

# Contents

<b>1</b>	<b>Introduction to Initiating Substances . . . . .</b>	<b>1</b>
1.1	Primary Explosives . . . . .	4
1.2	Priming Compositions . . . . .	5
1.3	Environmental Hazards: Emergence of Green Initiating Substances . . . . .	6
	References . . . . .	10
<b>2</b>	<b>Explosive Properties of Primary Explosives . . . . .</b>	<b>11</b>
2.1	Influence of Density on Detonation Parameters . . . . .	11
2.2	Initiating Efficiency . . . . .	13
2.2.1	Influence of Density and Compacting Pressure . . . . .	13
2.2.2	Influence of Specific Surface . . . . .	19
2.2.3	Influence of the Charge Diameter . . . . .	20
2.2.4	Influence of Confinement . . . . .	20
2.2.5	Influence of Secondary Charge Type . . . . .	22
2.2.6	Mixtures . . . . .	23
2.3	Sensitivity . . . . .	23
2.3.1	Impact Sensitivity . . . . .	25
2.3.2	Friction Sensitivity . . . . .	29
2.3.3	Sensitivity to Electrostatic Discharge . . . . .	31
2.3.4	Sensitivity to Flame . . . . .	32
	References . . . . .	33
<b>3</b>	<b>Fulminates . . . . .</b>	<b>37</b>
3.1	Introduction . . . . .	37
3.1.1	Fulminic Acid . . . . .	37
3.1.2	Mercury Fulminate . . . . .	39
3.1.3	Silver Fulminate . . . . .	58
3.1.4	Other Fulminates . . . . .	62
	References . . . . .	66

<b>4 Azides</b>	71
4.1 Azoimide	71
4.2 Lead Azide	72
4.2.1 Physical and Chemical Properties	72
4.2.2 Chemical Reactivity	74
4.2.3 Sensitivity	77
4.2.4 Explosive Properties	78
4.2.5 Preparation	80
4.2.6 Spontaneous Explosions During Crystal Growth	85
4.2.7 Uses	86
4.3 Other Substances Derived from Lead Azide	87
4.3.1 Basic Lead Azide	87
4.3.2 Lead (IV) Azide	88
4.4 Silver Azide	89
4.4.1 Physical and Chemical Properties	89
4.4.2 Sensitivity	91
4.4.3 Explosive Properties	92
4.4.4 Preparation	93
4.4.5 Uses	96
4.5 Copper Azides	96
4.5.1 Physical and Chemical Properties	97
4.5.2 Explosive Properties	98
4.5.3 Preparation	100
4.5.4 Undesired Formation of Copper Azides	102
4.5.5 Uses	104
4.6 Other Metallic Azides	105
4.6.1 Physical and Chemical Properties	105
4.6.2 Explosive Properties	106
4.6.3 Preparation	108
4.6.4 Uses	110
4.7 Organic Azides	110
4.8 Cyanuric Triazide	111
4.8.1 Physical and Chemical Properties	112
4.8.2 Explosive Properties	112
4.8.3 Preparation	115
4.8.4 Uses	115
4.9 4,4',6,6'-Tetra(azido)hydrazo-1,3,5-triazine and 4,4',6,6'-Tetra (azido)azo-1,3,5-triazine	116
4.9.1 Physical and Chemical Properties	116
4.9.2 Explosive Properties	116
4.9.3 Preparation	117
4.9.4 Uses	118
4.10 1,3,5-Triazido-2,4,6-trinitrobenzene	118
4.10.1 Physical and Chemical Properties	118
4.10.2 Explosive Properties	119

4.10.3	Preparation . . . . .	120
4.10.4	Uses . . . . .	121
4.11	2,3,5,6-Tetraazido-1,4-benzoquinone . . . . .	121
4.11.1	Physical Properties . . . . .	121
4.11.2	Explosive Properties . . . . .	122
4.11.3	Preparation . . . . .	123
4.11.4	Uses . . . . .	123
	References . . . . .	123
<b>5</b>	<b>Salts of Polynitrophenols . . . . .</b>	<b>131</b>
5.1	Salts of Picric Acid . . . . .	131
5.1.1	Normal Lead Picrate . . . . .	132
5.1.2	Basic Lead Picrate . . . . .	133
5.2	Salts of Dinitroresorcinol . . . . .	133
5.2.1	Lead salts of 2,4-Dinitroresorcinol . . . . .	133
5.2.2	Lead Salts of 4,6-Dinitroresorcinol . . . . .	135
5.3	Salts of Trinitroresorcine . . . . .	138
5.3.1	Lead Styphnate . . . . .	138
5.3.2	Basic Lead Styphnate . . . . .	145
5.3.3	Double Salts of Lead Styphnate . . . . .	148
5.3.4	Barium Styphnate . . . . .	149
5.3.5	Other Salts of Styphnic Acid . . . . .	152
	References . . . . .	152
<b>6</b>	<b>Diazodinitrophenol . . . . .</b>	<b>157</b>
6.1	Introduction . . . . .	157
6.2	Structure . . . . .	157
6.3	Physical and Chemical Properties . . . . .	159
6.4	Explosive Properties . . . . .	160
6.5	Preparation . . . . .	162
6.6	Use . . . . .	164
	References . . . . .	165
<b>7</b>	<b>Salts of Benzofuroxan . . . . .</b>	<b>167</b>
7.1	Introduction . . . . .	167
7.2	Salts of 4,6-Dinitrobenzofuroxan . . . . .	168
7.2.1	Physical and Chemical Properties . . . . .	169
7.2.2	Explosive Properties . . . . .	169
7.2.3	Preparation of 4,6-Dinitrobenzofuroxan . . . . .	172
7.2.4	Preparation of 4,6-Dinitrobenzofuroxan Salts . . . . .	173
7.2.5	Uses . . . . .	174
7.3	Potassium Salt of 7-Hydroxylamino-4,6-dinitro-4,7-dihydrobenzofuroxan . . . . .	175
7.4	Potassium Salt of 7-Hydroxy-4,6-dinitrobenzofuroxan . . . . .	176
7.4.1	Physical and Chemical Properties . . . . .	176
7.4.2	Explosive Properties . . . . .	176

7.4.3	Preparation . . . . .	177
7.4.4	Uses . . . . .	179
7.5	Salts of Bis(furoxano)-2-nitrophenol . . . . .	179
7.5.1	Physical and Chemical Properties . . . . .	180
7.5.2	Explosive Properties . . . . .	180
7.5.3	Preparation . . . . .	181
7.5.4	Uses . . . . .	182
	References . . . . .	183
<b>8</b>	<b>Tetrazoles . . . . .</b>	<b>187</b>
8.1	Tetrazene . . . . .	189
8.1.1	Physical and Chemical Properties . . . . .	190
8.1.2	Explosive Properties . . . . .	191
8.1.3	Preparation . . . . .	192
8.1.4	Uses . . . . .	193
8.2	5-Aminotetrazole Salts . . . . .	194
8.2.1	Physical and Chemical Properties . . . . .	194
8.2.2	Explosive Properties . . . . .	195
8.2.3	Preparation . . . . .	195
8.2.4	Uses . . . . .	197
8.3	5-Nitrotetrazole Salts . . . . .	197
8.3.1	Physical and Chemical Properties . . . . .	197
8.3.2	Explosive Properties . . . . .	199
8.3.3	Preparation . . . . .	203
8.3.4	Uses . . . . .	206
8.4	5-Chlorotetrazole Salts . . . . .	207
8.4.1	Physical and Chemical Properties . . . . .	207
8.4.2	Explosive Properties . . . . .	207
8.4.3	Preparation . . . . .	208
8.4.4	Uses . . . . .	209
8.5	5-Azidotetrazole Salts . . . . .	209
8.5.1	Physical and Chemical Properties . . . . .	209
8.5.2	Explosive Properties . . . . .	209
8.5.3	Preparation . . . . .	210
8.5.4	Uses . . . . .	211
8.6	5,5'-Azotetrazole Salts . . . . .	212
8.6.1	Physical and Chemical Properties . . . . .	213
8.6.2	Explosive Properties . . . . .	214
8.6.3	Preparation . . . . .	216
8.6.4	Uses . . . . .	217
8.7	Tetrazoles with Organic Substituent . . . . .	217
8.7.1	5-Picrylaminetetrazole . . . . .	218
8.7.2	1-(1 <i>H</i> -Tetrazol-5-yl)guanidinium Nitrate . . . . .	219

8.8	Organic Derivatives of 5-Nitrotetrazole . . . . .	221
8.9	Organic Derivatives of 5-Azidotetrazole . . . . .	222
8.9.1	Explosive Properties . . . . .	222
8.9.2	Preparation . . . . .	222
	References . . . . .	223
<b>9</b>	<b>Tetrazole Ring-Containing Complexes . . . . .</b>	<b>227</b>
9.1	Cobalt Perchlorate Complexes . . . . .	228
9.1.1	Pentaamine(5-cyano-2 <i>H</i> -tetrazolato- <i>N</i> <sup>2</sup> )cobalt(III) perchlorate (CP) . . . . .	228
9.1.2	CP Analogs . . . . .	235
9.1.3	1,5-Cyclopentamethylenetetrazole Complexes . . . . .	238
9.1.4	Tetraammine- <i>cis</i> -bis(5-Nitro-2 <i>H</i> -tetrazolato- <i>N</i> <sup>2</sup> ) cobalt(III) perchlorate (BNCP) . . . . .	241
9.1.5	BNCP Analogs . . . . .	244
9.1.6	Perchlorate Complexes of 1,5-Diaminotetrazole . . . . .	245
9.1.7	Other Perchlorate-Based Complexes . . . . .	247
9.2	Perchlorate-Free Complexes . . . . .	247
9.2.1	Iron- and Copper-Based 5-Nitrotetrazolato- <i>N</i> <sup>2</sup> Complexes . . . . .	247
9.2.2	Perchlorate-Free CP Analogs . . . . .	250
9.3	Other Transition Metal-Based 5-Nitrotetrazolato- <i>N</i> <sup>2</sup> Complexes . . . . .	251
	References . . . . .	252
<b>10</b>	<b>Organic Peroxides . . . . .</b>	<b>255</b>
10.1	Peroxides of Acetone . . . . .	255
10.1.1	Diacetone Diperoxide . . . . .	256
10.1.2	Triacetone Triperoxide . . . . .	262
10.1.3	Tetraacetone Tetraperoxide . . . . .	274
10.2	Hexamethylene Triperoxide Diamine . . . . .	275
10.2.1	Physical and Chemical Properties . . . . .	275
10.2.2	Explosive Properties . . . . .	278
10.2.3	Preparation . . . . .	279
10.2.4	Uses . . . . .	280
10.3	Tetramethylene Diperoxide Dicarbamide . . . . .	280
10.3.1	Physical and Chemical Properties . . . . .	281
10.3.2	Preparation . . . . .	281
10.3.3	Use . . . . .	281
	References . . . . .	282

<b>11 Nitrogen Halides</b> . . . . .	289
11.1 Nitrogen Trichloride . . . . .	289
11.1.1 Physical and Chemical Properties . . . . .	289
11.1.2 Explosive Properties . . . . .	290
11.1.3 Preparation . . . . .	291
11.1.4 Use . . . . .	293
11.2 Nitrogen Tribromide . . . . .	293
11.2.1 Physical and Chemical Properties . . . . .	294
11.2.2 Preparation . . . . .	294
11.3 Nitrogen Triiodide . . . . .	295
11.3.1 Structure . . . . .	296
11.3.2 Physical and Chemical Properties . . . . .	297
11.3.3 Explosive Properties . . . . .	298
11.3.4 Preparation . . . . .	299
11.3.5 Use . . . . .	300
References . . . . .	300
<b>12 Acetylides</b> . . . . .	303
12.1 Silver Acetylides . . . . .	303
12.1.1 Silver Acetylide . . . . .	304
12.1.2 Silver Acetylide–Silver Nitrate . . . . .	308
12.1.3 Silver Acetylide–Silver Hexanitrate . . . . .	312
12.1.4 Other Salts of Silver Acetylide–Silver Nitrate . . . . .	312
12.2 Cuprous Acetylide . . . . .	313
12.2.1 Physical and Chemical Properties . . . . .	313
12.2.2 Explosive Properties . . . . .	314
12.2.3 Preparation . . . . .	315
12.2.4 Uses . . . . .	316
12.3 Cupric Acetylide . . . . .	316
12.3.1 Physical and Chemical Properties . . . . .	316
12.3.2 Explosive Properties . . . . .	317
12.3.3 Preparation . . . . .	317
12.3.4 Uses . . . . .	318
12.4 Mercuric Acetylide . . . . .	318
12.4.1 Physical and Chemical Properties . . . . .	318
12.4.2 Explosive Properties . . . . .	319
12.4.3 Preparation . . . . .	319
12.4.4 Uses . . . . .	320
12.5 Mercurous Acetylide . . . . .	320

12.6	Aurous Acetylide . . . . .	321
12.6.1	Physical and Chemical Properties . . . . .	321
12.6.2	Explosive Properties . . . . .	321
12.6.3	Preparation . . . . .	321
	References . . . . .	322
<b>13</b>	<b>Other Substances . . . . .</b>	<b>325</b>
13.1	Salts of Nitramines . . . . .	325
13.2	Organophosphates . . . . .	328
13.3	Hydrazine Complexes . . . . .	331
	References . . . . .	333
	<b>Index . . . . .</b>	<b>335</b>

Primary Explosives

Matyáš, R.; Pachman, J.

2013, XIX, 338 p. 242 illus., 164 illus. in color.,

Hardcover

ISBN: 978-3-642-28435-9