

Contents

1. Introduction	1
2. Tests for the Identification of Plastics and Rubbers	3
2.1 Simple tests	3
2.1.1 Melting.....	3
2.1.2 Solubility	3
2.1.3 Burning characteristics	3
2.1.4 Odour recognition	4
2.1.5 Dripping	4
2.1.6 Flotation.....	4
2.1.7 Halogen test	4
2.1.8 Nitrogen- and sulphur-test	5
2.1.9 Burchfield colour reaction	5
2.1.10 Liebermann-Storch-Morawski reaction	6
2.2 Recording an IR spectrum	7
2.2.1 Principles of infrared spectroscopy	7
2.2.2 Origin of infrared absorption	7
2.2.3 Normal vibrations of a molecular fragment	8
2.2.4 Sample preparation for recording an IR-spectrum	11
2.3 The identification flow charts	12
2.3.1 Flow chart – Melting behaviour	13
2.3.2 Flow chart – Sample floats in water	14
2.3.3 Flow chart – Sample sinks in water	15
2.3.4 Flow chart – Sample keeps burning after removal from the flame	16
2.3.5 Flow chart – Sample burns but extinguishes after removal from the flame	17

2.3.6 Flow chart – Sample does not burn	18
2.3.7 Flow chart – Sample does not dissolve in toluene.....	19
2.3.8 Flow chart – Rubbers or foams	20
2.3.9 Flow chart – Elastomers which burn and keep on burning after removal from the flame	21
2.3.10 Flow chart – Elastomers which burn but extinguish on removal from the flame	22
3. Thermoplastics	23
3.1 What is a thermoplastic?	23
3.2 Thermoplastic homopolymers.....	23
3.3 Thermoplastic copolymers	24
3.4 Characteristics of individual thermoplastic materials	25
3.4.1 PE (Polyethene; polyethylene)	25
3.4.2 PP (Polypropene; polypropylene)	28
3.4.3 PS (Polystyrene)	31
3.4.4 POM (Polyoxymethylene; acetal)	34
3.4.5 Saturated polyester – PET (Polyethene terephthalate; polyethylene terephthalate)	37
3.4.6 PMMA (Polymethyl methacrylate; acrylic)	40
3.4.7 CA (Cellulose acetate)	43
3.4.8 CN (Cellulose nitrate)	46
3.4.9 PVAc (Polyvinyl acetate)	49
3.4.10 PAN (Polyacrylonitrile)	52
3.4.11 PC (Polycarbonate)	55
3.4.12 PA (Polyamide; nylon)	58
3.4.13 PSU (Polysulphone; PSUL)	61
3.4.14 PPSU (Polyphenylsulphone)	64
3.4.15 PPS (Polyphenylene sulphide)	67
3.4.16 PVC (Polyvinyl chloride)	70
3.4.17 PVDF (Polyvinylidene fluoride)	73
3.4.18 PEI (Polyetherimide)	76

3.4.19 PEEK (Polyetheretherketone)	79
3.4.20 PAI (Polyamide-imide)	82
3.4.21 PI (Polyimide)	85
3.4.22 PBI (Polybenzimidazole)	88
3.4.23 PPO (Polyphenylene oxide)	91
3.4.24 PTFE (Polytetrafluoroethylene; polytetrafluoroethylene)	94
3.4.25 EVA (Ethene-vinylacetate copolymer)	97
3.4.26 SB (Styrene-butadiene copolymer)	100
3.4.27 ABS (Acrylonitrile-butadiene-styrene terpolymer)	103
4. Cellulose and Starch	107
4.1 Introduction to biopolymers	107
4.2 Characteristics of individual biopolymers	108
4.2.1 Cellulose	108
4.2.2 Starch	111
5. Thermosets	115
5.1 What is a thermoset?	115
5.2 Sample preparation for recording an IR-spectrum	115
5.3 Thermoset materials.....	115
5.4 Characteristics of individual thermoset materials.....	116
5.4.1 Unsaturated polyester resin (UP)	116
5.4.2 Epoxy resin	119
5.4.3 UF (Urea-formaldehyde resin)	122
5.4.4 MF (Melamine-formaldehyde resin)	125
5.4.5 PF (Phenol-formaldehyde resin; phenolic resin).....	128
5.4.6 PUR (Polyurethane)	131
6. Elastomers	135
6.1 What is an elastomer?	135
6.2 Recording an IR-spectrum	135

Easy Identification of Plastics and Rubbers

6.3	The Burchfield colour reaction	135
6.4	The Liebermann-Storch-Morawski reaction	136
6.5	Elastomeric materials	136
6.6	Characteristics of individual elastomers	137
6.6.1	NR (<i>Poly-cis</i> -1,4-isoprene; natural rubber; polyisoprene)	137
6.6.2	IIR (Isobutene-isoprene rubber; butyl rubber)	140
6.6.3	EPR (Ethene-propene rubber; poly(ethene-propene))	143
6.6.4	EPDM (Ethene-propene-diene rubber; poly(ethene-propene-diene-methylene))	146
6.6.5	SBR (Styrene-butadiene rubber; poly(styrene-butadiene))	149
6.6.6	CR (Chloroprene rubber; polychlorobutadiene, poly- <i>trans</i> -chloroprene)	152
6.6.7	NBR (Nitrile rubber; poly(acrylonitrile-butadiene))	155
6.6.8	Silicone rubber and thermoset	158
6.6.9	PUR (Polyurethane)	161
7.	Chemical Products Required	165
7.1	Introduction	165
7.2	Organic solvents and reagents	165
7.3	Inorganic products, acids and bases	165
	Abbreviations	167
	Symbols	168
	References	168