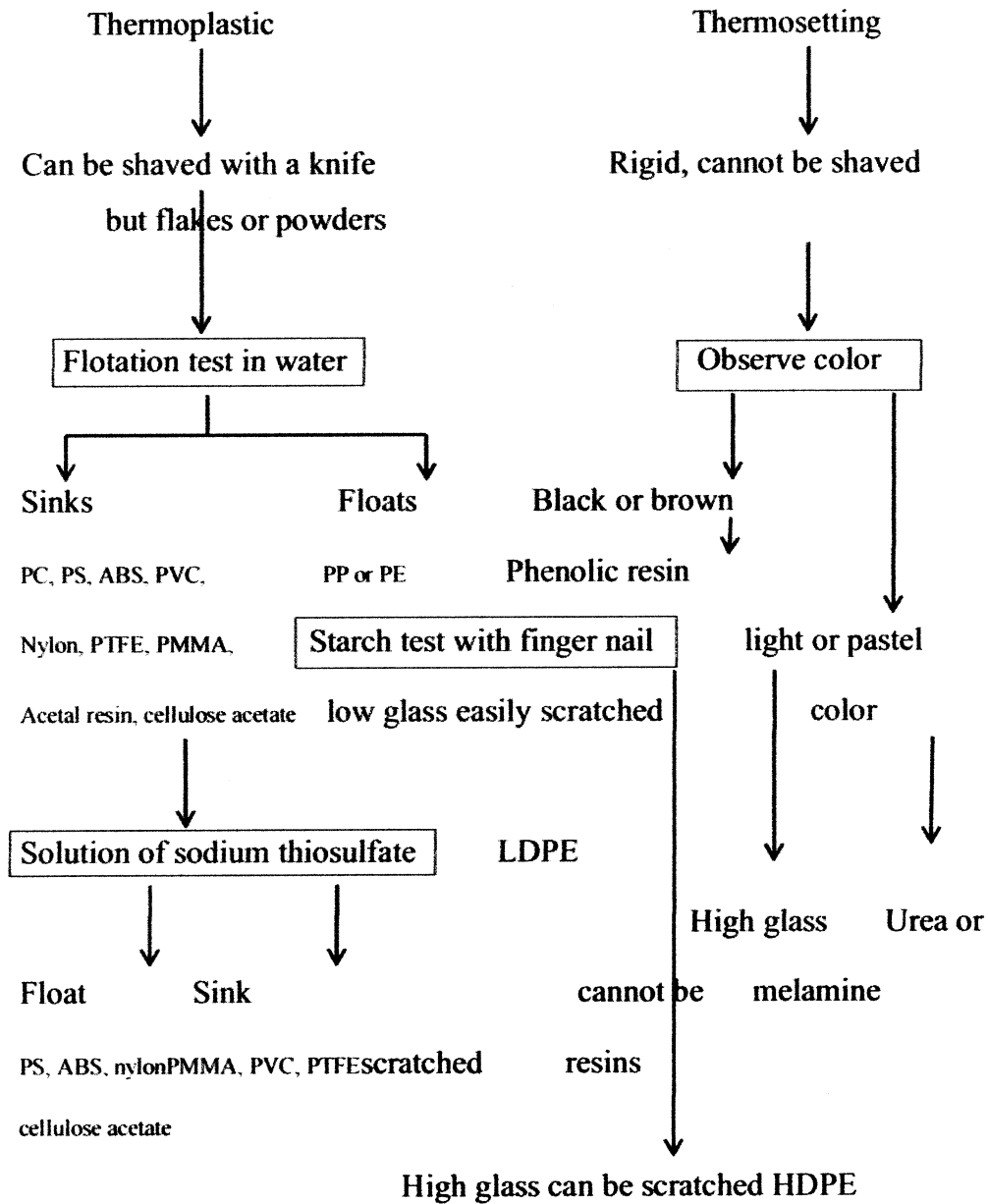
It should be realized that these simple tests is not always possible to give a positive identification of every type of plastic material. As some plastics are modified by additions, fillers, colors ... etc.

1st test: Thermosetting or Thermoplastic

The material should be cutted to a small pieces, exposing to heat and notice if



Another tests are followed.



2nd test: Density measurement (Specific gravity)

Put small piece of plastic material in cylinder containing water and the floatation.

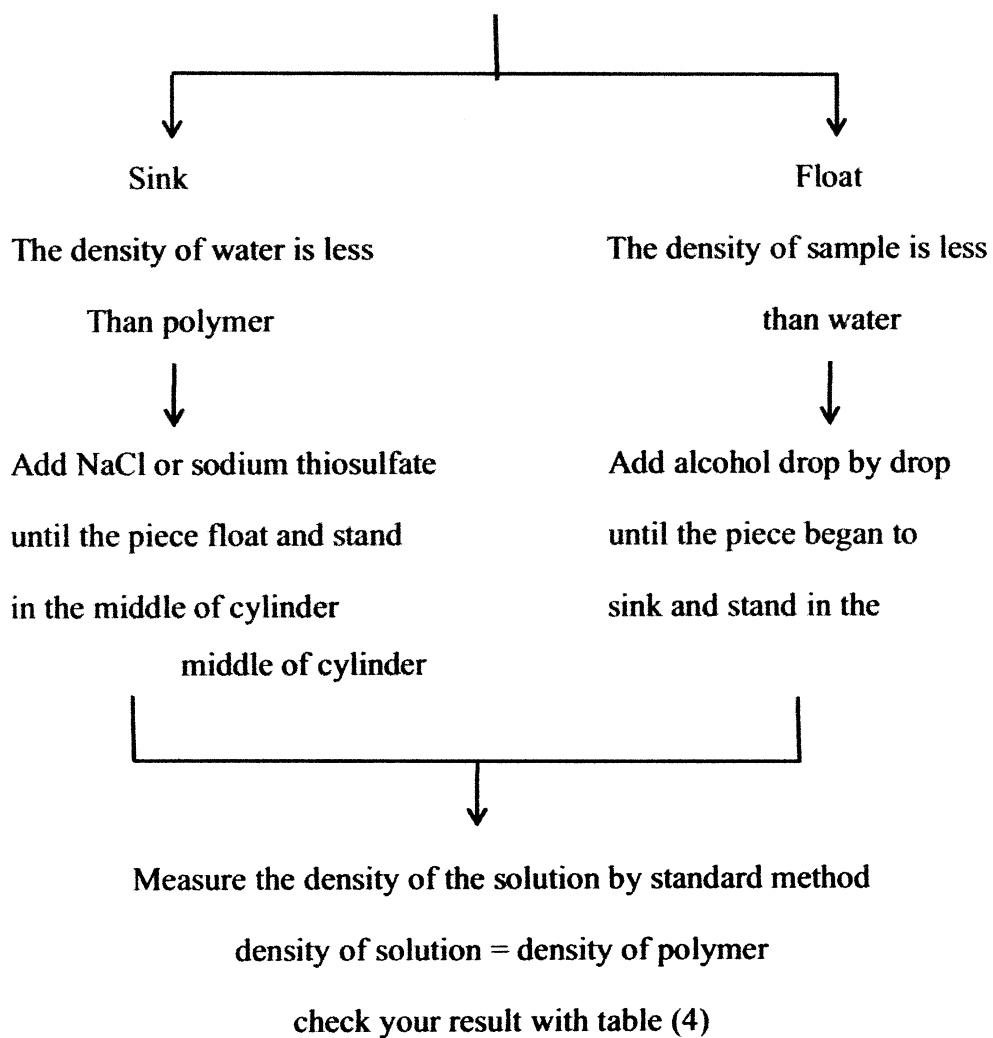


Table 4: Density and specific gravity of some polymer

	Polymer	Density	Specific gravity
Float on water	PP	0.850	0.90
	LDPE	0.90	0.92
	HDPE	0.96	0.96
Sink in water	PS	1.04	1.07
	ABS	1.10	1.10
	Nylon	1.10	1.10
Sink in hypo	PMMA	<u>1.20</u>	1.20
	PVC	1.40	1.40
	UREA	1.50	1.50
	PTFE	2.00	2.75
	Cellulous	1.28	1.30

3rd test: Burning test

The plastic materials can be classified into three types according to their burning characteristic.

1. Burned and did not extinguish after the fire source was keep back (extinguishable) e.g. PS, PE, PP, ...
2. Burned and self extinguish after the fire source was keep back (extinguishable) e.g. PVC, Rubber.
3. Unburned, PTFE.

Procedure

Hold a small in flame. If it ignites, withdraw it from the flame a distance of about 6cm. Make observations as listed below:

1. Degree of flammability: burns; self extinguishing or not, dose not burn.
2. Color of flame: yellow and orange, blue, blue with yellow edge, etc... (notice the tip and the base of the flame).
3. Color of smoke: no smoke; black, white.
4. Type of flame: steady, tall, short, sputtering.
5. Vapor after extinguishing: acidic or basic by litmus paper.

Compare your results with table (5) to decide the type of the polymer

Table 5: Typical results of burning tests

Polymer	Color of flame	Kind of smoke	Vapor	Other features
PE	Blue with yellow tip	Absent	Neutral	Flaming plastic
PP	Yellow with blue base	Absent	Neutral	Flaming plastic
PTFE	Will not burn	Non	Non	Non
PS	Orange-yellow with blue base	Heavy black smoke	Neutral	Spurting burns
PVC	Yellow with green base	White smoke	Acid	Difficult to burn and self extinguish
Cellulose acetate	Yellow and turn brown at base	Light smoke	Acid	Burn, strong smell of vinegar
PMMA	Blue and yellow bubble at base	Little black smoke	Neutral	Burns and not extinguish
Nylon	Blue with yellow tip	Non	Neutral	Burns and flame lead to go out
Acetal resin	Pale blue	Non	Neutral	Burn
Poly carbonat	Yellow	Black smoke	Neutral	difficult to light
Phenol resin	Yellow with spark	Non	Neutral	Difficult to burn and self extinguish
Urea resin	Yellow with light blue edge	Non	Basic	Burn and flame lead to go out
Melamine resin	Pale yellow with light blue-green edge	non	Basic	Difficult to burn
Poly ester	Yellow with blue base	very dense smoke	Neutral	burn
Poly urethan	Yellow with blue base	Non	Neutral	burn
ABS	Yellow with blue base	Black smoke	Neutral	Difficult to burn and self extinguish

4th test: Melting and odor characteristics

Heat a metal plate over a Bunsen flame or electric plate and piece of polymeric material on it.

Observe the melt behavior (softness, hard, flows, bubbles, swells does not char but melts and chars). For odor, use a description by relating it to a familiar smell (burning rubber, sweet fruity, marigold, burning paperacid, rancid rubber). In most cases a strong odor will be noticed when the material is burning. Check your result against table 6.

Table 6: Melting and odor characteristics

Polymer	Melting behavior	Odor
PE	Melt and bubbles fiercely around the edge	Waxy burning candle
PP	Becomes soft, tends to form a ball	Waxy smell
PTFE	Does not melt	Non
PS	Melt and bubbles around edges	Marigold (styrene)
ABS	Becomes soft but not fluid	Burning rubber
PVC	Softens and forms a ball, chars at the bottom	Characteristic smell
Cellulose acetate	Melt and emits white smoke boils and chars	Vinegar
PMMA	Boils and bubbles	Fruity, floral smell
Poly carbonat	Bubbles develops acellulor structures before decomposing	Non
Nylon	Melt round edge and chars	Burning hair or wool
Phenol resin	Does not melt	Carbolic smell
Urea resin	Does not melt	Fishy smell
Melamine resin	Does not melt	Fishy smell

5th test: Solubility test

The solubility process of polymer is different than the solubility of organic materials (small molecules). In polymer solubility, the polymer swells in primary stage. In some cases there are only swelling but no stability. This case is not solubility so the polymer dissolving needs long time with stirring. In this test need two solvents acetone and *n*-propanol.

Procedure

1. Shave off small amount of plastic materials, place the shaving into a test tube.
2. Add just enough solvent to cover the shavings.
3. Stir with glass rod for a few minutes and note the results.
4. If the plastic does not dissolve, leave for many minutes and stir again.

Check your results against table 7.

Table 7: Typical results at solubility tests

Polymer	Dissolved in acetone	Dissolved in <i>n</i> -propanol
PE	×	×
PP	×	×
PTFE	×	×
PS	○	×
ABS	○	×
PVC	+	×
Cellulose acetate	○	+
PMMA	○	×
Nylon	×	×
All resin	×	×

× = not soluble

○ = Soluble

+ = slightly soluble