JOURNAL OF POLYMER SCIENCE VOL. 54, PAGES 411–455 (1961)

Copolymerization Parameters

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INTRODUCTION

To the researcher who is continually attempting to fabricate salable polymers from new monomers or combinations of monomers, it is often desirable to be able to predict fairly closely the composition of the copolymers he might try to make. For high-conversion methods he has little problem. However, for low-conversion processes, or for processes based on difficultly polymerizable monomers, it is useful to apply the principles developed by Alfrey [*J. Chem. Phys.*, **12**, 205 (1944)], Mayo [*J. Am. Chem. Soc.*, **66**, 1594 (1944)], Wall [*J. Am. Chem. Soc.*, **66**, 2050 (1944)], Price [*J. Polymer Sci.*, **2**, 101 (1947)], and others to aid in the prediction of copolymer composition. By these principles, it is possible to approximate, with the exception of a few perverse systems, the starting feeds required to produce a desired copolymer composition. Determination of the relative reactivity ratios for only a few systems with a new monomer allows the calculation of the copolymerization parameters, Q and e, for that monomer. Subsequently, the relative reactivity ratios of any two monomers whose parameters are known may be calculated rather than be determined experimentally.

DISCUSSION

Relative Reactivity Ratios

Since 1952, when Alfrey, Bohrer, and Mark wrote their book on copolymerization (*Copolymerization*, Interscience, New York, 1952), much work has been reported on the determination of the relative reactivity ratios for more and more pairs of monomers. These ratios, r_1 and r_2, are defined as the ratio k_{11}/k_{12} and k_{22}/k_{21}, respectively, where k_{11} is the rate of addition of a polymeric radical from monomer 1 to a molecule of monomer 1. The other k values are similarly defined, i.e., the first subscript refers to the radical and the second to the monomer with which the radical reacts. As more and more data appear in the literature, it becomes increasingly difficult to keep track of the results. It is with the intention of providing a more up-to-date tabulation in one place of the rapidly growing quantity of data that this work was undertaken. Table I lists all the r_1, r_2 values which the author has been able to find in the literature and a few values

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TABLE I
Relative Reactivity Ratios

No.	r_1	±	M_2	r_2	±	T, °C.	Reference
			Acrylamide (M_1)				
1	0.76		Acrolein	2.00		20	185
2	0.60	0.02	Acrylic acid	1.43	0.03	25	33
3	1.38		Acrylic acid	0.36		60	195
4	1.357		Acrylonitrile	0.875		30	95
5	1.10	0.05	Sodium acrylate (90%)	0.35	0.03	60	33
6	14.9		Sodium vinylsulfonate	0		50	37
7	0.68		Vinyl isothiocyanate	0.47		—	197
			Acrylic Acid (M_1)				
8	6.0	2.0	Acrylonitrile	0.13	0.02	80	235
9	1.15		Acrylonitrile	0.35		50	98
10	1.0		2-Chloroallyl acetate	0		100	107
11	0.10	0.02	Sodium styrenesulfonate	1.0	0.2	70	79
12	0.35		Styrene	0.22		70	77
13	0.25	0.02	Styrene	0.15	0.01	60	42
14	0.45	0.1	Styrene	0.25	0.05	80	235
15	2.0		Vinyl acetate	0.1		70	15
16	10.	1.	Vinyl acetate	0.01	0.003	70	33
17	0.26	0.06	Vinylidene cyanide	0.29	0.08	50	72
18	1.3	0.2	*N*-Vinylpyrrolidone	0.15	0.1	75	220
			Acrylonitrile (M_1)				
19	0.09	0.17	α-Acetoxyacrylonitrile	7.4	0.40	60	155
20	0		1-Acetoxy-1,3-butadiene	0.7		70	83
21	0.08	0.01	α-Acetoxystyrene	0.4	0.05	75	42
22	0.77		Acrolein	1.09		20	185
23	3.96	0.53	Allyl alcohol	0.11	0.10	25	161
24	1.7		Allyltriethoxysilane	0		50	204
25	14.5	0.5	α-Angelolactone	0		—	102
26	113.	14.	β-Angelolactone	0		—	102
27	10.0		2-Butenyltriethoxysilane	0		50	204
28	0.14	0.004	*tert*-Butyl vinyl ether	0.0032	0.0002	60	92
29	0.024	0.003	1,1-Bis(*p*-Chlorophenyl)-ethylene	0		60	54
30	0.7		α-Chlorovinyl triethoxysilane	0		50	204
31	12.0		Δ^3-Cyclohexenyltriethoxysilane	0		50	204
32	9.0		Diethoxyethylvinylsilane	0		50	204
33	6.0		Diethoxymethylvinylsilane	0		50	204
34	8.3		Diethoxyphenylvinylsilane	0		50	204
35	0.59	.02	Diethyleneglycol monovinyl ether	0.0021	0.0004	60	94
36	0.22	.02	2,4-Dimethoxy-6-(β-itaconylhydrazino)*s*-triazine	0.7	0.5	60	49
37	13.6	1.0	Diphenyl acetylene	0		60	52
38	3.2	0.5	Dodecyl acrylate	1.3	0.1	60	201

(*continued*)

TABLE I (*cont.*)

No.	r_1	±	M_2	r_2	±	T, °C.	Reference
39	10.5	1.5	Ethyl β-ethoxyacrylate	0.02	0.02	80	175
40	0.17	0.01	2-Ethyl-1-vinylacetylene	0.63	0.4	60	173
41	12.2	2.4	1-Hexene	0		60	52
42	5.4	0.3	1-Hexyne	0		60	52
43	1.1	0.1	Hydronopyl acrylate	0.9	0.1	60	137
44	0.33	0.01	Isopropenylacetylene	0.47	0.01	60	173
45	0.05	0.01	β-Isopropenylnaphthalene	0.23	0.02	99	53
46	0.06		Methacrolein	2.0		70	83
47	0.15	0.03	Methyl acrylate	1.05	0.40	20	236
48	1.5	0.1	Methyl acrylate	0.84	0.05	50	137
49	0.67	0.1	Methyl acrylate	1.26	0.1	60	19
50	1.4	0.1	Methyl acrylate	0.95	0.05	60	201
51	0.84		Methyl acrylate	0.83		65	157
52	0.50	0.047	Methyl acrylate	0.71	0.012	80	105
53	1.5	0.5	Methyl bicyclo-[2,2,1]-2-heptene-5-carboxylate	0.2	0.05	60	106
54	6.	2.	Methyl cinnamate	0		60	51
55	7.52	0.08	β-Methylene-β-propiolactone	0		—	102
56	0.75	0.20	Methyl methacrylate	1.22	0.20	20	236
57	0.15	0.07	Methyl methacrylate	1.20	0.14	60	120
58	0.06	0.05	*o*-Methylstyrene	0.33	0.1	—	19
59	0.07	0.04	*m*-Methylstyrene	0.43	0.1	—	19
60	0.05	0.02	*p*-Methylstyrene	0.33	0.1	—	19
61	0.10	0.05	2-Methyl-5-vinylpyridine	1.10	0.20	—	234
62	4.1	0.8	Octadecyl acrylate	1.2	0.1	60	201
63	0.07	0.02	*p*-Potassium styrenesulfonate	1.5	0.4	70	79
64	20.0		Propenyltriethoxysilane	0		50	204
65	0.95	0.05	*trans*-1,2-Bis-(2-pyridyl)-ethylene	0.02	0.05	50	140
66	0.05	0.02	Sodium styrenesulfonate	1.5	0.2	40	79
67	0.05	0.02	Styrene	0.38	0.03	41.5	76
68	0.070	0.006	Styrene	0.37	0.03	50	205
69	0.04	0.04	Styrene	0.40	0.05	60	52
70	0.04	0.04	Styrene	0.41	0.08	60	120
71	0.02	0.02	Styrene	0.45	0.03	65	76
72	0.03	0.03	Styrene	0.52	0.04	67–80	62
73	0.03	0.03	Styrene	0.41	0.08	75	63
74	0.02	0.02	Styrene	0.47	0.03	86.5	76
75	0.06	0.01	Styrene	0.39	0.02	99	53
76	0.7		6-Triethoxysilyl bicyclo-[2,2,1]-2-heptene	0		50	204
77	6.0		Trimethoxyvinylsilane	0		50	204
78	3.9	3.	Trimethylvinylsilane	0.07	0.03	60	187
79	6.5		Triisopropoxyvinylsilane	0		50	204
80	3.88		Vinyl acetate	0.009		25	202
81	4.05	0.3	Vinyl acetate	0.061	0.013	60	143
82	6.	2.	Vinyl acetate	0.02	0.02	60	64

(*continued*)

TABLE I (*cont.*)

No.	r_1	±	M_2	r_2	±	T, °C.	Reference
83	4.05		Vinyl acetate	0.061		60	233
84	6.0	15%	Vinyl acetate	0.07	15%	70	6
85	6.0		Vinyl acetate	0.07		70	233
86	0.13	0.01	Vinyl acetylene	0.60	0.02	60	173
87	2.8	0.5	Vinyl chloride	0.04	0.02	40	181
88	3.7		Vinyl chloride	0.074		50	41
89	3.6	0.2	Vinyl chloride	0.052	0.009	50	205
90	3.28	0.06	Vinyl chloride	0.02	0.02	60	122
91	0.25		Vinyl dichloroacetate	0.18		80	235
92	12.	2.	Vinyl 2-ethylhexanoate	0.01	0.01	30	42
93	3.0	0.05	Vinyl formate	0.04	0.005	60	42
94	0.91	0.10	Vinylidene chloride	0.37	0.10	60	120
95	0.36		Vinyl isothiocyanate	1.4		—	197
			Allyl acetate (M_1)				
96	0		β-Chloroethyl acrylate	5.5	1.0	60	122
97	0.0075		Maleic anhydride	0.13		30	27
98	0.0075		Maleic anhydride	0.13		38.5	27
99	0		Methyl acrylate	5.		60	141
100	0		Methyl methacrylate	23.		60	141
101	0.01		Styrene	90.		60	141
102	0.45	0.15	Vinyl acetate	0.60	0.15	60	122
103	0.7		Vinyl acetate	1.0		60	182
104	—		Vinyl chloride	1.2		40	141
105	0		Vinylidene chloride	6.6		60	141
			Allyl chloride (M_1)				
106	—		Acrylonitrile	5.5		60	141
107	0.05	0.01	Acrylonitrile	3.0	0.2	60	42
108	0.48	0.05	Ethyl acrylate	2.3		70	13
109	0		Methyl methacrylate	50.		60	141
110	0.016	0.016	Styrene	31.5	4.	70	11
111	0.67		Vinyl acetate	0.7		68	3
112	0		9-Vinyl carbazole	∞		70	13
113	0		Vinylidene chloride	4.5		60	141
114	0.26		Vinylidene chloride	3.8		68	3
			Anethole (M_1)				
115	0	0.01	*o*-Chlorostyrene	22.	8.	70	4
			1,1-Bis(*p*-anisyl)ethylene (M_1)				
116	0		Acrylonitrile	0.014	0.003	60	54
117	0		Methyl acrylate	0.049	0.005	60	54
			1,3-Butadiene (M_1)				
118	0.28		Acrylonitrile	0.02		5	57
119	0.35	0.08	Acrylonitrile	0.0	0.04	50	90
120	0.46	0.03	Acrylonitrile	0.0		50	223
121	0.40	0.02	Acrylonitrile	0.04	0.01	50	24

(*continued*)

TABLE I (*cont.*)

No.	r_1	±	M_2	r_2	±	T, °C.	Reference
122	0.99	0.07	Butyl acrylate	0.08	0.02	5	226
123	0.78	0.12	2-Chlorobenzalacetophenone	−0.03	0.05	60	189
124	0.059	0.015	Chloroprene	3.41	0.07	50	90
125	1.07		*p*-Chlorostyrene	0.42		50	223
126	0		1-Cyano-1,3-butadiene	1.70		50	223
127	0.46	0.01	2,5-Dichlorostyrene	0.46	0.01	50	223
128	0.65	0.10	2,5-Dichlorostyrene	0.20	0.04	70	9
129	2.13		Diethyl fumarate	0.25		—	128
130	8.08		Diethyl maleate	0.11		—	128
131	0.35		1,1-Dihydroperfluorobutyl acrylate	0.07		50	184
132	0.85		2,3-Dimethyl-1,3-butadiene	0.63		5	73
133	0.0106	0.0175	Dimethyl dithiolfumarate	−0.0014	0.027	50	135
134	2.02		Dinonyl fumarate	0.32		—	128
135	5.36		Dinonyl maleate	0.12		—	128
136	0.25		Ethyl α-cyanocinnamate	0		35	151
137	1.1		Hydronopyl acrylate	0.2		—	138
138	0.75		Isoprene	0.85		5	73
139	0.201		Methacrylic acid	0.526		50	67
140	0.36	0.07	Methacrylonitrile	0.04	0.04	5	226
141	0.76	0.04	Methyl acrylate	0.05	0.02	5	226
142	1.07	0.12	Methyl 2-chlorocinnamate	−0.02	0.05	60	189
143	1.20	0.12	Methyl 2-chlorocinnamate	−0.03	0.05	80	189
144	2.7	0.3	Methyl 4-chlorocinnamate	0.00	0.05	80	189
145	0.53	0.05	Methyl methacrylate	0.06	0.03	5	226
146	0.75		Methyl methacrylate	0.31		—	129
147	0.75	0.05	Methyl methacrylate	0.25	0.03	90	122
148	0.35	0.01	Methyl thiolacrylate	0.20	0.05	70	131
149	1.32	0.01	2-Methyl-5-vinylpyridine	0.72	0.03	—	211
150	0.76		Nonyl methacrylate	0.32		—	129
151	1.37		Styrene	0.38		−18	158
152	1.38		Styrene	0.64		5	73
153	1.30	0.1	Styrene	0.01	0.01	43	24
154	1.83		Styrene	0.65		45	73
155	1.8	0.4	Styrene	0.6	0.1	45	148
156	1.4	0.2	Styrene	0.5	0.1	50	145
157	1.48	0.08	Styrene	0.23	0.07	50	90
158	1.39	0.03	Styrene	0.78	0.01	60	122
159	0.37	0.03	Triethyl aconitate	0.00	0.01	60	132
160	0.40	0.03	Trimethyl aconitate	0.00	0.015	60	132
161	8.8		Vinyl chloride	0.035		50	207
162	5.0	0.1	Vinyl formate	0.2	0.05	120	214
163	1.9	0.2	Vinylidene chloride	<0.05		5	226
164	26.3	10.0	Vinyl pelargonate	0.02	0.02	60	130
165	37.8	6.5	Vinyl pinonate	0.015	0.015	60	130
166	34.5	6.6	Vinyl stearate	0.034	0.034	60	130
167	37.9	4.0	Vinyl undecylenate	0.015	0.015	60	130

(*continued*)

TABLE I (*cont.*)

No.	r_1	±	M_2	r_2	±	T, °C.	Reference
			Butyl acrylate (M_1)				
168	1.005	0.005	Acrylonitrile	1.003	0.012	60	153
169	0.89	0.08	Acrylonitrile	1.2	0.1	60	201
170	0.40		Dimethyl itaconate	0.94		—	43
171	0.65	0.07	Methyl vinyl ketone	1.6	0.1	50	47
172	0.15	0.04	Styrene	0.48	0.04	25	22
173	0.19		Styrene	0.76		60	34
174	4.4		Vinyl chloride	0.07		45	208
175	0.58	0.03	Vinylidene chloride	0.87	0.01	0	126
176	0.46	0.13	Vinylidene chloride	0.84	0.2	70	126
177	0.10	0.04	2-Vinylpyridine	2.50	0.05	60	68
178	0.46	0.09	4-Vinylpyridine	5.15	0.09	60	68
			n-Butyl vinylsulfonate (M_1)				
179	0.11	0.03	Methyl acrylate	5.0	1.5	70	162
180	0.13	0.03	Styrene	2.5	1.0	90	162
181	0.20	0.05	Vinyl acetate	0.40	0.01	70	162
182	0.30	0.05	Vinyl chloride	0.35	0.05	70	162
183	0.065	0.007	Vinylidene chloride	7.5	0.6	80	162
			2-Chloroallyl acetate (M_1)				
184	0		Maleic anhydride	0		120	107
185	0		Methyl acrylate	0.7		100	107
186	0		Methyl methacrylate	1.0		50	107
187	0		Styrene	4.10		50	107
188	0		Vinyl chloride	1.16		100	107
			2-Chloroallyl chloride (M_1)				
189	0		Methacrylic acid	4.0		100	107
190	0		Methyl methacrylate	0.5		40	107
191	0.17	0.025	Methyl methacrylate	5.5	0.8	70	12
192	0		Styrene	2.5		40	107
193	0.06	0.01	Styrene	5.0	0.8	70	12
194	0		9-Vinylcarbazole	∞		70	13
			Chloroprene (M_1)				
195	6.07	0.53	Acrylonitrile	0.01	0.01	50	90
196	5.35	0.20	Acrylonitrile	0.045	0.004	60	54
197	6.65	0.37	Diethyl fumarate	0.027	0.009	60	54
198	3.2	0.2	1,1-Diphenylethylene	0.0	0.5	60	54
199	5.47		Hexachloro-1,3-butadiene	0.10		40	112
200	5.52		Hexachloro-1,3-butadiene	0.10		40	112
201	3.65	0.11	Isoprene	0.133	0.025	50	90
202	11.1	1.5	Methyl acrylate	0.078	0.010	60	54
203	6.12	0.20	Methyl methacrylate	0.080	0.007	60	54
204	0.164		Isopropyl vinyl ether	11.45		—	149
205	6.3	0.1	Styrene	0.0		50	90
206	8.11	0.34	Styrene	0.053	0.005	60	54

(*continued*)

TABLE I (*cont.*)

No.	r_1	±	M_2	r_2	±	T, °C.	Reference
207	7.	2.	Styrene	0.05	0.02	70	9
208	50.0		Vinyl acetate	0.01		65	218
209	90.0		Vinyl butyrate	0.02		65	218
210	30.0		Vinyl formate	0.01		65	218
211	0.016		Vinylidene cyanide	0.0048		40	72
212	70.0		Vinyl propionate	0.05		65	218
213	5.19	0.03	2-Vinylpyridine	0.06	0.01	60	115
214	2.10	0.02	2-Vinylquinoline	0.38	0.03	60	115
			p-Chlorostyrene (M_1)				
215	0.69		Dimethyl itaconate	0.15		—	43
216	0.45		Methacrylonitrile	0.73		80	179
217	0.86	0.08	*p*-Methoxystyrene	0.58	0.03	60	225
218	—		Methyl methacrylate	0.4	0.2	30–40	136
219	0.89	0.05	Methyl methacrylate	0.415	0.02	60	225
220	1.48	0.02	α-Methylstyrene	0.25	0.05	74	194
221	1.15	0.05	*p*-Methylstyrene	0.61	0.03	60	225
222	0.25	0.05	*m*-Nitrostyrene	1.3	0.1	75	196
223	0.70	0.08	*p*-Nitrostyrene	0.91	0.37	60	225
224	1.025	0.050	Styrene	0.74	0.03	60	225
225	1.032	0.030	Styrene	0.742	0.030	60	121
226	1.042	0.015	Styrene	0.816	0.015	131	121
			Chlorotrifluoroethylene (M_1)				
227	0.005		Methyl methacrylate	75.0		60	203
228	0.001		Styrene	7.0		60	203
229	1.0		Tetrafluoroethylene	1.0		60	56
230	0.05		Bis(trimethylsiloxyl)vinylmethylsilane	0.20		60	166
231	0.05		Tris(trimethylsiloxyl)vinylsilane	0.20		60	166
232	0.01		Vinyl acetate	0.6		60	203
233	0.01		Vinyl chloride	2.53		60	113
234	1.2		Vinyl fluoride	0.8		80	56
235	0.02		Vinylidene chloride	17.14		60	113
			Crotonic acid (M_1)				
236	0		Acrylonitrile	21.	10.	60	51
237	0		Styrene	20.		60	51
238	0.01	0.01	Vinyl acetate	0.33	0.05	60	42
239	0.01		Vinyl acetate	0.3		70	215
240	0.065	0.005	Vinylidene chloride	35.	5.	60	42
			cis-Dichloroethylene (M_1)				
241	0		Styrene	56.1		50	36
242	0		Styrene	210.	15.	60	119
243	0		Styrene	50–100		68	10
244	0		Styrene	47.5		90	36

(*continued*)

TABLE I (*cont.*)

No.	r_1	±	M_2	r_2	+	T, °C.	Reference
245	0		Styrene	72.7		90	36
246	0.018	0.003	Vinyl acetate	6.3	0.2	60	119
247	0		Vinyl acetate	2.8		68	10
248	0		Vinylidene cyanide	30.0		40	72
			trans-Dichloroethylene (M_1)				
249	0		Styrene	44.4		50	36
250	0		Styrene	44.9		50	36
251	0		Styrene	37.	3.	60	119
252	0		Styrene	11.		68	10
253	0		Styrene	29.8		90	36
254	0		Styrene	25.9		90	36
255	0.086	0.010	Vinyl acetate	0.99	0.02	60	119
256	0		Vinyl acetate	0.85		68	10
257	0		Vinylidene cyanide	30.0		40	72
			2,5-Dichlorostyrene (M_1)				
258	0.09	0.02	Acrylonitrile	0.26	0.02	38.5	76
259	0.07	0.05	Acrylonitrile	0.22	0.05	67.5	76
260	0.07	0.06	Acrylonitrile	0.25	0.11	86.5	76
261	1.55		2,5-Dimethylstyrene	0.27		70.	83
262	4.		Methyl acrylate	0.15		70	117
263	2.25		Methyl methacrylate	0.44		68	3
264	3.		α-Methylstyrene	0.14		70	15
265	2.0		Methyl vinyl ketone	0.5		70	5
266	0.25	0.09	Styrene	0.18	0.07	41.5	76
267	0.08	0.05	Styrene	0.32	0.06	65	76
268	0.8		Styrene	0.2		70	16
269	2.2		Styrene	0.29		70	91
270	1.8		Styrene	0.30		70	91
271	2.2		Styrene	0.23		70	91
272	1.9		Styrene	0.31		70	91
273	0.05	0.03	Styrene	0.40	0.03	86.5	76
274	—		Vinyl acetate	<0.04		70	91
275	8.	0.5	9-Vinylcarbazole	0.016	0.002	70	15
276	0.031		Vinylidene cyanide	0.0092		40	72
277	0.9		2-Vinylpyridine	1.1		70	15
			Diethyl fumarate (M_1)				
278	0		Acrylonitrile	8.		60	141
279	0.070	0.007	Styrene	0.30	0.02	60	119
280	0.0697	0.0041	Styrene	0.301	0.024	60	121
281	0.0905	0.0008	Styrene	0.400	0.014	131	121
282	1.10	0.10	3,3,3-Trichloropropene	1.46	0.35	60	51
283	0.444	0.003	Vinyl acetate	0.011	0.001	60	119
284	0.47	0.05	Vinyl chloride	0.12	0.01	60	119
285	0.046	0.015	Vinylidene chloride	12.2	2.	60	50

(*continued*)

TABLE I (*cont.*)

No.	r_1	±	M_2	r_2	±	T, °C.	Reference
			Diethyl maleate (M_1)				
286	0		Acrylonitrile	12.		60	141
287	0		Methyl methacrylate	20.		60	141
288	<0.01		Styrene	6.52	0.05	60	121
289	<0.01		Styrene	6.52	0.50	60	119
290	0.0		Styrene	5.		70	16
291	0		Styrene	5.48	0.56	131	121
292	0.043	0.005	Vinyl acetate	0.17	0.01	60	119
293	0.009	0.003	Vinyl chloride	0.77	0.03	60	119
294	0	15%	Vinyl chloride	0.9	15%	70	6
			Dimethyl itaconate (M_1)				
295	1.1		Di-*n*-butyl itaconate	1.1		—	43
296	0.28		Methacrylonitrile	1.26		—	43
297	0.3		Methyl methacrylate	1.3		—	43
298	0.3		Methyl methacrylate	1.2		—	43
299	0.14		Styrene	0.48		—	43
300	5.1	0.2	Vinyl chloride	0.053	0.01	50	154
			1,1-Diphenylethylene (M_1)				
301	0		Acrylonitrile	0.028	0.003	60	54
302	0		2,3-Dichloro-1,3-butadiene	4.5	0.5	60	54
303	0		Methyl acrylate	0.102	0.006	60	54
			Ethyl α-acetoxyacrylate (M_1)				
304	1.0	0.05	Ethyl acrylate	1.0	0.1	60	213
305	0.65	0.05	Methyl methacrylate	1.65	0.07	60	213
306	0.20	0.05	Styrene	0.57	0.05	60	213
307	5.4	0.5	Vinyl acetate	0.08	0.03	60	213
			Ethyl acrylate (M_1)				
308	0.95		Acrylonitrile	0.44		80	235
309	0.79	0.11	Isopropenyl isocyanate	0.15	0.07	—	100
310	5.7		Sodium acrylate	1.5		50	99
311	0.19		Styrene	0.79		50	219
312	0.20		Styrene	0.80		70	219
313	0.48		Styrene	0.80		80	235
314	0.19	0.06	2-Vinylpyridine	0.23	0.05	75	220
			Ethyl vinyl ether (M_1)				
315	0		Acrylonitrile	5.		60	141
316	0.03	0.02	Acrylonitrile	0.7	0.02	60	186
317	0.03	0.02	Acrylonitrile	0.7	0.2	80	175
318	0		Methyl acrylate	3.3		60	141
319	0		Styrene	90.	20.	60	122

(*continued*)

TABLE I (*cont.*)

No.	r_1	±	M_2	r_2	±	T, °C.	Reference
320	0		Vinyl acetate	3.0	0.1	60	143
321	0		Vinylidene chloride	3.2		60	141
			5-Ethyl-2-vinylpyridine (M_1)				
322	0.43	0.05	Acrylonitrile	0.02	0.02	60	103
323	1.16	0.08	Methyl acrylate	0.179	0.006	60	200
324	0.69	0.03	Methyl methacrylate	0.395	0.003	60	200
325	1.2	0.2	Styrene	0.79	0.03	60	200
			N-Ethyl-*N'*-vinylurea (M_1)				
326	0.015		Methyl methacrylate	1.8		75	87
327	0.020		Styrene	20.		75	87
328	0.63		Vinyl acetate	0.45		75	87
			2-Fluoro-1,3-butadiene (M_1)				
329	0.59	0.10	Acrylonitrile	0.07	0.03	50	160
330	2.05	0.19	Isoprene	0.19	0.10	50	160
331	1.54	0.08	Methyl methacrylate	0.64	0.08	50	160
332	1.77	0.19	α-Methylstyrene	0.38	0.11	50	160
333	1.61	0.24	Styrene	0.16	0.18	5	160
334	1.55	0.10	Styrene	0.50	0.10	50	160
			Fumaronitrile (M_1)				
335	0.01	0.01	Methyl methacrylate	3.5	0.5	60	169
336	0		α-Methylstyrene	0.022	0.005	50	66
337	0		Styrene	0.3		50–70	152
338	0		Styrene	0.19	0.03	60	119
339	0.01	0.01	Styrene	0.23	0.10	60	169
340	0.0		Styrene	0.09	0.005	79	66
			Indene (M_1)				
341	0		Acrylonitrile	0.3		—	125
342	0		*o*-Chlorostyrene	3.5	15%	70	6
343	0.33	15%	Vinylidene chloride	0.4	15%	70	6
			Isobutylene (M_1)				
344	0.02	0.02	Acrylonitrile	1.8	0.2	50	24
345	0		Acrylonitrile	1.02		60	157
346	0.0		Tetrafluoroethylene	0.3		80	97
347	0.03		Vinyl chloride	1.3		0	190
348	0.08	0.10	Vinyl chloride	2.05	0.3	60	122
349	0		Vinyl chloride	4.3		65	74
350	0		Vinylidene chloride	1.5		60	141
351	0.00176		Vinylidene cyanide	0.182		—	21
			Isoprene (M_1)				
352	0.45	0.05	Acrylonitrile	0.03	0.03	50	90
353	1.30		Styrene	0.48		−18	73

(*continued*)

TABLE I (*cont.*)

No.	r_1	±	M_2	r_2	±	T, °C.	Reference
354	1.30	0.02	Styrene	0.48	0.01	−18	159
355	1.68	0.00	Styrene	0.80	0.00	50	90
356	2.05	0.45	Styrene	1.38	0.54	50	90
357	2.02		Styrene	0.42		—	237
358	1.98		Styrene	0.44		—	237
359	0.59	0.05	2-Vinylpyridine	0.47	0.07	60	115
360	0.53	0.01	2-Vinylquinoline	1.88	0.02	60	115
			Isopropenyl acetate (M_1)				
361	0.032	0.005	Maleic anhydride	0.002		75	229
362	0.017		Methyl methacrylate	30.		75	86
363	1.0		Vinyl acetate	1.0		75	86
364	0.25		Vinyl chloride	2.2		65	86
			Isopropenyl isocyanate (M_1)				
365	0.08	0.01	Methyl acrylate	0.8	0.1	60	85
366	0.11	0.04	Methyl acrylate	0.60	0.03	—	100
367	0.14	0.10	Methyl methacrylate	3.10	0.29	—	100
368	0.07	0.00	Styrene	8.12	0.00	—	100
369	0.14	0.04	Styrene	7.0	0.5	60	85
370	0.31	0.02	Vinylidene chloride	0.85	0.04	—	100
			Maleic anhydride (M_1)				
371	0		Acrylonitrile	6.		60	141
372	0		Methyl acrylate	2.5		60	141
373	0.02		Methyl acrylate	2.8	0.05	75	229
374	0.03		Methyl methacrylate	3.5		60	28
375	0.02		Methyl methacrylate	6.7	0.2	75	229
376	0.03	0.03	Stilbene	0.03	0.03	60	119
377	0.08	0.08	Isostilbene	0.07	0.07	60	119
378	0		Styrene	0.01		60	141
379	0		Styrene	0.042	0.008	80	14
380	0		Styrene	0.02		60	25
381	0.010		Vinyl acetate	0.072		—	96
382	0.003		Vinyl acetate	0.055	0.015	75	229
383	0.008		Vinyl chloride	0.296	0.07	75	229
384	0		Vinylidene chloride	9.		60	141
385	0		Vinylidene cyanide	45.0		50	72
			Methacrylic acid (M_1)				
386	4.5		2-Chloroallyl alcohol	0		100	107
387	0.7	15%	*o*-Chlorostyrene	0.12	15%	70	6
388	0.98	0.16	Diethylaminoethyl methacrylate	0.90	0.23	70	18
389	2.0		Methacrylamide	0.22	0.02	50	48
390	2.0		Methacrylamide	0.3		70	167
391	2.50		Methacrylamide	0.30		70	167

(*continued*)

TABLE I (*cont.*)

No.	r_1	±	M_2	r_2	±	T, °C.	Reference
392	1.64	0.05	Methacrylonitrile	0.62	0.05	65	80
393	1.63	0.08	Methacrylonitrile	0.59	0.08	80	40
394	0.7	0.05	Styrene	0.15	0.01	60	42
395	20.		Vinyl acetate	0.01		70	15
396	3.0	15%	Vinylidene chloride	0.15	15%	70	6
397	0.58	0.05	2-Vinylpyridine	1.55	0.10	70	17
			Methacrylonitrile (M_1)				
398	2.68		Acrylonitrile	0.32		60	157
399	0.55	0.08	*n*-Amyl methacrylate	0.51	0.08	80	40
400	0.73	0.08	Isobutyl methacrylate	0.67	0.08	80	40
401	0.51	0.08	*n*-Butyl methacrylate	0.69	0.08	80	40
402	0.37	0.08	*tert*-Butyl methacrylate	0.70	0.08	80	40
403	0.86		*o*-Chlorostyrene	0.78		80	179
404	0.46	0.08	Ethyl methacrylate	0.83	0.08	80	40
405	0.75	0.08	*n*-Hexyl methacrylate	0.56	0.08	80	40
406	0.65	0.06	Methyl methacrylate	0.67	0.10	60	122
407	0.80		Methyl methacrylate	0.68		80	179
408	0.70	0.08	Methyl methacrylate	0.74	0.08	80	40
409	0.35	0.02	α-Methylstyrene	0.12	0.02	80	64
410	0.15		α-Methylstyrene	0.21		80	179
411	0.75	0.08	*n*-Octyl methacrylate	0.58	0.08	80	40
412	0.43	0.08	Isopropyl methacrylate	0.92	0.08	80	40
413	0.29	0.08	*n*-Propyl methacrylate	0.79	0.08	80	40
414	0.90	0.08	Stearyl methacrylate	1.13	0.08	80	40
415	0.16	0.06	Styrene	0.30	0.10	60	122
416	0.25	0.02	Styrene	0.25	0.02	80	64
417	0.43		Styrene	0.28		80	179
418	0.26	0.08	Styrene	0.38	0.08	80	40
419	12.	2.	Vinyl acetate	0.01	0.01	70	64
			Methacryloxymethyl pentamethyl disiloxane (M_1)				
420	1.44	0.15	Acrylonitrile	0.19	0.04	50	146
421	1.13	0.10	Methyl methacrylate	0.93	0.10	50	146
422	0.58	0.20	Styrene	0.77	0.02	50	146
423	24.	5.	Vinyl acetate	0.16	0.16	50	146
			Methallyl acetate (M_1)				
424	0		β-Chloroethyl acrylate	4.	1.	60	122
425	0		Methyl methacrylate	10.		60	141
426	0		Styrene	71.	10.	60	141
427	0		Vinylidene chloride	2.4		60	141
			Methallyl chloride (M_1)				
428	0		Methyl methacrylate	7.7		60	141
429	0		Styrene	22.		60	141

(*continued*)

TABLE I (*cont.*)

No.	r_1	±	M_2	r_2	±	T, °C.	Reference
430	0		Vinyl acetate	0.31		73–90	150
431	0		Vinyl chloride	0.31		45	150
432	0		Vinylidene chloride	1.1		60	141
			p-Methoxystyrene (M_1)				
433	0.32		Methyl methacrylate	0.29		60	30
434	0.32	0.05	Methyl methacrylate	0.29	0.03	60	225
435	0.82	0.07	Styrene	1.16	0.09	60	225
			Methyl acrylate (M_1)				
436	0.2		Acrolein	10.0		20	185
437	0.9	0.1	β-Chloroethyl acrylate	0.9	0.1	60	122
438	0.092	0.006	1,1-Bis(*p*-chlorophenyl)-ethylene	0		60	54
439	0.25	0.04	Dichlorostyrenes (mixed)	4.27	0.28	60	2
440	55.	5.	Diphenyl acetylene	0		60	52
441	8.5	2.	1-Hexene	0		60	52
442	11.2	2.	1-Hexyne	0		60	52
443	0.89	0.25	Pentachlorophenyl vinyl sulfide	0.26	0.30	80	93
444	0.40		Phenyl vinyl sulfide	0.05	0.02	60	174
445	0.18	0.02	Styrene	0.75	0.03	60	52
446	0.182	0.016	Styrene	0.747	0.028	60	121
447	0.15	0.05	Styrene	0.72	0.1	60	137
448	0.20	0.05	Styrene	0.75	0.1	70	16
449	0.238	0.005	Styrene	0.825	0.005	131	121
450	9.	2.5	Vinyl acetate	0.1	0.1	60	143
451	9.0		Vinyl acetate	0.1		60	233
452	4.0		Vinyl chloride	0.06		45	208
453	9.0		Vinyl chloride	0.083		50	41
454	4.4	0.5	Vinyl chloride	0.12	0.01	50	137
455	5.		Vinyl chloride	—		60	141
456	1.		Vinylidene chloride	1.		60	141
457	1.		Vinylidene chloride	1.		70	15
458	0.1		2-Vinyl mercaptobenzo-thiazole	1.0		60	108
			Methyl α-chloroacrylate (M_1)				
459	2.0	15%	Acrylonitrile	0.15	15%	70	6
460	1.2	15%	Methyl methacrylate	0.3	15%	70	6
461	0.41		Vinylidene cyanide	0.091		50	72
			Methyl isopropenyl ketone (M_1)				
462	0.70	0.14	Acrylonitrile	0.36	0.08	80	104
463	1.7		α-Methylstyrene	0.03		—	179
464	0.66		Styrene	0.32		80	179

(*continued*)

TABLE I (*cont.*)

No.	r_1	±	M_2	r_2	±	T, °C.	Reference
465	0.29	0.06	Styrene	0.44	0.10	80	104
466	4.5	0.1	Vinylidene chloride	0.15	0.02	60	42
			Methyl methacrylate (M_1)				
467	0.30	0.05	*p*-Acetylaminostyrene	0.50	0.05	65	84
468	50.		Allyl chloroacetate	0		75	44
469	0.14		*N*-(*p*-Anisyl)methacrylamide	0.57		70	165
470	0.48	0.02	*m*-Bromostyrene	1.17	0.25	60	225
471	0.395	0.02	*p*-Bromostyrene	1.10	0.25	60	225
472	1.33	0.03	*N*-Butyl maleimide	0.12	0.02	50	45
473	4.4		2-Chloroallyl alcohol	0		100	107
474	0.61		*N*-(*p*-Chlorophenyl)-methacrylamide	0.24		70	165
475	0.47	0.075	*m*-Chlorostyrene	0.91	0.11	60	225
476	0.50	0.03	*o*-Chlorostyrene	1.37	0.1	60	224
477	0.7	0.2	4-Chloro-1-vinylnaphthalene	0.7	0.2	60	172
478	0.45	0.05	6-Chloro-3-vinylnaphthalene	1.6	0.2	60	172
479	0.22	0.02	*p*-Cyanostyrene	1.41	0.13	60	225
480	0.8		Di-*n*-butyl itaconate	0.4		—	43
481	0.073	0.015	2,3-Dichloro-1,3-butadiene	10.3	2.0	60	54
482	2.63	0.2	Di-β-chloroethyl itaconate	0.10	0.05	50	154
483	1.4		1,1-Dihydroperfluorobutyl acrylate	0.25		50	184
484	0.77		*N*-(1,1-Dihydroperfluorobutyl)-*N*-ethyl acrylamide	0.89		66	114
485	0.205	0.02	*p*-Dimethylaminostyrene	0.11	0.02	60	225
486	16.67		Dimethyl methacrylyliminodiacetate	0.013		70	165
487	0.85	0.05	Divinyl sulfide	0.13	0.05	60	188
488	1.75		*N*-Ethyl methacrylamide	0.11		70	165
489	1.09		Ethyl methacrylylaminoacetate	0.90		70	165
490	2.7	1.5	Ethyl vinyl sulfide	0.3	0.1	—	191
491	0.80		Glycidyl methacrylate	1.05		60	75
492	0.36	0.03	*p*-Iodostyrene	0.95	0.20	60	225
493	0.45	0.03	β-Isopropenylnaphthalene	0.0		99	53
494	1.14		Itaconic acid	0		90	58
495	1.65	0.05	Methacrylamide	0.49	0.02	70	192
496	1.54		*N*-Methyl methacrylamide	0.24		70	165
497	0.53	0.025	*m*-Methylstyrene	0.49	0.02	60	225
498	0.405	0.025	*p*-Methylstyrene	0.44	0.02	60	225
499	0.35	0.05	*m*-Nitrostyrene	0.85	0.2	75	196
500	4.0	0.4	Pentachlorostyrene	0.35	0.05	70	8

(*continued*)

TABLE I (*cont.*)

No.	r_1	±	M_2	r_2	±	T, °C.	Reference
501	0.54		*N*-Phenyl methacrylamide	0.46		70	165
502	10–25		Poly(ethyleneglycol fumarate)	0–0.7		60	78
503	0.422		Styrene	0.485		30	23
504	0.44	0.02	Styrene	0.50	0.02	35	222
505	0.50	0.02	Styrene	0.50	0.02	60	120
506	0.46	0.026	Styrene	0.52	0.026	60	121
507	0.46		Styrene	0.48		60	230
508	0.49	0.03	Styrene	0.54	0.03	99	53
509	0.536	0.026	Styrene	0.590	0.026	131	121
510	0.55		Styrene	0.60		132	230
511	0.39		*N*-(*p*-Tolyl)methacrylamide	0.67		70	165
512	0.60	0.10	3-Trifluoromethylstyrene	0.98	0.15	60	46
513	0.57	0.07	2,5-Bis(trifluoromethyl)-styrene	1.35	0.05	60	46
514	0.4	0.05	2-Vinylnaphthalene	1.0	0.15	60	172
515	0.1	0.03	2-Vinylphenanthrene	2.0	0.20	60	172
516	0.8	0.05	3-Vinylphenanthrene	1.75	0.25	60	172
517	Very large		Vinylsulfonic acid	0		70	83
			α-Methylstyrene (M_1)				
518	0.10	0.02	Acrylonitrile	0.06	0.02	75	64
519	0.14	0.01	Methyl methacrylate	0.50	0.03	60	224
520	−0.01	0.01	Methyl methacrylate	0.89	0.03	99	53
			Methyl vinyl ketone (M_1)				
521	1.78	0.22	Acrylonitrile	0.61	0.04	60	122
522	0.26	0.04	4,6-Diamino-2-vinyl-*s*-triazine	1.2	0.15	60	164
523	0.35	0.02	Styrene	0.29	0.04	60	122
524	7.0		Vinyl acetate	0.05		70	83
525	8.3		Vinyl chloride	0.10		70	5
526	1.8		Vinylidene chloride	0.55		70	5
			Methyl vinyl sulfide (M_1)				
527	0.05		Methyl acrylate	0.35		60	176
528	0.11		Styrene	5.11		60	176
529	10.6	1.2	Vinylene carbonate	0.05	0.04	60	106
			Methyl vinyl sulfone (M_1)				
530	0		Methyl methacrylate	14.	2.	60	51
531	0.01		Styrene	2.0		60	176
532	0.0	0.02	Styrene	2.4	0.10	60	51
533	0.01		Styrene	1.40		60	176
534	0.4		Vinyl acetate	0.3		60	176
535	0.40	0.08	Vinyl acetate	0.0	0.01	60	51

(*continued*)

TABLE I (*cont.*)

No.	r_1	±	M_2	r_2	±	T, °C.	Reference
			N-Methyl-*N*-vinyl-*p*-toluenesulfonamide (M_1)				
536	0		Acrylonitrile	0.42		60	70
537	0		Methyl methacrylate	4.68		60	70
538	0		Styrene	12.3		60	70
			Phenylacetylene (M_1)				
539	0.33	0.05	Acrylonitrile	0.26	0.03	60	52
540	0.27	0.04	Methyl acrylate	0.62	0.02	60	52
541	1.4		Vinylidene chloride	0.1		60	51
542	0.2	0.05	2-Vinylpyridine	4.0	0.7	60	171
			Sodium acrylate (M_1)				
543	0.77		Acrylonitrile	0.21		50	98
544	5.8		Sodium vinylsulfonate	0		60	37
545	0.34	0.23	Sodium styrenesulfonate	2.3	1.2	70	79
546	2.0		Vinyl acetate (M_1 = 90% pure)	0.01		70	33
			Sodium methacrylate (M_1)				
547	0.08	0.015	Diethylaminoethyl methacrylate	0.65	0.03	70	18
			Styrene (M_1)				
548	3.81		Acenaphthalene	0.33		90	212
549	0.19	0.056	α-Acetoxyacrylonitrile	0.20	0.052	60	155
550	0.24	0.01	*N*-Benzylidene-4-methacryloxyaniline	0.25	0.05	60	178
551	0.55	0.03	*m*-Bromostyrene	1.05	0.21	60	225
552	0.695	0.02	*p*-Bromostyrene	0.99	0.07	60	225
553	37.5	2.0	β-Bromovinyl ethyl ether	0.02	0.02	80	175
554	0.87		*n*-Butyl cinnamate	0.10		80	235
555	0.025	0.025	*N*-Butyl maleimide	0.06	0.02	50	45
556	0.68		Butyl methacrylate	0.63		50	219
557	0.64		Butyl methacrylate	0.54		70	219
558	0.97		*n*-Butyl methacrylate	0.67		30	39
559	12.5		2-Chloroallyl alcohol	0		40	107
560	0.54	0.01	β-Chloroethyl acrylate	0.10	0.01	60	122
561	0.64	0.05	*m*-Chlorostyrene	1.09	0.23	60	225
562	0.56	0.03	*o*-Chlorostyrene	1.64	0.07	60	224
563	0.85	0.1	4-Chloro-1-vinylnaphthalene	0.8	0.1	60	172
564	0.4	0.1	6-Chloro-2-vinylnaphthalene	1.5	0.2	60	172
565	0.9	0.2	Cinnamonitrile	0.1	0.1	90	32
566	0.85	0.05	3-Cinnamoyl pyridine	0.09	0.10	50	139
567	0.15	0.02	Citraconic anhydride	0.01	0.01	60	42

(*continued*)

TABLE I (*cont.*)

No.	r_1	±	M_2	r_2	±	°C.	Reference
568	8.5	5.0	γ-Crotonolactone	0		60	106
569	0.28	0.025	*p*-Cyanostyrene	1.16	0.13	60	225
570	0.041	0.012	2,3-Dichloro-1,3-butadiene	10.8	1.5	60	54
571	0.50	0.05	Di-β-chloroethyl itaconate	0		50	154
572	1.6		1,1-Dichloro-2,2-difluoroethylene	0		45	144
573	2.5		Diethyl chloromaleate	0		70	16
574	3.25		Diethyl vinyl phosphonate	0		116	20
575	0.33		1,1-Dihydroperfluorobutyl acrylate	0.07		50	184
576	1.015	0.06	*p*-Dimethylaminostyrene	0.84	0.05	60	225
577	0.35	0.02	2-(*N*,*N*-Dimethylamino)-4-vinylpyrimidine	1.4	0.1	60	164
578	0.42	0.02	2,3-Dimethyl-1,3-butadiene	0.92	0.02	−18	159
579	0.098	0.013	Dimethyl dithiolfumarate	0.0163	0.013	50	135
580	0.21	0.02	Dimethyl fumarate	0.025	0.015	60	119
581	8.5	0.2	Dimethyl maleate	0.03	0.01	60	119
582	0.65		*m*-Divinylbenzene	0.60		100	231
583	1.90	0.1	Divinyl sulfide	0.47	0.05	60	188
584	2.62		1,4-Divinyl-2,3,5,6-tetrachlorobenzene	—		49.2	180
585	0.18	0.1	Ethyl acid fumarate	0.25	0.10	60	119
586	0.13	0.01	Ethyl acid maleate	0.035	0.01	60	119
587	0.35		Ethyleneglycol dimethacrylate	0.65		60	231
588	0.67		Ethyl methacrylate	0.26		50	219
589	0.65		Ethyl methacrylate	0.29		70	219
590	6.0	1.5	Ethyl vinyl sulfide	0.25	0.1	—	191
591	0.04		Fumaryl chloride	0		27	83
592	Very large		Hexachloro-1,3-butadiene	0		70	6
593	0.66	0.1	Hydronopyl acrylate	0.29	0.1	50	137
594	0.62	0.05	*p*-Iodostyrene	1.25	0.30	60	225
595	0.301		Itaconic acid	0.201		70	65
596	0.19	0.01	Maleonitrile	0		60	119
597	0.25	0.03	4-Methacryloxybenzylidene aniline	2.4	0.5	60	178
598	0.18	0.03	4-Methacryloxybenzylidene-4′-chloroaniline	5.4	0.6	60	178
599	1.0		*N*-Methacryloyl ε-caprolactam	0		70–80	228
600	1.9	0.2	Methyl cinnamate	0		60	51
601	0.92	0.08	2-Methyl-5-cinnamoylpyridine	−0.15	0.2	50	139
602	4.2	0.2	Methyl vinyl sulfoxide	0.01	0.01	60	170
603	0.45	0.05	*m*-Nitrostyrene	0.85	0.1	75	196
604	0.19	0.02	*p*-Nitrostyrene	1.15	0.20	60	225
605	3.9	0.2	Pentachlorophenyl vinyl sulfide	0.24	0.08	80	93

(*continued*)

TABLE I (*cont.*)

No.	r_1	±	M_2	r_2	±	T, °C.	Reference
606	1.31	0.2	Pentachlorostyrene	0.10	0.02	70	8
607	4.5		Phenyl vinyl sulfide	0.15		60	174
608	3.3		Phenyl vinyl sulfone	0.01	0.01	60	174
609	3.0	0.4	Poly(1,3-butyleneglycol fumarate)	0.03	0.03	60	210
610	−0.06		*p*-Potassium styrenesulfonate	0.54		90	232
611	0.02		*p*-Potassium styrenesulfonate	0.93		110	232
612	0.50	0.10	3-Pyridalacetophenone	0.00	0.25	50	139
613	1.85	0.1	*trans*-1,2-Bis(2-pyridyl)-ethylene	0.17	0.1	50	140
614	0.24		*p*-Sulfonamidostyrene	1.07		90	232
615	1.10	0.10	Triethyl aconitate	−0.10	0.10	60	132
616	0.70	0.05	3-Trifluoromethylstyrene	1.05	0.05	60	46
617	0.45	0.05	2,5-Bis(trifluoromethyl)-styrene	1.15	0.08	60	46
618	0.66		α,β,β-Trifluorostyrene	0.070		50	123
619	0.71	0.02	*p*-Trimethoxysilylstyrene	1.4	0.1	70	118
620	1.0	0.2	*p*-Trimethylsilylstyrene	1.0	0.2	70	118
621	26.	8.	Trimethyl vinyl silane	·0		60	187
622	20.		Vinyl dichloroacetate	0.28		80	235
623	0.8		Vinyl isothiocyanate	0.5		—	197
624	0.67	0.03	1-Vinylnaphthalene	1.35	0.15	60	124
625	0.5	0.1	2-Vinylnaphthalene	1.4	0.1	60	172
626	8.73		Vinyl perfluorobutyrate	0.017		80	235
627	0.91		*m*-Vinylphenol	1.21		60	30
628	0.17	0.02	4-Vinylpyrimidine	1.2	0.1	60	164
629	0.49	0.14	2-Vinylquinoline	2.09	0.55	60	115
630	0.35	0.025	2-Vinylthiophene	3.10	0.45	60	224
			Tetrachloroethylene (M_1)				
631	0		Acrylonitrile	470.		60	50
632	0		Methyl acrylate	200.		60	141
633	0		Styrene	165.		50	36
634	0		Styrene	208		50	36
635	0		Styrene	185	20.	60	50
636	0		Styrene	66.4		90	36
637	0		Styrene	129.		90	36
638	0		Styrene	187		90	36
639	0		Vinyl acetate	6.8	0.5	60	50
640	0		Vinyl acetate	5.		68	3
			Tetrafluoroethylene (M_1)				
641	0.85		Ethylene	0.15		80	97
			Trichloroethylene (M_1)				
642	0		Acrylonitrile	67.		60	50
643	0		Methyl acrylate	33.		60	141

(*continued*)

TABLE I (*cont.*)

No.	r_1	±	M_2	r_2	±	°C.	Reference
644	0		Methyl methacrylate	100.		60	141
645	0		Styrene	16.5		50	36
646	0		Styrene	17.1		50	36
647	0		Styrene	16.	2.	60	50
648	0		Styrene	12.1		90	36
649	0		Styrene	12.7		90	36
650	0.01	0.01	Vinyl acetate	0.66	0.04	60	143
651	0		Vinyl acetate	0.67		68	3
			3,3,3-Trichloropropene (M_1)				
652	0.100	0.015	Acrylonitrile	12.2	1.2	60	51
653	0.0	0.02	Styrene	6.9	0.2	60	51
654	0.19	0.03	Vinyl acetate	0.19	0.04	60	51
			Triethoxyvinylsilane (M_1)				
655	0		Acrylonitrile	4.5		50	204
656	0		Acrylonitrile	5.	1.	60	187
657	0		Styrene	22.	5.	60	187
658	0		Vinyl chloride	0.9		50	204
			Trimethyl aconitate (M_1)				
659	−0.10	0.10	Acrylonitrile	5.50	0.50	60	132
660	0.00	0.01	Styrene	1.10	0.01	60	132
661	0.00	0.50	Vinyl chloride	0.15	0.10	60	132
662	0.01	0.10	Vinylidene chloride (M_1 = *trans*)	54.	5.	60	134
			Trimethylsiloxylvinyldimethylsilane (M_1)				
663	0.1		Acrylonitrile	8.0		50	166
664	0.1		Styrene	60.0		—	166
665	0.01		Vinyl acetate	0.99		70	166
			Bis(trimethylsiloxyl)vinylmethylsilane (M_1)				
666	0.1		Acrylonitrile	8.0		50	166
667	0.1		Styrene	60.0		—	166
668	0.01		Vinyl acetate	0.99		70	166
669	0.50		Vinyl chloride	0.90		50	166
			Tris(trimethylsiloxyl)vinylsilane (M_1)				
670	0.1		Acrylonitrile	8.0		50	166
671	0.1		Styrene	60.0		—	166
672	0.01		Vinyl acetate	0.99		70	166
673	0.50		Vinyl chloride	0.90		50	166
674	0.1		*N*-Vinylpyrrolidone	4.0		125	166
			Vinyl acetate (M_1)				
675	0.0		1-Acetoxy-1,3-butadiene	Very large		70	83
676	0.1		Acrolein	3.33		20	185
677	0.71		Allyl laurate	0.8		60	183

(*continued*

TABLE I (*cont.*)

No.	r_1	±	M_2	r_2	±	*T*, °C.	Reference
678	0.72		Diallyl phthalate	2.0		—	198
679	0.02		Di-*n*-butyl itaconate	6.3		—	43
680	0.6	15%	1,1-Dichloro-2,2-difluoroethylene	0	15%	70	6
681	0.17		Diisopropyl maleate	0.043		60	233
682	0.3	0.2	*dl*-Ethyl 2-methyl-2-ethyl-1-butenoate	3.2	0.50	60	199
683	0.1	0.1	*d*-Ethyl 2-methyl-2-ethyl-1-butenoate	2.2	0.4	60	199
684	0.14		Fumaryl chloride	0		70	83
685	0.522		Methyl acid maleate	0.035		56	216
686	1.5	0.24	Methyl bicyclo-[2,2,1]-2-heptene-5-carboxylate	0.45	0.07	60	106
687	0.015	0.015	Methyl methacrylate	20.	3.	60	143
688	0.28		Phenyl vinyl sulfone	0.35		60	174
689	0.01	0.01	Styrene	55.	10.	60	143
690	0.67		Vinyl isocaproate	1.14		79.6	116
691	0.6	0.2	Vinyl chloride	1.8	0.6	40	133
692	0.65	0.04	Vinyl chloride	1.35	0.05	40	111
693	0.23	0.02	Vinyl chloride	1.68	0.08	60	143
694	0.3		Vinyl chloride	2.1		68	3
695	0.0	0.03	Vinylidene chloride	3.6	0.5	60	50
696	0.1		Vinylidene chloride	6.		68	3
697	1.4		Vinyl laurate	0.7		60	183
698	1.15	0.13	Vinyl palmitate	0.78	0.10	70	168
699	0.97		Vinyl stearate (70%)–vinyl palmitate (30%)	1.00		50	1
700	0.6		Vinyl trifluoroacetate	0.32		60	81
701	0.33		*N*-Vinylurethane	0.33		65	71
			Vinyl benzoate (M_1)				
702	0.05	0.005	Acrylonitrile	5.0	0.05	75	42
703	0.05		Styrene	38.0		80	26
704	0.99	0.13	Vinyl acetate	0.35	0.09	60	221
705	1.5		Vinyl acetate	0.70		80	26
706	0.5		Vinyl chloride	1.7		40	111
707	0.28		Vinyl chloride	0.72		45	209
708	0.1	0.02	Vinylidene chloride	7.0	1.	50	42
709	0.008		Vinylidene cyanide	0.10		43	72
710	0.44	0.09	*N*-Vinylpyrrolidone	2.45	0.1	60	221
			Vinyl bromide (M_1)				
711	0.05	0.01	Methyl methacrylate	25.	2.	0	29
712	0.05	0.015	Methyl methacrylate	20.	2.	28	29
713	<0.05		Styrene	20–25		0	29
714	0.06	0.015	Styrene	18.	2.	28	29
715	4.5	1.2	Vinyl acetate	0.35	0.09	60	143

(*continued*)

TABLE I (*cont.*)

No.	r_1	±	M_2	r_2	±	T, °C.	Reference
			9-Vinylcarbazole (M_1)				
716	0.20	0.03	Methyl methacrylate	2.0	0.3	70	12
717	0.012	0.002	Styrene	5.5	0.8	70	12
718	2.680	0.100	Vinyl acetate	0.126	0.032	65	217
719	3.020	0.240	Vinyl acetate	0.152	0.018	100	217
720	1.280	0.060	Vinyl butyrate	0.059	0.020	100	217
721	4.220	0.160	Vinyl formate	0.196	0.004	100	217
722	1.680	0.140	Vinyl propionate	0.076	0.018	100	217
			Vinyl chloride (M_1)				
723	0.13	0.01	Abityl acrylate	4.2	0.2	60	137
724	2.0		Allyl triethoxy silane	0		50	204
725	0.4		2-Butenyltriethoxysilane	0		50	204
726	5.	15%	*tert*-Butylethylene	0.0		70	6
727	0.05		*n*-Butyl methacrylate	13.5		45	209
728	2.0	0.2	Isobutyl vinyl ether	0.02	0.01	50	42
729	1.13		1-Chloro-1-propene	0.24		50	207
730	0.75		2-Chloro-1-propene	0.58		50	207
731	0.2		α-Chlorovinyl triethoxy silane	0		50	204
732	0.4		Δ^3-Cyclohexenyl triethoxy silane	0		50	204
733	0.65	0.05	Diisobutyl maleate	0.1		75	110
734	1.4		Di-*n*-butyl maleate	0		40	109
735	1.0		Diethoxyethylvinylsilane	0		50	204
736	1.2		Diethoxymethylvinylsilane	0		50	204
737	0.7		Diethoxyphenylvinylsilane	0		50	204
738	0.42		Di-2-ethylhexyl maleate	0		68	3
739	0.14	0.01	Hydronopyl acrylate	4.3	0.2	60	137
740	0.02		Methyl methacrylate	15.		45	209
741	0		Methyl methacrylate	12.5		60	141
742	0.1		Methyl methacrylate	10.		68	3
743	0.12		*n*-Octyl acrylate	4.8		45	208
744	0.04		*n*-Octyl methacrylate	14.0		45	209
745	0.43		Pentachlorostyrene	5.3		—	206
746	5.		1-Pentene	<0.2		68	3
747	8.0		Propenyltriethoxysilane	0		50	204
748	0.067		Styrene	35.		48	41
749	0.077		Styrene	35.		50	41
750	0.02		Styrene	17.	3.	60	50
751	0.045		Styrene	12.4		—	206
752	1.6		6-Triethoxysilyl bicyclo-[2,2,1]-2-heptene	0		50	204
753	0.8		Trimethoxyvinylsilane	0		50	204
754	0.8		Triisopropoxyvinylsilane	0		50	204
755	1.35	0.05	Vinyl butyrate	0.65	0.04	40	111

(*continued*)

TABLE I (*cont.*)

No.	r_1	±	M_2	r_2	±	T, °C.	Reference
756	4.7		Vinyl caprate	0.2		40	111
757	1.8		Vinyl caproate	0.1		40	111
758	1.35	0.05	Vinyl caproate	0.65	0.04	40	111
759	3.2		Vinyl caprylate	0.2		40	111
760	0.2	0.2	Vinylidene chloride	1.8	0.5	45	177
761	0.2		Vinylidene chloride	4.5		50	207
762	0.3		Vinylidene chloride	3.2		60	141
763	0.14		Vinylidene chloride	Large		68	3
764	7.4		Vinyl laurate	0.2		40	111
765	1.40	0.004	Vinyl levulinate	0.419	0.002	60	130
766	1.35	0.05	Vinyl propionate	0.65	0.04	40	111
			Vinyl chloroacetate (M_1)				
767	0.09		Acrylonitrile	0.34		80	235
768	0.03		Styrene	45.		80	235
769	1.20		Vinyl acetate	0.73		60	61
770	0		Vinylidene cyanide	0.13		40	72
			Vinylene carbonate (M_1)				
771	0.005		Methyl methacrylate	70.0		70	89
772	0.0579		Vinyl acetate	3.71		55	127
773	0.013	0.10	Vinyl acetate	7.3	0.7	60	106
774	0.15		Vinyl acetate	4.00		70	82
775	0.27		Vinyl acetate	3.0		70	89
776	0.09		Vinyl chloride	5.2		80	89
777	0.4		*N*-Vinylpyrrolidone	0.7		60	89
778	0.04	0.01	Vinyl thiolacetate	12.9	1.1	60	163
			Vinylidene chloride (M_1)				
779	33.		*n*-Butyl crotonate	0		70	55
780	0.35		*n*-Butyl methacrylate	2.2		68	3
781	Very large		Coumarin	0		70	6
782	17.		Crotonaldehyde	0		70	55
783	4.8	0.2	Dimethallyl oxalate	0.16	0.01	40	38
784	0.35		Ethyl methacrylate	2.2		68	3
785	2.6		4-Hydroabietyl alcohol	0		70	55
786	0.24	0.03	Methyl methacrylate	2.53	0.1	60	120
787	20.		*n*-Propyl crotonate	0		70	55
788	0.145	0.009	Styrene	2.1	0.2	50	205
789	0.085	0.010	Styrene	1.85	0.05	60	50
790	0.14	0.05	Styrene	2.0	0.1	60	120
791	1.8		Vinylcyclohexene	0		70	55
			Vinylidene cyanide (M_1)				
792	0.20		2-Chloro-1-propene	0		40	72
793	0.0307		Methyl methacrylate	0.0455		—	59
794	0.031		Methyl methacrylate	0.046		50	72
795	0.0459		Styrene	0		—	147
796	0.001		Styrene	0.005		45	72

(*continued*)

TABLE I (*cont.*)

No.	r_1	±	M_2	r_2	±	T, °C.	Reference
797	0.11		Vinyl acetate	0.0054		45	72
798	0.72		Vinyl chloride	0.0093		—	60
799	0.54		Vinyl chloride	0.017		50	72
800	0.049		Vinylidene chloride	0.012		22	72
			Vinyl isocyanate (M_1)				
801	0.16		Acrylonitrile	0.19		60	101
802	0.14		Methyl acrylate	1.38		60	101
803	0.01		Methyl methacrylate	3.3		—	227
804	0.16		Methyl methacrylate	5.57		60	101
805	0.1		Styrene	6.9		—	227
806	0.08		Styrene	8.13		60	101
807	0.33		Vinylidene chloride	1.46		60	101
			N-Vinyl-2-oxazolidone (M_1)				
808	0.015	0.05	Decyl methacrylate	12.8	0.5	50	31
809	0.035	0.015	Methyl methacrylate	9.6	0.2	50	31
810	0.03		Methyl methacrylate	6.00		75	88
811	0.05	0.05	Styrene	30.0	0.5	50	31
812	1.90	0.10	Vinyl acetate	0.52	0.08	50	31
813	1.50		Vinyl acetate	0.60		75	88
814	0.35	0.02	Vinyl chloride	0.84	0.02	50	31
815	0.08		Vinylidene chloride	1.35		75	88
			Vinyl pelargonate (M_1)				
816	0.059	0.059	Acrylonitrile	3.57	0.16	60	130
817	0.01	0.01	Styrene	49.5	15.	60	130
818	0.282	0.035	Vinyl chloride	1.16	0.06	60	130
819	0.0	0.01	Vinylidene chloride	4.08	0.20	60	130
			Vinyl pinonate (M_1)				
820	0.143	0.046	Acrylonitrile	3.40	0.04	60	130
821	0.01	0.01	Styrene	65.	17.	60	130
822	0.446	0.028	Vinyl chloride	1.458	0.04	60	130
823	0.030	0.028	Vinylidene chloride	3.00	0.18	60	130
			2-Vinylpyridine (M_1)				
824	0.47	0.03	Acrylonitrile	0.113	0.002	60	103
825	21.88	5.52	Acrylonitrile	0.05	0.01	60	115
826	0.63	0.07	Dichlorostyrenes (mixed)	0.11	0.07	60	2
827	1.5	0.5	2-Ethyl-1-vinylacetylene	0.6	0.1	60	173
828	1.65	0.05	Isopropenylacetylene	0.55	0.1	60	173
829	1.58	0.05	Methyl acrylate	0.168	0.003	60	200
830	2.03	0.49	Methyl acrylate	0.20	0.09	60	2
831	0.86	0.06	Methyl methacrylate	0.395	0.025	60	224
832	0.77	0.02	Methyl methacrylate	0.439	0.002	60	200
833	0.70	15%	Methyl methacrylate	0.33	15%	70	6
834	1.135	0.08	Styrene	0.55	0.025	60	224

(*continued*)

TABLE I (*cont.*)

No.	r_1	±	M_2	r_2	±	T, °C.	Reference
835	1.14		Styrene	0.55		60	164
836	1.81	0.05	Styrene	0.55	0.03	60	115
837	0.9	0.2	Styrene	0.56	0.02	60	200
838	10.0		Vinyl acetate	0.3		—	156
839	30.	15%	Vinyl acetate	0		70	,6
			4-Vinylpyridine (M_1)				
840	0.41	0.09	Acrylonitrile	0.113	0.005	60	103
841	1.7	0.2	Methyl acrylate	0.22	0.01	60	200
842	0.79	0.05	Methyl methacrylate	0.574	0.004	60	200
843	0.7	0.1	Styrene	0.54	0.03	60	200
844	0.52	0.06	Styrene	0.62	0.02	80	69
845	0.30	0.02	*N,N,N*-Triethyl-*N*-(2-methacryloxyethyl)-ammonium iodide	0.61	0.09	60	163
			N-Vinylpyrrolidone (M_1)				
846	0.041	0.024	Methyl acrylate	0.27	0.16	60	92
847	0.005	0.05	Methyl methacrylate	4.7	0.5	50	31
848	0.045	0.05	Styrene	15.7	0.5	50	31
849	0.11		Styrene	9.0		80	104
850	3.30	0.15	Vinyl acetate	0.205	0.015	50	31
851	0.44		Vinyl acetate	0 38		70	89
852	0.53		Vinyl chloride	0.38		—	35
853	0.38		Vinyl chloride	0.53		50	31
854	2.0		*N*-Vinylurethane	0.42		65	71
			Vinyl stearate (M_1)				
855	0.064	0.005	Acrylonitrile	4.20	0.02	60	130
856	0.03		Acrylonitrile	4.3		70	233
857	0		Diisopropyl maleate	0.0075		70	233
858	0.03		Methyl acrylate	5.8		70	233
859	0.01	0.01	Styrene	68.	30.	60	130
860	0.73		Vinyl acetate	0.90		70	233
861	0.290	0.025	Vinyl chloride	0.745	0.025	60	130
862	0.075	0.025	Vinylidene chloride	3.80	0.05	60	130
			N-Vinylsuccinimide (M_1)				
863	0.16		Acrylonitrile	0.54		60	70
864	15.		*n*-Butyl vinyl ether	0		60	70
865	0.4		Methyl acrylate	1.2		60	70
866	0.09		Styrene	7.0		60	70
867	6.05		Vinyl acetate	0.18		60	70
			Vinyl undecylenate (M_1)				
868	0.0	0.010	Acrylonitrile	1.82	0.04	60	130
869	0.031	0.026	Methyl acrylate	3.69	0.12	60	130
870	0.02	0.02	Styrene	29.	9.	60	130
871	0.358	0.065	Vinyl chloride	1.06	0.05	60	130
872	0.054	0.030	Vinylidene chloride	2.58	0.09	60	130

which have been determined at the Dow Chemical Company but not published. No attempt has been made to evaluate the quality of the work cited. Rather, the values are reported as found in the references cited. The values herein have been restricted to those for free-radical copolymerization, although there have been many good articles in the past few years on ionic copolymerization. The monomers are arranged alphabetically in a rather arbitrary manner. Rather than listing them under the more common monomers, e.g., styrene or acrylonitrile, it was felt that each monomer should be listed under its own name with values for the more common comonomers included thereunder. For example, instead of listing the ratios for butyl acrylate under acrylonitrile, styrene, and vinyl chloride, these ratios are listed under butyl acrylate. Thus one needs not look under several "standard" monomers to find out whether butyl acrylate has been run against them. Consequently, the values listed under styrene and acrylonitrile are limited to those for monomers which were determined only against styrene or acrylonitrile. Where only one or two sets of ratios were available it was not deemed necessary to give this monomer a separate listing. Actually, the monomer index in Table II eliminates the need for "searching" the Table I for any given monomer. The ratios in Table I are all numbered consecutively and indexed in Table II.

Copolymerization Parameters

Since the relative reactivity ratios depend on the system used for their determination, they would have to be determined experimentally for each monomer pair which is of interest. The need for more general and constant factors by which a given monomer could be characterized has led to the development of the copolymerization parameters, Q and e, by Alfrey and Price [*J. Polymer Sci.*, **2,** 101 (1947)]. Since Q is a measure of the general reactivity of the monomer, and e depends on the polar properties of the monomer, these two parameters should be constant and unique for a given monomer, regardless of the copolymerization system. The merits and demerits of the Alfrey-Price relationship have been discussed adequately many times, so we will not argue the point further. However, as Mayo and Walling have pointed out [*Chem. Revs.*, **46,** 191 (1950); see p. 242], reasonable "guestimates" of Q and e may be perfectly usable for estimating monomer reactivity ratios since the calculated polymer compositions are fairly insensitive to these ratios. Table III contains calculated values of Q and e for most of the monomers whose reactivity ratios are known and available. The values were calculated from the data in Table I by the use of the following two equations:

$$e_2 = e_1 \pm (-\ln r_1 r_2)^{1/2}$$

and

$$Q_2 = Q_1/r_1 \exp\left\{-e_1(e_1 - e_2)\right\}$$

(turn to page 443)

TABLE II
Monomer Index

Monomer	Run number (Table I)	Monomer number (Table III)
Abityl acrylate	723	226
Acenaphthalene	548	59
α-Acetoxyacrylonitrile	19, 549	212
1-Acetoxy-1,3-butadiene	20, 675	—
α-Acetoxystyrene	21	79
p-Acetylaminostyrene	467	42
Acrolein	1, 22, 436, 676	220
Acrylamide	1–7	245
Acrylic acid	2, 3, 8–18	210
Acrylonitrile	4, 8, 9, 19–95, 106–107, 116, 118–21, 168–69, 195–96, 236, 258–60, 278, 286, 301, 308, 315–7, 322, 329, 341, 344–45, 352, 371, 398, 420, 459, 462, 518, 521, 536, 539, 543, 631, 642, 652, 655–6, 659, 663, 666, 670, 702, 767, 801, 816, 820, 824–25, 840, 855–56, 863, 868	237
Allyl acetate	96–105	30
Allyl alcohol	23	168
Allyl chloride	106–14	157
Allyl chloroacetate	468	96
Allyl laurate	677	191
Allyltriethoxysilane	24, 724	44
n-Amyl methacrylate	399	117
Anethole	115	—
α-Angelolactone	25	—
β-Angelolactone	26	—
N-(*p*-Anisyl)methacrylamide	469	26
N-Benzylidene-4-methacryloxyaniline	550	219
1,1-Bis(*p*-anisyl)ethylene	116, 117	1
1,1-Bis(*p*-chlorophenyl)ethylene	29, 438	53
trans-1,2-Bis(pyridyl)ethylene	65, 613	19
2,5-Bis(trifluoromethyl)styrene	513, 617	146
Bis(trimethylsiloxy)vinylmethylsilane	230, 666–69	64
m-Bromostyrene	470, 551	131
p-Bromostyrene	471, 552	114
β-Bromovinyl ethyl ether	553	124
1,3-Butadiene	118–67	37
2-Butenyltriethoxysilane	27, 725	21
Butyl acrylate	122, 168–78	229
n-Butyl cinnamate	554	208
n-Butyl crotonate	779	169
tert-Butylethylene	726	82
N-Butyl maleimide	472, 555	261
n-Butyl methacrylate	401, 556–58, 727, 780	128
tert-Butyl methacrylate	402	115

(*continued*)

TABLE II (*cont.*)

Monomer	Run number (Table I)	Monomer number (Table III)
n-Butyl vinyl ether	864	5
tert-Butyl vinyl ether	28	9
n-Butyl vinylsulfonate	179–83	236
2-Chloroallyl acetate	10, 184–88	31
2-Chloroallyl alcohol	386, 473, 559	195
2-Chloroallyl chloride	189–94	182
2-Chlorobenzalacetophenone	123	227
β-Chloroethyl acrylate	96, 424, 437, 560	193
N-(*p*-Chlorophenyl)methacrylamide	474	41
Chloroprene	124, 195–214	150
1-Chloro-1-propene	729	17
2-Chloro-1-propene	730, 792	217
m-Chlorostyrene	475, 561	109
o-Chlorostyrene	115, 342, 387, 403, 476, 562	110
p-Chlorostyrene	125, 215–26	116
Chlorotrifluoroethylene	227–35	250
4-Chloro-1-vinylnaphthalene	477, 563	118
6-Chloro-2-vinylnaphthalene	478, 564	138
α-Chlorovinyltriethoxysilane	30, 731	160
Cinnamonitrile	565	207
3-Cinnamoylpyridine	566	213
Citraconic anhydride	567	260
Coumarin	781	—
Crotonaldehyde	782	171
Crotonic acid	236–40	184
γ-Crotonolactone	568	—
1-Cyano-1,3-butadiene	126	167
p-Cyanostyrene	479, 569	132
Δ^3-Cyclohexenyltriethoxysilane	31, 732	93
Decyl methacrylate	808	186
Diallyl phthalate	678	172
4,6-Diamino-2-vinyl-*s*-triazine	522	262
Dibutyl itaconate	295, 480, 679	248
Diisobutyl maleate	733	266
Di-*n*-butyl maleate	734	255
2,3-Dichloro-1,3-butadiene	302, 481, 570	187
1,1-Dichloro-2,2-difluoroethylene	572, 680	271
cis-Dichloroethylene	241–48	240
trans-Dichloroethylene	249–57	242
Di-β-chloroethyl itaconate	482, 571	253
2,5-Dichlorostyrene	127–28, 258–77, 439, 826	155
Diethoxyethylvinylsilane	32, 735	111
Diethoxymethylvinylsilane	33, 736	51
Diethoxyphenylvinylsilane	34, 737	106
Diethylaminoethyl methacrylate	388, 547	181
Diethyl chloromaleate	573	258
Diethyleneglycol monovinyl ether	35	14
Diethyl fumarate	129, 197, 278–85	241

(*continued*)

TABLE II (*cont.*)

Monomer	Run number (Table I)	Monomer number (Table III)
Di-2-ethylhexyl maleate	738	231
Diethyl maleate	130, 286–94	251
Diethylvinylphosphonate	574	166
1,1-Dihydroperfluorobutyl acrylate	131, 483, 575	234
N-(1,1-Dihydroperfluorobutyl)-*N*-ethyl acrylamide	484	228
Dimethallyl oxalate	783	136
2,4-Dimethoxy-6-(β-itaconylhydrazino)-*s*-triazine	36	135
p-Dimethylaminostyrene	485, 576	16
2-(*N*,*N*-Dimethylamino)-4-vinylpyrimidine	577	152
2,3-Dimethyl-1,3-butadiene	132, 578	3
Dimethyl dithiolfumarate	133, 579	264
Dimethyl fumarate	580	252
Dimethyl itaconate	170, 215, 295–300	247
Dimethyl maleate	581	174
Dimethyl methacrylyliminodiacetate	486	257
2,5-Dimethylstyrene	261	52
Dinonyl fumarate	134	104
Dinonyl maleate	135	103
Diphenylacetylene	37, 440	24
1,1-Diphenylethylene	198, 301–303	15
Diisopropyl maleate	681, 857	270
m-Divinylbenzene	582	4
Divinyl sulfide	487, 583	33
1,4-Divinyl-2,3,5,6-tetrachlorobenzene	584	—
Dodecyl acrylate	38	—
Ethyl α-acetoxyacrylate	304–307	183
Ethyl acid fumarate	585	224
Ethyl acid maleate	586	254
Ethyl acrylate	108, 304, 308–14	163
Ethyl α-cyanocinnamate	136	218
Ethylene	641	130
Ethyleneglycol dimethacrylate	587	180
Ethyl β-ethoxyacrylate	39	145
Ethyl 2-ethyl-2-methyl-1-butenoate	682–83	189
N-Ethyl methacrylamide	488	47
Ethyl methacrylate	404, 588–89, 784	159
Ethyl methacrylylaminoacetate	489	194
2-Ethyl-1-vinylacetylene	40, 827	120
Ethyl vinyl ether	315–21	28
5-Ethyl-2-vinylpyridine	322–25	69
Ethyl vinyl sulfide	490, 590	139
N-Ethyl-*N'*-vinylurea	326–28	10
2-Fluoro-1,3-butadiene	329–34	98
Fumaronitrile	335–40	268
Fumaryl chloride	591, 684	—

(*continued*)

TABLE II (*cont.*)

Monomer	Run number (Table I)	Monomer number (Table III)
Glycidyl methacrylate	491	149
Hexachloro-1,3-butadiene	199, 200, 592	209
1-Hexene	41, 441	122
n-Hexyl methacrylate	405	140
1-Hexyne	42, 442	71
4-Hydroabietyl alcohol	785	57
Hydronopyl acrylate	43, 137, 593, 739	204
Indene	341–43	39
p-Iodostyrene	492, 594	102
Isobutylene	344–51	43
Isobutyl methacrylate	400	147
Isobutyl vinyl ether	728	8
Isoprene	138, 201, 330, 352–60	25
Isopropenyl acetate	361–64	92
Isopropenylacetylene	44, 828	134
Isopropenyl isocyanate	309, 365–70	40
β-Isopropenylnaphthalene	45, 493	38
Isopropyl methacrylate	412	137
Isopropyl vinyl ether	204	22
Isostilbene	377	148
Itaconic acid	494, 595	201
Maleic anhydride	97–98, 184, 361, 371–85	272
Maleonitrile	596	273
Methacrolein	46	126
Methacrylamide	389–91, 495	239
Methacrylic acid	139, 189, 386–97	203
Methacrylonitrile	140, 216, 296, 392–93, 398–419	214
4-Methacryloxybenzylideneaniline	597	142
4-Methacryloxybenzylidene-4′-chloroaniline	598	84
Methacryloxymethylpentamethyldisiloxane	420–23	161
N-Methacryloyl-ε-caprolactam	599	246
Methallyl acetate	424–27	20
Methallyl chloride	428–32	46
p-Methoxystyrene	217, 433–35	34
Methyl acid maleate	685	263
Methyl acrylate	47–52, 99, 117, 141, 179, 185, 202, 262, 303, 318, 323, 365–66, 372–73, 436–58, 527, 540, 632, 643, 802, 829–30, 841, 846, 858, 865, 869	199
Methyl bicyclo-[2,2,1]-2-heptene-5-carboxylate	53, 686	165
Methyl α-chloroacrylate	459–61	211
Methyl 2-chlorocinnamate	142–43	216
Methyl 4-chlorocinnamate	144	202
Methyl cinnamate	54, 600	188

(*continued*)

TABLE II (*cont.*)

Monomer	Run number (Table I)	Monomer number (Table III)
2-Methyl-5-cinnamoylpyridine	601	223
β-Methylene-β-propiolactone	55	—
Methyl isopropenyl ketone	462–66	192
N-Methyl methacrylamide	496	85
Methyl methacrylate	56–57, 100, 109, 145–47, 186, 190–91, 203, 218–19, 227, 263, 287, 297–98, 305, 324, 326, 331, 335, 362, 367, 374–75, 406–408, 421, 425, 428, 433–34, 460, 467–517, 519–20, 530, 537, 644, 687, 711–12, 716, 740–42, 771, 786, 793–94, 803–804, 809–10, 831–33, 842, 847	177
α-Methylstyrene	220, 264, 332, 336, 409–10, 463, 518–20	23
m-Methylstyrene	59, 497	70
o-Methylstyrene	58	66
p-Methylstyrene	60, 221, 498	48
Methyl thiolacrylate	148	198
Methyl vinyl ketone	171, 265, 521–26	205
2-Methyl-5-vinylpyridine	61, 149	90
Methyl vinyl sulfide	527–29	12
Methyl vinyl sulfone	530–35	244
Methyl vinyl sulfoxide	602	225
N-Methyl-*N*-vinyl-*p*-toluenesulfonamide	536–38	35
m-Nitrostyrene	222, 499, 603	215
p-Nitrostyrene	223, 604	176
Nonyl methacrylate	150	158
Octadecyl acrylate	62	—
n-Octyl acrylate	743	221
n-Octyl methacrylate	411, 744	119
Pentachlorophenyl vinyl sulfide	443, 605	87
Pentachlorostyrene	500, 606, 745	190
1-Pentene	746	83
Phenylacetylene	539–42	76
N-Phenyl methacrylamide	501	65
Phenyl vinyl sulfide	444, 607	13
Phenyl vinyl sulfone	608, 688	235
Poly(1,3-butyleneglycol fumarate)	609	206
Poly(ethyleneglycol fumarate)	502	259
p-Potassium styrenesulfonate	63, 610–11	2
Propenyltriethoxysilane	64, 747	36
n-Propyl crotonate	787	170
n-Propyl methacrylate	413	99
3-Pyridalacetophenone	612	200
Sodium acrylate	5, 310, 543–46	141
Sodium methacrylate	547	27

(*continued*)

TABLE II (*cont.*)

Monomer	Run number (Table I)	Monomer number (Table III)
Sodium styrenesulfonate	11, 66, 545	86
Sodium vinylsulfonate	6, 544	178
Stearyl methacrylate	414	196
Stilbene	376	100
Styrene	12–14, 67–75, 101, 110, 151–58, 172–73, 180, 187, 192–93, 205–207, 224–26, 228, 237, 241–45, 249–54, 266–73, 279–81, 288–91, 299, 306, 311–13, 319, 325, 327, 333–34, 337–40, 353–58, 368–69, 378–80, 394, 415–18, 422, 426, 429, 435, 445–49, 464–65, 503–10, 523, 528, 531–33, 538, 548–630, 633–38, 645–49, 653, 657, 660, 664, 667, 671, 689, 703, 713–14, 717, 748–51, 768, 788–90, 795–96, 805–806, 811, 817, 821, 834–37, 843–44, 848–49, 859, 866, 870	61
p-Sulfonamidostyrene	614	175
Tetrachloroethylene	631–40	269
Tetrafluoroethylene	229, 346, 641	238
N-(*p*-Tolyl)methacrylamide	511	67
Trichloroethylene	642–51	267
3,3,3-Trichloro-1-propene	282, 652–54	249
6-Triethoxysilyl bicyclo-[2,2,1]-2-heptene	76, 752	113
Triethoxyvinylsilane	655–58	97
Triethyl aconitate	159, 615	265
N,*N*,*N*-Triethyl-*N*-(2-methacryloxyethyl]-ammonium iodide	845	232
3-Trifluoromethylstyrene	512, 616	121
α,β,β-Trifluorostyrene	618	222
p-Trimethoxysilylstyrene	619	49
Trimethoxyvinylsilane	77, 753	105
Trimethyl aconitate	160, 659–62	233 (*trans*), 256 (*cis*)
Trimethylsiloxyvinyldimethylsilane	663–65	56
p-Trimethylsilylstyrene	620	60
Trimethylvinylsilane	78, 621	151
Triisopropoxyvinylsilane	79, 754	108
Tris(trimethylsiloxyl)vinylsilane	231, 670–74	73
Vinyl acetate	15, 16, 80–85, 102–103, 111, 181, 208, 232, 238–39, 246–47, 255–56, 274, 283, 292, 307, 320, 328, 363, 381–82, 395, 419, 423, 430,	129

(*continued*)

TABLE II (*cont.*)

Monomer	Run number (Table I)	Monomer number (Table III)
	450–51, 524, 534–35, 546, 639–40, 650–51, 654, 665, 668, 672, 675–701, 704–705, 715, 718–19, 769, 772–75, 797, 812–13, 838–39, 850–51, 860, 867	
Vinyl acetylene	86	101
Vinyl benzoate	702–10	89
Vinyl bromide	711–15	127
Vinyl butyrate	209, 720, 755	179
Vinyl caprate	756	144
Vinyl caproate	757–58	80
Vinyl isocaproate	690	68
Vinyl caprylate	759	95
9-Vinylcarbazole	112, 194, 275, 716–22	18
Vinyl chloride	87–90, 104,161, 174, 182, 188, 233, 284, 293–94, 300, 347–49, 364, 383, 431, 452–55, 525, 658, 661, 669, 673, 691–94, 706–707, 723–66, 776, 798–99, 814, 818, 822, 852–53, 861, 871	162
Vinyl chloroacetate	767–70	78
Vinylcyclohexene	791	6
Vinyl dichloroacetate	91, 622	75
Vinylene carbonate	529, 771-78	77
Vinyl 2-ethylhexanoate	92	123
Vinyl fluoride	234	243
Vinyl formate	93, 162, 210, 721,	54
Vinylidene chloride	94, 105, 113–14, 163, 175–76, 183, 235, 240, 285, 321, 343, 350, 370, 384, 396, 427, 432, 456–57, 466, 526, 541, 662, 695–96, 708, 760–63, 779–91, 800, 807, 815, 819, 823, 862, 872	173
Vinylidene cyanide	17, 211, 248, 257, 276, 351, 385, 461, 709, 770, 792–800	274
Vinyl isocyanate	801–807	72
Vinyl isothiocyanate	7, 95, 623	164
Vinyl laurate	697, 764	153
Vinyl levulinate	765	91
2-Vinylmercaptobenzothiazole	458	45
1-Vinylnaphthalene	624	32
2-Vinylnaphthalene	514, 625	107
N-Vinyl-2-oxazolidinone	808–15	58
Vinyl palmitate	698, 699	156
Vinyl pelargonate	164, 816–19	74
Vinyl perfluorobutyrate	626	197
2-Vinylphenanthrene	515	50

(*continued*)

TABLE II (*cont.*)

Monomer	Run number (Table I)	Monomer number (Table III)
3-Vinylphenanthrene	516	154
m-Vinylphenol	627	62
Vinyl pinonate	165, 820–23	112
Vinyl propionate	212, 722, 766	143
2-Vinylpyridine	177, 213, 277, 314, 359, 397, 542, 824–39	94
4-Vinylpyridine	178, 840–45	133
4-Vinylpyrimidine	628	185
N-Vinylpyrrolidone	18, 674, 710, 777, 846–54	29
2-Vinylquinoline	214, 360, 629	55
Vinyl stearate	166, 699, 855–62	88
N-Vinylsuccinimide	863–67	125
Vinylsulfonic acid	517	—
Vinyl thiolacetate	778	11
2-Vinylthiophene	630	63
Vinyl trifluoroacetate	700	230
Vinyl undecylenate	167, 868–72	81
N-Vinylurethane	701, 854	7

The resulting values of Q and e were then averaged and the arithmetic mean listed in Table III. Where r_1 or r_2 is reported as zero, some small, finite value was assumed in order to obtain a reasonable value for e. These assumptions seem to be justifiable in view of the fact that maleic anhydride has been shown [Bartlett and Nozaki, *J. Am. Chem. Soc.*, **68**, 1495 (1946)] to polymerize under the appropriate conditions, and that many of the same monomers whose ratios were considered to be zero by some authors have been reported with finite ratios by other authors. Also, when the product r_1r_2 was greater than 1.0, it became necessary to assume that it *was* 1.0 (or slightly less) in order to solve for the square root term in the equation for e. More accurate values might have been arrived at by plotting Q versus e and allowing for uncertainties, etc., but for the purpose of being able to calculate rough copolymer compositions, it was felt that the extra labor involved would not be justified in this case. To be sure, there may be errors in the values reported herein, especially for those monomers for which the only data available show r_2 equal to zero. Also, where only one pair of reactivity ratios was available, it became necessary to select the positive or negative value for e on the basis of personal preference or similarity to other, better-characterized monomers. Often, the value listed, in this case, is the one chosen by the original author, even though the alternate value may have some arguments in its favor. A particular monomer in Table III may perhaps be found most rapidly by reference to the monomer Index (Table II).

(*References, page 449*)

TABLE III
Copolymerization Parameters

No.	Monomer	e	Q	Notes
1	1,1-Bis(p-anisyl)ethylene	−1.96	1.46	a
2	p-Potassium styrenesulfonate	−1.92	107.15	
3	2,3-Dimethyl-1,3-butadiene	−1.81	5.86	
4	m-Divinylbenzene	−1.77	3.35	b
5	n-Butyl vinyl ether	−1.64	0.014	a,b
6	Vinyl cyclohexene	−1.64	0.060	a,b
7	N-Vinylurethane	−1.62	0.12	
8	Isobutyl vinyl ether	−1.59	0.015	b
9	*tert*-Butyl vinyl ether	−1.58	0.15	b
10	N-Ethyl-N'-vinylurea	−1.53	0.13	
11	Vinyl thiolacetate	−1.46	0.31	b
12	Methyl vinyl sulfide	−1.45	0.32	
13	Phenyl vinyl sulfide	−1.40	0.34	
14	Diethyleneglycol monovinyl ether	−1.39	0.046	b
15	1,1-Diphenylethylene	−1.38	1.60	c
16	p-Dimethylaminostyrene	−1.37	1.51	
17	1-Chloro-1-propene	−1.34	0.049	b
18	9-Vinyl carbazole	−1.34	0.44	
19	*trans*-1,2-Bis(2-pyridyl)ethylene	−1.34	0.66	
20	Methyallyl acetate	−1.33	0.037	a
21	2-Butenyltriethoxysilane	−1.32	0.040	a
22	Isopropyl vinyl ether	−1.31	45.40	b
23	α-Methylstyrene	−1.27	0.98	
24	Diphenylacetylene	−1.23	0.0025	a
25	Isoprene	−1.22	3.33	
26	N-(p-Anisyl)methacrylamide	−1.19	2.80	b
27	Sodium methacrylate	−1.18	1.36	
28	Ethyl vinyl ether	−1.17	0.032	c
29	N-Vinylpyrrolidone	−1.14	0.14	
30	Allyl acetate	−1.13	0.028	c
31	2-Chloroallyl acetate	−1.12	0.53	a
32	1-Vinylnaphthalene	−1.12	1.94	b
33	Divinyl sulfide	−1.11	0.58	
34	p-Methoxystyrene	−1.11	1.36	
35	N-Methyl-N-vinyl-p-toluene-sulfonamide	−1.10	0.082	a
36	Propenyltriethoxysilane	−1.08	0.0034	a
37	1,3-Butadiene	−1.05	2.39	
38	β-Isopropenylnaphthalene	−1.04	0.92	c
39	Indene	−1.03	0.36	c
40	Isopropenyl isocyanate	−1.02	0.23	
41	N-(p-Chlorophenyl)methacryl-amide	−0.98	0.70	b
42	p-Acetylaminostyrene	−0.98	1.43	b
43	Isobutylene	−0.96	0.033	c
44	Allyltriethoxysilane	−0.94	0.024	a
45	2-Vinylmercaptobenzothiazole	−0.92	1.68	b
46	Methallyl chloride	−0.91	0.12	a
47	N-Ethyl methacrylamide	−0.88	0.70	b
48	p-Methylstyrene	−0.88	1.10	

(*continued*)

TABLE III (*cont.*)

No.	Monomer	*e*	*Q*	Notes
49	*p*-Trimethoxysilylstyrene	−0.88	1.50	b
50	2-Vinylphenanthrene	−0.87	4.44	b
51	Diethoxymethylvinylsilane	−0.86	0.020	a
52	2,5-Dimethylstyrene	−0.84	0.95	b
53	1,1-Bis(*p*-chlorophenyl)ethylene	−0.84	2.16	a
54	Vinyl formate	−0.83	0.20	
55	2-Vinylquinoline	−0.82	3.79	
56	Trimethylsiloxylvinyldimethylsilane	−0.81	0.034	
57	4-Hydroabietyl alcohol	−0.80	0.056	a,b
58	*N*-Vinyl-2-oxazolidinone	−0.80	0.057	
59	Acenaphthalene	−0.80	0.26	b
60	*p*-Trimethylsilylstyrene	−0.80	1.0	b
61	Styrene	(−0.80)	(1.00)	assumed
62	*m*-Vinylphenol	−0.80	1.10	b
63	2-Vinylthiophene	−0.80	2.86	b
64	Bis(trimethylsiloxyl)vinylmethylsilane	−0.78	0.036	
65	*N*-Phenyl methacrylamide	−0.78	0.85	b
66	*o*-Methylstyrene	−0.78	0.90	b
67	*N*-(*p*-Tolyl)methacrylamide	−0.76	1.20	b
68	Vinyl isocaproate	−0.74	0.043	b
69	5-Ethyl-2-vinylpyridine	−0.74	1.37	
70	*m*-Methylstyrene	−0.72	0.91	
71	1-Hexyne	−0.70	0.014	a
72	Vinyl isocyanate	−0.70	0.16	
73	Tris(trimethylsiloxyl)vinylsilane	−0.69	0.030	
74	Vinyl pelargonate	−0.68	0.037	c
75	Vinyl dichloroacetate	−0.68	0.17	
76	Phenylacetylene	−0.66	0.35	
77	Vinylene carbonate	−0.65	0.0073	
78	Vinyl chloroacetate	−0.65	0.074	c
79	α-Acetoxystyrene	−0.65	0.82	b
80	Vinyl caproate	−0.64	0.022	
81	Vinyl undecylenate	−0.64	0.035	c
82	*tert*-Butylethylene	−0.63	0.007	a,b
83	1-Pentene	−0.63	0.074	a,b
84	4-Methacryloxybenzylidene-4′-chloroaniline	−0.63	4.83	b
85	*N*-Methyl methacrylamide	−0.60	0.32	b
86	Sodium styrenesulfonate	−0.59	2.49	
87	Pentachlorophenyl vinyl sulfide	−0.58	0.22	
88	Vinyl stearate	−0.57	0.034	
89	Vinyl benzoate	−0.55	0.061	
90	2-Methyl-5-vinylpyridine	−0.55	1.22	
91	Vinyl levulinate	−0.53	0.027	b
92	Isopropenyl acetate	−0.50	0.045	
93	Δ^3-Cyclohexenyltriethoxysilane	−0.50	0.050	a
94	2-Vinylpyridine	−0.50	1.30	
95	Vinyl caprylate	−0.47	0.012	b

(*continued*)

TABLE III (*cont.*)

No.	Monomer	*e*	*Q*	Notes
96	Allyl chloroacetate	−0.43	0.011	a,b
97	Triethoxyvinylsilane	−0.42	0.028	a
98	2-Fluoro-1,3-butadiene	−0.42	2.10	
99	*n*-Propyl methacrylate	−0.41	1.47	b
100	Stilbene	−0.40	0.020	b
101	Vinylacetylene	−0.40	0.69	b
102	*p*-Iodostyrene	−0.40	1.17	
103	Dinonyl maleate	−0.39	0.22	b
104	Dinonyl fumarate	−0.39	0.60	b
105	Trimethoxyvinylsilane	−0.38	0.031	a
106	Diethoxyphenylvinylsilane	−0.38	0.034	a
107	2-Vinylnaphthalene	−0.38	1.25	
108	Triisopropoxyvinylsilane	−0.36	0.031	a
109	*m*-Chlorostyrene	−0.36	1.03	
110	*o*-Chlorostyrene	−0.36	1.28	
111	Diethoxyethylvinylsilane	−0.35	0.011	a,b
112	Vinyl pinonate	−0.35	0.034	
113	6-Triethoxysilyl bicyclo-[2,2,1]-2-heptene	−0.35	0.072	a
114	*p*-Bromostyrene	−0.35	1.10	
115	*tert*-Butyl methacrylate	−0.35	1.18	b
116	*p*-Chlorostyrene	−0.33	1.03	
117	*n*-Amyl methacrylate	−0.32	0.82	b
118	4-Chloro-1-vinylnaphthalene	−0.31	0.74	
119	*n*-Octyl methacrylate	−0.31	0.78	
120	2-Ethyl-1-vinylacetylene	−0.29	0.60	
121	3-Trifluoromethylstyrene	−0.29	0.92	
122	1-Hexene	−0.28	0.019	a
123	Vinyl-2-ethylhexanoate	−0.26	0.008	b
124	β-Bromovinyl ethyl ether	−0.26	0.017	b
125	*N*-Vinylsuccinimide	−0.26	0.15	
126	Methacrolein	−0.26	1.70	b
127	Vinyl bromide	−0.25	0.047	
128	*n*-Butyl methacrylate	−0.23	0.72	
129	Vinyl acetate	−0.22	0.026	
130	Ethylene	−0.21	0.010	b
131	*m*-Bromostyrene	−0.21	1.07	
132	*p*-Cyanostyrene	−0.21	1.86	
133	4-Vinylpyridine	−0.20	0.82	
134	Isopropenylacetylene	−0.18	0.54	
135	2,4-Dimethoxy-6-(β-itaconyl-hydrazino)-*s*-triazine	−0.17	0.52	b
136	Dimethallyl oxalate	−0.15	0.038	b
137	Isopropyl methacrylate	−0.15	1.20	b
138	6-Chloro-2-vinylnaphthalene	−0.13	1.35	
139	Ethyl vinyl sulfide	−0.12	0.37	
140	*n*-Hexyl methacrylate	−0.12	0.70	b
141	Sodium acrylate	−0.12	0.71	
142	4-Methacryloxybenzylideneaniline	−0.09	2.24	b
143	Vinyl propionate	−0.07	0.052	
144	Vinyl caprate	−0.05	0.009	b
145	Ethyl β-ethoxyacrylate	−0.05	0.013	b

(*continued*)

TABLE III (*cont.*)

No.	Monomer	*e*	*Q*	Notes
146	2,5-Bis(trifluoromethyl)styrene	−0.05	1.11	
147	Isobutyl methacrylate	−0.04	0.77	b
148	Isostilbene	−0.03	0.017	b
149	Glycidyl methacrylate	−0.02	0.78	b
150	Chloroprene	−0.02	7.26	
151	Trimethylvinylsilane	0.04	0.029	c
152	2-(*N*,*N*-Dimethylamino)-4-vinylpyrimidine	0.04	1.45	b
153	Vinyl laurate	0.06	0.012	
154	3-Vinylphenanthrene	0.08	0.87	b
155	2,5-Dichlorostyrene	0.09	1.60	
156	Vinyl palmitate	0.11	0.021	b
157	Allyl chloride	0.11	0.056	c
158	Nonyl methacrylate	0.14	0.91	b
159	Ethyl methacrylate	0.17	0.56	
160	α-Chlorovinyltriethoxysilane	0.18	0.23	a
161	Methacryloxymethylpentamethyldisiloxane	0.19	0.74	
162	Vinyl chloride	0.20	0.044	
163	Ethyl acrylate	0.22	0.52	
164	Vinyl isothiocyanate	0.25	0.54	
165	Methyl bicyclo-[2,2,1]-2-heptene-5-carboxylate	0.26	0.059	
166	Diethylvinylphosphonate	0.26	0.13	a,b
167	1-Cyano-1,3-butadiene	0.28	5.98	a,b
168	Allyl alcohol	0.29	0.052	b
169	*n*-Butyl crotonate	0.36	0.007	a,b
170	*n*-Propyl crotonate	0.36	0.011	a,b
171	Crotonaldehyde	0.36	0.013	a,b
172	Diallyl phthalate	0.36	0.044	b
173	Vinylidene chloride	0.36	0.22	
174	Dimethyl maleate	0.37	0.046	b
175	*p*-Sulfonamidostyrene	0.37	1.62	b
176	*p*-Nitrostyrene	0.39	1.63	
177	Methyl methacrylate	0.40	0.74	
178	Sodium vinylsulfonate	0.41	0.064	a
179	Vinyl butyrate	0.42	0.038	
180	Ethyleneglycol dimethacrylate	0.42	1.08	b
181	Diethylaminoethyl methacrylate	0.42	2.08	
182	2-Chloroallyl chloride	0.44	0.27	c
183	Ethyl α-acetoxyacrylate	0.44	0.44	
184	Crotonic acid	0.45	0.013	c
185	4-Vinylpyrimidine	0.45	2.18	b
186	Decyl methacrylate	0.48	1.37	b
187	2,3-Dichloro-1,3-butadiene	0.48	12.86	c
188	Methyl cinnamate	0.49	0.12	a
189	Ethyl 2-ethyl-2-methyl-1-butenoate	0.50	0.14	
190	Pentachlorostyrene	0.52	0.22	
191	Allyl laurate	0.53	0.031	b
192	Methyl isopropenyl ketone	0.53	1.49	
193	β-Chloroethyl acrylate	0.54	0.41	c
194	Ethyl methacrylylaminoacetate	0.54	0.72	b

(*continued*)

TABLE III (*cont.*)

No.	Monomer	*e*	*Q*	Notes
195	2-Chloroallyl alcohol	0.56	0.24	a
196	Stearyl methacrylate	0.56	1.07	b
197	Vinyl perfluorobutyrate	0.58	0.038	b
198	Methyl thiolacrylate	0.58	1.23	b
199	Methyl acrylate	0.60	0.42	
200	3-Pyridalacetophenone	0.64	0.64	a,b
201	Itaconic acid	0.64	0.76	c
202	Methyl 4-chlorocinnamate	0.65	0.15	a,b
203	Methacrylic acid	0.65	2.34	
204	Hydronopyl acrylate	0.67	0.50	
205	Methyl vinyl ketone	0.68	0.69	
206	Poly(1,3-butyleneglycol fumarate)	0.75	0.097	b
207	Cinnamonitrile	0.75	0.32	b
208	*n*-Butyl cinnamate	0.76	0.33	b
209	Hexachloro-1,3-butadiene	0.76	1.31	
210	Acrylic acid	0.77	1.15	
211	Methyl α-chloroacrylate	0.77	2.02	
212	α-Acetoxyacrylonitrile	0.78	2.14	
213	3-Cinnamoylpyridine	0.80	0.33	b
214	Methacrylonitrile	0.81	1.12	
215	*m*-Nitrostyrene	0.81	3.47	
216	Methyl 2-chlorocinnamate	0.85	0.28	a
217	2-Chloro-1-propene	0.86	0.035	c
218	Ethyl α-cyanocinnamate	0.87	1.24	a,b
219	*N*-Benzylidene-4-methacryloxy-aniline	0.88	1.08	b
220	Acrolein	0.89	1.08	
221	*n*-Octyl acrylate	0.94	0.42	b
222	α,β,β-Trifluorostyrene	0.95	0.38	b
223	2-Methyl-5-cinnamoylpyridine	0.96	0.26	b
224	Ethyl acid fumarate	0.96	1.33	b
225	Methyl vinyl sulfoxide	0.98	0.057	b
226	Abityl acrylate	0.98	0.40	b
227	2-Chlorobenzalacetophenone	0.99	0.37	b
228	*N*-(1,1-Dihydroperfluorobutyl)-*N*-ethyl acrylamide	1.01	1.22	b
229	Butyl acrylate	1.02	0.51	
230	Vinyl trifluoroacetate	1.06	0.033	b
231	Di-2-ethylhexyl maleate	1.08	0.10	a,b
232	*N,N,N*-Triethyl-*N*-(2-methacryloxyethyl)-ammonium iodide	1.10	2.10	b
233	*trans*-Trimethyl aconitate	1.14	0.0054	b
234	1,1-Dihydroperfluorobutyl acrylate	1.15	0.78	
235	Phenyl vinyl sulfone	1.18	0.069	
236	*n*-Butyl vinylsulfonate	1.19	0.13	
237	Acrylonitrile	1.20	0.60	
238	Tetrafluoroethylene	1.22	0.049	c
239	Methacrylamide	1.24	1.46	
240	*cis*-Dichloroethylene	1.25	0.003	c
241	Diethyl fumarate	1.25	0.61	c
242	*trans*-Dichloroethylene	1.28	0.010	c

(*continued*)

TABLE III (*cont.*)

No.	Monomer	e	Q	Notes
243	Vinyl fluoride	1.28	0.012	b
244	Methyl vinyl sulfone	1.29	0.11	c
245	Acrylamide	1.30	1.18	
246	*N*-Methacryloxy-ε-caprolactam	1.34	0.18	a,b
247	Dimethyl itaconate	1.34	1.03	
248	Dibutyl itaconate	1.34	1.18	
249	3,3,3-Trichloro-1-propene	1.37	0.056	c
250	Chlorotrifluoroethylene	1.48	0.020	
251	Diethyl maleate	1.49	0.059	c
252	Dimethyl fumarate	1.49	0.76	b
253	Di-β-chloroethyl itaconate	1.52	0.38	c
254	Ethyl acid maleate	1.52	1.23	b
255	Di-*n*-butyl maleate	1.60	0.042	a,b
256	*cis*-Trimethyl aconitate	1.62	0.32	c
257	Dimethyl methacrylyliminodiacetate	1.64	0.073	b
258	Diethyl chloromaleate	1.65	0.056	a,b
259	Poly(ethyleneglycol fumarate)	1.73	0.074	b
260	Citraconic anhydride	1.75	0.87	b
261	*N*-Butyl maleimide	1.75	3.08	
262	4,6-Diamino-2-vinyl-*s*-triazine	1.76	5.52	b
263	Methyl acid maleate	1.78	0.032	b
264	Dimethyl dithiolfumarate	1.78	1.23	
265	Triethyl aconitate	1.79	0.22	a
266	Diisobutyl maleate	1.85	0.094	b
267	Trichloroethylene	1.86	0 019	c
268	Fumaronitrile	1.96	0.80	c
269	Tetrachloroethylene	2.03	0.0028	a
270	Diisopropyl maleate	2.06	0.084	c
271	1,1-Dichloro-2,2-difluoroethylene	2.10	0.041	a
272	Maleic anhydride	2.25	0.23	c
273	Maleonitrile	2.32	0.42	a,b
274	Vinylidene cyanide	2.58	20.13	c

[a] Calculated from data wherein r_2 was assumed to be zero.

[b] One set of data only.

[c] Calculated from data wherein some r_2 values were assumed to be zero.

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Synopsis

Copolymerization parameters, Q and e, have been calculated for several monomers whose relative reactivity ratios, r_1 and r_2, are available. The ratios and parameters are tabulated in an effort to bring the various data in the literature to a single source of reference.

Résumé

On a calculé les paramètres de copolymérisation, Q et e, pour plusieurs monomères dont on connaît les rapports de réactivité relatifs, r_1 et r_2. Les rapports et les paramètres ont été rassemblés dans le but d'avoir une seule source de références pour les différentes données rapportées dans la littérature.

Zusammenfassung

Copolymerisationsparameter, Q und e, wurden für einige Monomere mit bekannten, relativen Reaktivitätsverhältnissen, r_1 und r_2, berechnet. Die Verhältnisse und Parameter werden tabelliert, um die verschiedenen Literaturdaten zu einer einzigen Referenzenquelle zu vereinigen.

Received November 2, 1960