

## Contents

	Page		Page
Preface . . . . .	V	2.2.3.8. <b>Benzyl cellulose</b> . . . . .	25
Abbreviations . . . . .	VI	Cellulose acetate, cellulose acetate <b>butyrate</b> , and cellulose nitrate . . . . .	25
Introduction . . . . .	XI	2.2.3.9. Phenolic resins . . . . .	25
<b>1.</b> Simple Physical Parameters . . . . .	1	2.2.4. Indene-coumarone resins . . . . .	25
<b>1.1.</b> <b>Softening</b> Range and Melting Point . . . . .	1	2.2.5. Alkyd resins and other ester resins . . . . .	25
<b>1.2.</b> Solubility . . . . .	1	2.2.6. Phthalic esters . . . . .	25
<b>1.3.</b> Density . . . . .	6	2.2.6.1. Isophthalic esters . . . . .	26
<b>1.4.</b> Refractive Index . . . . .	6	2.2.6.2. Terephthalic esters . . . . .	26
<b>1.5.</b> Dielectric Constants . . . . .	12	2.2.6.3. Unsaturated polyester resins . . . . .	26
<b>2.</b> Chemical Identification Reactions . . . . .	13	2.2.6.4. Polycarbonates . . . . .	26
<b>2.1.</b> Chemical Reactions with Heteroelements and Functional Groups . . . . .	13	2.2.6.5. Epoxy resins . . . . .	26
<b>2.1.1.</b> Detection of nitrogen, sulfur, and halogens by fusion with potassium . . . . .	13	2.2.7. Nitrogen-containing resins, sulfonamide resins . . . . .	26
<b>2.1.2.</b> Detection of nitrogen, sulfur, chlorine, fluorine, and phosphorus by combustion in oxygen . . . . .	13	2.2.8. Amines, aniline resins . . . . .	26
<b>2.1.3.</b> Detection of nitrogen, silicon, phosphorus, and titanium. After oxidation by $\text{HClO}_4$	13	2.2.8.1. Melamine resins and benzoguanamine resins . . . . .	27
<b>2.1.4.</b> Phosphorus, sulfur, and silicon . . . . .	14	2.2.8.2. Urea resins . . . . .	27
<b>2.1.5.</b> Alcohols . . . . .	18	2.2.8.3. Dicyandiamide resins . . . . .	27
<b>2.1.6.</b> Phenols . . . . .	18	2.2.8.4. Isocyanate resins and urethane resins . . . . .	27
<b>2.1.7.</b> Carboxylic acids . . . . .	19	2.2.8.5. Thiourea resins . . . . .	27
<b>2.1.7.1.</b> General method of detection by means of hydroxamic acid/ $\text{FeCl}_3$ complex . . . . .	19	2.2.8.6. Sulfonamide resins . . . . .	27
<b>2.1.7.2.</b> Lower fatty acids . . . . .	19	2.2.8.7. Silicone resins . . . . .	27
<b>2.1.7.3.</b> Higher fatty acids . . . . .	20	<b>2.3.</b> Thermosets and Thermoplastics . . . . .	28
<b>2.1.7.4.</b> Polybasic aliphatic carboxylic acids . . . . .	20	2.3.1. Protein plastics and other thermosets . . . . .	28
<b>2.1.7.5.</b> Aromatic carboxylic acids . . . . .	21	2.3.2. Polyhydrocarbons . . . . .	28
<b>2.1.8.</b> Esters . . . . .	21	2.3.2.1. Aliphatic polyhydrocarbons . . . . .	28
<b>2.1.9.</b> Aldehydes and ketones . . . . .	22	2.3.2.2. Aromatic polyhydrocarbons . . . . .	28
<b>2.2.</b> Coating Vehicles (Resins and Oils) . . . . .	22	2.3.3. Color reactions of vinyl polymers . . . . .	28
<b>2.2.1.</b> Natural resins and their derivatives . . . . .	22	2.3.4. Polymers containing chlorine . . . . .	28
<b>2.2.1.1.</b> LIEBERMANN-STORCH reaction . . . . .	22	2.3.4.1. Polyvinyl chloride . . . . .	28
<b>2.2.1.2.</b> SANDERMANN reaction . . . . .	22	2.3.4.2. Post-chlorinated polyvinyl chloride . . . . .	29
<b>2.2.1.3.</b> HIRSCHHOHN-UNVERDORBEN-FRANCHIMONT reaction . . . . .	23	2.3.4.3. Polyvinylidene chloride . . . . .	29
<b>2.2.1.4.</b> Other reactions of natural resins . . . . .	23	2.3.4.4. Chlorinated rubber . . . . .	29
<b>2.2.2.</b> Vegetable oils . . . . .	23	2.3.4.5. Rubber hydrochloride . . . . .	29
<b>2.2.2.1.</b> The ARCHBUTT elaidic acid test . . . . .	23	2.3.4.6. Polychloroprene . . . . .	29
<b>2.2.2.2.</b> Tung oil . . . . .	23	2.3.4.7. Chlorosulfonated polyethylene . . . . .	30
<b>2.2.2.3.</b> Linseed oil . . . . .	23	2.3.5. Polyvinyl acetate . . . . .	30
<b>2.2.2.4.</b> Cottonseed oil . . . . .	23	2.3.6. Polyacrylates and polymethacrylates . . . . .	30
<b>2.2.2.5.</b> Sesame oil . . . . .	24	2.3.7. Polymeric alcohols, ethers, and acetals . . . . .	30
<b>2.2.2.6.</b> Castor oil . . . . .	24	2.3.7.1. Polyvinyl alcohol . . . . .	30
<b>2.2.2.7.</b> Rapeseed oil . . . . .	24	2.3.7.2. Linear polyethers having the ether group in the main chain . . . . .	31
<b>2.2.2.8.</b> Oiticica oil . . . . .	24	2.3.7.3. Polyvinyl ethers . . . . .	31
<b>2.2.3.</b> Cellulose and its derivatives; other carbohydrates . . . . .	24	2.3.7.4. Polyvinyl acetals . . . . .	31
<b>2.2.3.1.</b> MOLISCH reaction with carbohydrates . . . . .	24	2.3.8. Nitrogen-containing polymers . . . . .	31
<b>2.2.3.2.</b> Anthrone reaction of carbohydrates . . . . .	24	2.3.8.1. Polyvinyl carbazole . . . . .	31
<b>2.2.3.3.</b> Aniline acetate reaction of cellulose and lignin and their derivatives . . . . .	24	2.3.8.2. Polyamides . . . . .	31
<b>2.2.3.4.</b> Iodine reaction of cellulose, cellulose derivatives, and some polymers . . . . .	24	2.3.8.3. Polyacrylamide and polymethacrylamide . . . . .	32
<b>2.2.3.5.</b> Nitride-naphthol reaction of oxycellulose . . . . .	24	2.3.8.4. Polyurethanes . . . . .	32
<b>2.2.3.6.</b> Methyl cellulose . . . . .	24	2.3.8.5. Polyacrylonitrile and polymethacrylonitrile . . . . .	32
<b>2.2.3.7.</b> Ethyl cellulose and other ethoxy compounds . . . . .	24	<b>3.</b> Degradation Reactions and Subsequent Identification of the Degradation Products . . . . .	33
		<b>3.1.</b> Thermal Degradation, Pyrolysis . . . . .	33
		<b>3.1.1.</b> Fundamentals . . . . .	33
		<b>3.1.2.</b> IR spectroscopic investigation of pyrolysis products . . . . .	33
		<b>3.1.3.</b> Gas-chromatographic investigation of pyrolysis products . . . . .	33

	Page		Page
<b>3.1.4.</b> Mass-spectrometric identification of the pyrolysis products . . . . .	35	<b>7.1.3.</b> Resins and balsams having low acid- and ester contents (rescnes) . . . . .	93
<b>32</b> Controlled Degradation . . . . .	36	<b>7.1.4.</b> Vegetable and animal oils . . . . .	95
<b>3.2.1.</b> Saponification of esters . . . . .	36	<b>7.1.4.1.</b> Drying oils . . . . .	95
<b>3.2.1.1.</b> Alkyd resins . . . . .	36	<b>7.1.4.2.</b> Semidrying oils . . . . .	97
<b>3.2.1.2.</b> Ester gums . . . . .	37	<b>7.1.4.3.</b> Nondrying oils . . . . .	97
<b>3.2.1.3.</b> Acrylic and methacrylic resins . . . . .	37	<b>7.1.4.4.</b> Glyceryl esters of fatty acids having triple bonds . . . . .	97
<b>3.2.2.</b> Cleavage of amides . . . . .	38	<b>7.1.4.5.</b> Glyceryl esters of fatty keto acids . . . . .	98
<b>3.2.3.</b> Cleavage of ethers . . . . .	39	<b>7.1.5.</b> Vegetable and animal waxes . . . . .	98
<b>3.2.4.</b> Identification of cleavage products . . . . .	39	<b>7.1.6.</b> Polysaccharides . . . . .	101
<b>3.2.4.1.</b> Separation and identification by paper chromatography . . . . .	39	<b>7.1.6.1.</b> Cellulose . . . . .	101
<b>3.2.4.1.1.</b> Dicarboxylic acids . . . . .	39*	<b>7.1.6.2. to</b>	
<b>3.2.4.1.2.</b> Alcohols . . . . .	41	<b>7.1.6.5.</b> Other polysaccharides . . . . .	101
<b>3.2.4.1.3.</b> Diamines and aminocarboxylic acids from polyamides . . . . .	43 †	<b>7.1.7.</b> Natural asphalts . . . . .	102
<b>3.2.4.1.4.</b> Aromatic diamines from polyurethanes . . . . .	43	<b>7.1.8.</b> Polypeptides . . . . .	103
<b>3.2.4.2.</b> Separation and identification by thin-layer chromatography . . . . .	43	<b>7.2.</b> Modified Natural Products . . . . .	103
<b>3.2.4.2.1.</b> Fatty acids . . . . .	44	<b>7.2.1.</b> Anhydrides and salts of resin acids and modified resin acids . . . . .	104
<b>3.2.4.2.2.</b> Dicarboxylic acids . . . . .	44	<b>7.2.1.1.</b> Anhydrides of resin acids and modified resin acids . . . . .	104
<b>3.2.4.2.3.</b> Polyhydric alcohols . . . . .	46	<b>7.2.1.2. to</b>	
<b>3.2.4.3.</b> Gas chromatographic separation and identification . . . . .	47	<b>7.2.1.9.</b> Salts of resin acids . . . . .	104
<b>3.2.4.4.</b> Identification by infrared spectroscopy . . . . .	47 ‡	<b>7.2.2.</b> Resin acid esters and hydrogenated and polymerized resin acids . . . . .	105
<b>4.</b> IR Spectroscopy . . . . .	48	<b>7.2.3.</b> Natural resins modified in the resin skeleton and by addition reactions . . . . .	105
<b>4.1.</b> Utility of Various Wavelength (Wave Number) Regions . . . . .	48	<b>7.2.4.</b> Simple modified vegetable or animal oils; tall oil and derivatives . . . . .	107
<b>4.1.1.</b> The near infrared . . . . .	48	<b>7.2.4.1.</b> Stand oil . . . . .	107
<b>4.1.2.</b> The middle infrared . . . . .	49	<b>7.2.4.2.</b> Isomerized oils . . . . .	108
<b>4.1.2.1.</b> Group frequencies . . . . .	49	<b>7.2.4.3.</b> Dehydrated oils . . . . .	108
<b>4.1.2.2.</b> . . . . .	51	<b>7.2.4.4.</b> Blown oils . . . . .	108
<b>4.1.2.3.</b> Electrical coupling . . . . .	53	<b>7.2.4.5.</b> Epoxidized oils . . . . .	108
<b>4.1.2.4.</b> Influence of crystallinity on the spectrum . . . . .	54	<b>7.2.4.6.</b> Vulcanized oils . . . . .	108
<b>4.1.3.</b> The far infrared . . . . .	55	<b>7.2.4.7.</b> Alkylpyrones from fatty acids . . . . .	108
<b>4.1.4.</b> The optimum spectrum . . . . .	57	<b>7.2.4.8.</b> Oils partly hydrolyzed with alkaline earth hydroxides . . . . .	109
<b>4.2.</b> Sample Preparation . . . . .	62	<b>7.2.4.9.</b> Tall oil and its esters . . . . .	109
<b>4.2.1.</b> Solutions and films from solutions . . . . .	62	<b>7.2.5.</b> Oils modified with larger molecules (film formers) . . . . .	109
<b>4.2.2.</b> Films prepared by pressing or by melting . . . . .	63	<b>7.2.5.1.</b> Styrenated oils . . . . .	109
<b>4.2.3.</b> Microsections . . . . .	64	<b>7.2.5.2.</b> Oils modified with vinyltoluene . . . . .	109
<b>4.2.4.</b> Dispersions in liquid of low absorption . . . . .	65	<b>7.2.5.4.</b> Fatty acids or oils, condensed with maleic anhydride or fumaric acid but not hydrophilized . . . . .	110
<b>4.2.5.</b> Dispersion of solids in KBr and in other IR-transparent materials . . . . .	65	<b>7.2.5.5.</b> Hydrophilized oils . . . . .	110
<b>4.2.6.</b> Attenuated total reflection (ATR) . . . . .	68	<b>7.2.5.6.</b> Thixotropic oils; amidized oils . . . . .	110
<b>5.</b> Investigation of High Polymers by Spectroscopy . . . . .	69	<b>7.2.5.7.</b> Urethane oils . . . . .	110
<b>6.</b> Special Analytical Problems . . . . .	70	<b>7.2.5.8.</b> Oils modified with cyclopentadiene or other cyclic olefins . . . . .	111
<b>6.1.</b> Fibers and Textiles . . . . .	70	<b>7.2.6.</b> Cellulose esters . . . . .	111
<b>6.2.</b> Paints and Coatings . . . . .	74	<b>7.2.6.1.</b> Cellulose acetate . . . . .	111
<b>6.2.1.</b> Paints prior to processing . . . . .	74	<b>7.2.6.2.</b> Mixed cellulose esters . . . . .	111
<b>6.2.2.</b> Coatings . . . . .	75	<b>7.2.6.3.</b> Cellulose tripropionate . . . . .	112
<b>6.3.</b> Natural and Synthetic Rubber . . . . .	76	<b>7.2.6.4.</b> Cellulose tributyrate . . . . .	112
<b>6.4.</b> End Groups . . . . .	77	<b>7.2.6.5.</b> Cellulose nitrate . . . . .	112
<b>6.5.</b> Copolymers . . . . .	84	<b>7.2.7.</b> Cellulose ethers and other cellulose derivatives . . . . .	112
<b>7.</b> Chemical Classes and Individual Substances . . . . .	87	<b>7.2.7.1.</b> Methyl cellulose . . . . .	112
<b>7.1.</b> Unmodified Natural Products . . . . .	88	<b>7.2.7.2.</b> Ethyl cellulose . . . . .	113
<b>7.1.1.</b> Acid resins and balsams; salts of natural resin acids . . . . .	88	<b>7.2.7.4.</b> Hydroxyethyl and ethyl hydroxyethyl cellulose . . . . .	113
<b>7.1.2.</b> Ester resins and ester-type balsams . . . . .	91	<b>7.2.7.5.</b> Carboxymethyl cellulose . . . . .	113

Page		Page	
7.2.7.6. to			
7.2.7.8. Benzyl cellulose and other cellulose ethers	113	7.5.1.1. Polyvinyl chloride . . . . .	146
7.2.8. Industrial bitumens and pitches . . . . .	114	7.5.1.1./CP Copolymers of vinyl chloride . . . . .	149
7.2.8.1. Bitumens from petroleum . . . . .	114	7.5.1.2. Poly(1,2-dichloroethylene) and postchlorinated polyvinyl chloride . . . . .	150
7.2.8.2. Coal-tar pith . . . . .	114	7.5.1.3. Polyvinylidene chloride . . . . .	150
7.2.8.3. Lignite pitch and montan wax . . . . .	114	7.5.1.5. Poly(2-chlorobutadiene) . . . . .	151
7.2.8.5. Resin pitch . . . . .	115	7.5.2. Products obtained by chlorination, hydrochlorination, or chloromethylation of aliphatic polyhydrocarbons . . . . .	153
7.2.8.6. Fatty-acid pitches . . . . .	115	Polyfluoroolefins, polyfluorochloroolefins . . . . .	153
7.2.9. Other modified natural products . . . . .	115	Polymeric halogenated aromatics . . . . .	155
7.3. Phenolic Resins . . . . .	115	7.5.3. 7.5.4. Ester-Type Resins and Polymers . . . . .	155
7.3.0. General . . . . .	115	Saturated polyesters from aliphatic hydroxycarboxylic acids (or lactones) or from polybasic aliphatic carboxylic acids and alcohols or phenols . . . . .	155
7.3.0.1. Types of substitution . . . . .	115	Polyesters from lower aliphatic hydroxy carboxylic acids . . . . .	155
7.3.0.2. Bridges . . . . .	118	Polyesters from lactones . . . . .	156
7.3.0.3. Substituents . . . . .	119	Polyesters of aromatic carboxylic acids . . . . .	156
7.3.0.4. Kinetic investigations . . . . .	119	Polyesters of carbonic acid . . . . .	156
7.3.0.4.1. Curing . . . . .	119	7.6.1. 7.6.1.1. 7.6.1.2. 7.6.1.3. 7.6.1.4. 7.6.1.5. to 7.6.1.9. Other aliphatic polyesters . . . . .	156
7.3.0.4.2. Oxidation . . . . .	121	Non-modified saturated polyesters from cycloaliphatic or aromatic components . . . . .	157
7.3.1. Novolacs . . . . .	121	7.6.2. 7.6.2.1. 7.6.2.3. 7.6.2.4. 7.6.2.5. Polyesters from hexahydrophthalic acid . . . . .	157
7.3.2. Phenolic resin molding compounds . . . . .	121	Polyesters from phthalic acid . . . . .	157
7.3.3. Resols and cured products therefrom . . . . .	122	Polyesters from isophthalic acid . . . . .	157
7.3.4. Etherified and plasticized phenol-formaldehyde resins . . . . .	122	Polyesters from terephthalic acid . . . . .	157
7.3.5. Alkyl- and arylphenolic resins . . . . .	123	7.6.2.6. to 7.6.2.9. Other saturated polyesters from cycloaliphatic or aromatic components . . . . .	159
7.3.7. Resins from phenols and unsaturated hydrocarbons . . . . .	124	7.6.3. 7.6.3.1. 7.6.3.2. Polyesters (simple alkyd resins) modified with vegetable oils or fatty acids . . . . .	160
7.4. Polyhydrocarbons . . . . .	124	Aliphatic alkyd resins . . . . .	160
7.4.1. Saturated, linear, aliphatic polyhydrocarbons . . . . .	124	Alkyd resins based on phthalic acid and prepared with branched synthetic fatty acids . . . . .	160
7.4.1.1. and		Alkyd resins based on phthalic acid and prepared with linear, saturated or slightly unsaturated oils or fatty acids . . . . .	160
7.4.1.2. Polyethylene . . . . .	125	Alkyd resins based on phthalic acid and prepared with oils or fatty acids of average unsaturation . . . . .	160
7.4.1.1./CP Copolymers of ethylene . . . . .	126	Alkyd resins based on phthalic acid and prepared with highly unsaturated oils or fatty acids; long-oil alkyds . . . . .	160
7.4.1.3. Polypropylene . . . . .	129	Alkyd resins based on isophthalic acid . . . . .	161
7.4.1.3./CP Copolymers of propylene . . . . .	131	Alkyd resins based on terephthalic acid . . . . .	161
7.4.1.4. Polybutenes . . . . .	132	7.6.3.9. Alkyd resins based on other carboxylic acids; thixotropic alkyd resins . . . . .	161
7.4.2. Cycloaliphatic polyhydrocarbons . . . . .	134	7.6.4. Alkyd resins modified with other components; special alkyds . . . . .	161
7.4.3. Unsaturated, acyclic, aliphatic polyhydrocarbons . . . . .	135	7.6.4.1. Alkyd resins with incorporated ester-type unsaturated acids . . . . .	161
7.4.3.1. Polymers of acetylene and of substituted acetylenes . . . . .	135	7.6.4.2. Alkyd resins with incorporated monobasic aromatic acids . . . . .	161
7.4.3.2. Polyallenes . . . . .	135	7.6.4.3. Styrenated alkyd resins . . . . .	161
7.4.3.3. Polybutadiene . . . . .	135	7.6.4.4. Alkyd resins modified with vinyltoluene . . . . .	162
7.4.3.3./CP Butadiene copolymers . . . . .	138	7.6.4.5. Alkyd resins modified with other polymerizable film formers . . . . .	162
7.4.3.4. Polyisoprenes . . . . .	139	Hydrophilic alkyd resins . . . . .	162
7.4.3.5. to		Metal-modified alkyd resins . . . . .	162
7.4.3.9. Polydimethylbutadiene and other unsaturated polyhydrocarbons . . . . .	141		
7.4.4. Alkyl-aromatic and aromatic polyhydrocarbons . . . . .	142		
7.4.4.1. Polystyrene . . . . .	142		
7.4.4.1./CP Copolymers of styrene . . . . .	143		
7.4.4.2. Polystyrenes having an alkyl substituent in the aromatic ring . . . . .	145		
7.4.4.3. Polystyrenes bearing alkyl substituents on the vinyl chain . . . . .	145		
7.4.4.4. Polymers and copolymers of divinylbenzene . . . . .	145		
7.4.4.6. Polymers produced by polymerization of non-vinylic aliphatic-aromatic hydrocarbons . . . . .	145		
7.4.4.7. Alkyl-aromatic polyhydrocarbons produced by polycondensation . . . . .	146		
7.5. Polyhalohydrocarbons and Polyhalohydrocarbon Compounds . . . . .	146		
7.5.1. Polymeric chloroolefins . . . . .	146		

	Page		Page
<b>7.6.4.8.</b> Flame resistant alkyd resins, particularly those prepared from halogen-containing components . . . . .	163	<b>7.7.7.</b> Poorly defined polycondensation and polymerization products of aldehydes and ketones . . . . .	178
<b>7.6.4.9.</b> Other special alkyds . . . . .	163	<b>7.8.</b> Resins and Polymers with Nitrogen as the Characterizing Heteroelement . . . . .	178
<b>7.6.5.</b> Curable unsaturated polyester resins . . . . .	163	<b>Polyamines</b> , polyimines, and similar compounds . . . . .	178
<b>7.6.5.1.</b> Polyesters produced from maleic or fumaric acid . . . . .	163	<b>7.8.1.</b> Amine-aldehyde resins . . . . .	179
<b>7.6.5.3.</b> Polyesters produced from tetrahydrophthalic acid . . . . .	164	<b>7.8.2.</b> Aniline-formaldehyde resins . . . . .	179
<b>7.6.5.4.</b> Polyesters produced from endomethylene-tetrahydrophthalic acid . . . . .	164	<b>7.8.2.2.</b> to	
<b>7.6.5.6.</b> Polyesters produced with tetrachlorophthalic acid . . . . .	164	<b>7.8.2.7.</b> Melamineresins . . . . .	179
<b>7.6.5.7.</b> Polyesters produced from HET acid . . . . .	164	<b>7.8.2.8.</b> Other triazine-aldehyde resins . . . . .	180
<b>7.6.6.</b> Esters of polyvinyl alcohol . . . . .	164	<b>7.8.3.</b> Polyamides of the type $(-\text{R}-\text{CO}-\text{NH}-)_n$ and their derivatives . . . . .	180
<b>7.6.6.3.</b> Polyvinyl acetate . . . . .	164	<b>7.8.4.</b> Polyamides of the type $(\text{R}-\text{CO}-\text{NH}-\text{R}'-\text{NH}-\text{CO}-)$ , and their derivatives . . . . .	182
<b>7.6.6.3./CP</b> Copolymers of vinyl acetate; mixtures of polymers . . . . .	165	<b>7.8.5.</b> Polymeric amides with the amide group in the side-chain; polyimides and other compounds similar to polyamides . . . . .	183
<b>7.6.6.4.</b> Polyvinyl propionate . . . . .	165	<b>7.8.5.1.</b> Polyacrylamide . . . . .	183
<b>7.6.7.</b> Esters of polyallyl alcohol and other polymeric alcohols . . . . .	165	<b>7.8.5.2.</b> Polyvinylpyrrolidone . . . . .	183
<b>7.6.8.</b> Esters of polyacrylic acid and polymers of polybasic acids . . . . .	166	<b>7.8.5.4. to</b>	
<b>7.6.8.1. to</b>		<b>7.8.5.6.</b> Polyimides and polyesterimides . . . . .	183
<b>7.6.8.8.</b> Polyacrylic esters . . . . .	166	<b>7.8.5.7. and</b>	
<b>7.6.8.8./CP</b> Copolymers of acrylic esters . . . . .	166	<b>7.8.5.8.</b> Polyureas . . . . .	184
<b>7.6.8.9.</b> Polymeric esters from polybasic acids . . . . .	167	<b>7.8.6.</b> Amide-aldehyde resins . . . . .	184
<b>7.6.9.</b> Polymethacrylic esters . . . . .	167	<b>7.8.7.</b> Polyisocyanates, their adducts and derivatives; urethane resins . . . . .	185
<b>7.7.</b> Ether-like Resins and Polymers; Polymeric Alcohols, Aldehydes, Ketones, Acids, Carboxylates, and Anhydrides . . . . .	168	<b>7.8.7.1.</b> Simple di- or polyisocyanates . . . . .	186
<b>7.7.1.</b> Linear polyethers having the ether group in the main chain . . . . .	168	<b>7.8.7.2.</b> Dimeric and "capped" isocyanates; urethanes with free isocyanate groups . . . . .	186
<b>7.7.1.1.</b> Polyoxymethylene . . . . .	168	<b>7.8.7.3.</b> Aliphatic polyurethanes . . . . .	186
<b>7.7.1.2. to</b>		<b>7.8.7.4.</b> Aromatic-aliphatic polyurethanes . . . . .	186
<b>7.7.1.9.</b> Higher linear polyethers . . . . .	169	<b>7.8.7.5. and</b>	
<b>7.7.2.</b> Polyvinyl and polyallyl ethers; other polyethers having the ether group in the side chain . . . . .	170	<b>7.8.7.6.</b> Polyester urethanes and polyether urethanes . . . . .	186
<b>7.7.3.</b> Polymeric acetals and ketals . . . . .	171	<b>7.8.7.8.</b> Urethane-formaldehyde resins . . . . .	187
<b>7.7.4.</b> Epoxy resins . . . . .	173	<b>7.8.8.</b> Resins and polymers containing nitrile groups . . . . .	187
<b>7.7.4.1. and</b>		<b>7.8.8.1.</b> Polyacrylonitrile . . . . .	187
<b>7.7.4.2.</b> Aliphatic epoxy resins . . . . .	173	<b>7.8.8.2. to</b>	
<b>7.7.4.3.</b> Epoxy resins based on epichlorohydrin and bisphenol A . . . . .	174	<b>7.8.8.9.</b> Other resins and polymers containing nitrile groups . . . . .	188
<b>7.7.4.4.</b> Other aromatic-aliphatic epoxy resins . . . . .	175	<b>7.9.</b> Resins and Polymers with SO Functions or with Nitrogen and Sulfur as the Characterizing Heteroelements; Materials having Heteroelements other than O, N, and S	
<b>7.7.4.5. to</b>		<b>Nitrogen-free resins and polymers with SO functions . . . . .</b>	189
<b>7.7.4.9.</b> Other epoxy resins . . . . .	175	<b>7.9.2.</b> Resins and polymers with nitrogen and sulfur as the characterizing heteroelement . . . . .	190
<b>7.7.5.</b> Polymeric thio ethers . . . . .	175	<b>7.9.3.</b> Polysiloxanes and other silicon compounds . . . . .	191
<b>7.7.6.</b> Polymeric alcohols, phenols, aldehydes, ketones, acids, carboxylates, and anhydrides having a continuous carbon chain		<b>7.9.3.1.</b> Polysiloxanes . . . . .	191
<b>7.7.6.1.</b> Polyvinyl alcohol . . . . .	176	<b>7.9.4.</b> Resins and polymers containing phosphorus as the characterizing heteroelement . . . . .	193
<b>7.7.6.3.</b> Polymeric aldehydes . . . . .	176	<b>7.9.5.</b> Other organic-inorganic resins and polymers . . . . .	193
<b>7.7.6.4.</b> Aliphatic polyketones . . . . .	177	<b>Bibliography . . . . .</b>	195
<b>7.7.6.6. to</b>		<b>Subject Index . . . . .</b>	221
<b>7.7.6.8.</b> Polymeric acids and carboxylates . . . . .	177		
<b>7.7.6.9.</b> Polymeric anhydrides . . . . .	177		