

LIST OF FIGURES

		Page
Figure 1.1	Some of the common polybasic acids used for preparation of alkyd	18
Figure 1.2	The properties to be expected from an alkyd of different oil length and iodine number (Adapted from Alkyd Resin Technology ⁷⁹ , page 175)	22
Figure 1.3	Chemical structure proposed for alkyds formed by fatty acid procedure	26
Figure 1.4	Chemical structure proposed for alkyds formed by alcoholysis (monoglyceride) procedure	27
Figure 1.5	The esterification reaction for the alkyds synthesized from anhydrides	29
Figure 1.6	Effect of esterification temperature and reaction time on viscosity of a typical medium oil linseed alkyd (Adapted from The Chemistry and Processing of Alkyd Resins ⁸⁹)	31
Figure 1.7	Effect of esterification temperature and reaction time on acid value of a typical medium oil linseed alkyd (Adapted from The Chemistry and Processing of Alkyd Resins ⁸⁹)	32
Figure 1.8	Metabolic pathway involved in the synthesis and breakdown of PHB in <i>R. eutropha</i> ¹¹⁹	36
Figure 2.1	The set-up of an alkyd cook: 2-litre reaction flask (A); Thermometer (B); Dean and Stark decanter (C); Stirrer motor (D) and Condenser (E).	56
Figure 2.2	The reactions of ENR/mcl-PHA in an oil bath set at 170°C: Hot plate and stirrer (A); Magnetic stirrer (B); Oil bath (C) and	60

Thermometer (D).

Figure 2.3	The Ubbelohde viscometer	67
Figure 3.1	Preparation of PKO alkyds	73
Figure 3.2	A plausible reaction mechanism in the preparation of alkyd A1	77
Figure 3.3	A plausible reaction mechanism in the preparation of alkyd A2	79
Figure 3.4	A plausible reaction mechanism in the preparation of the alkyd A3	80
Figure 3.5	Changes in acid numbers with reaction time during the synthesis of alkyd A1	84
Figure 3.6	Changes in acid numbers with reaction time during the synthesis of alkyds: ▲, A2 prepared at 120-130°C; *, A3 prepared at 180°C.	87
Figure 3.7	FTIR spectra of alkyds: A1 (A); A2 (B) and A3 (C).	89
Figure 3.8	FTIR spectra of the initial ENR (A); alkyd A1 (B) and ENR/A1 (C).	97
Figure 3.9	FTIR spectra of the initial ENR (A); alkyd A2 (B) and ENR/A2 (C).	98
Figure 3.10	FTIR spectra of the initial ENR (A); alkyd A3 (B) and ENR/A3 (C).	99
Figure 3.11	FTIR spectra of the ENR/A1 at different reaction time: 1 week (A); 1 month (B) and 3 months (C).	100
Figure 3.12	FTIR spectra of the ENR/A2 at different reaction time: 1 week (A); 1 month (B) and 3 months (C).	101
Figure 3.13	FTIR spectra of the ENR/A3 at different reaction time: 1 week (A); 1 month (B) and 3 months (C).	102
Figure 3.14	The predominant crosslinking reaction between ENR and alkyd	112
Figure 3.15	Changes in acid numbers with reaction time during the synthesis	115

of alkyd A4.

Figure 3.16	Molecular structure of alkyd A4 as could be determined from $^1\text{H-NMR}$ spectrum	117
Figure 3.17	$^1\text{H-NMR}$ spectrum of alkyd A4	119
Figure 3.18	FTIR spectra of alkyds: A1 (A) and A4 (B).	120
Figure 3.19	The $^1\text{H-NMR}$ spectrum of ENR.	127
Figure 3.20	The $^1\text{H-NMR}$ spectrum of A4 _{2.0} .	128
Figure 3.21	A plausible esterification between ENR and alkyd	129
Figure 4.1	The $^1\text{H-NMR}$ spectra of NR (A) and ENR 50 (B).	134
Figure 4.2	The reduced (η_{sp}/c) and inherent ($\ln \eta_r/c$) viscosities vs. concentration (c) for ENR before heated at 170°C for 30 minutes: ▲ values of η_{sp}/c ; ● values of $\ln \eta_r/c$.	140
Figure 4.3	The reduced (η_{sp}/c) and inherent ($\ln \eta_r/c$) viscosities vs. concentration (c) for ENR after heated at 170°C for 30 minutes: ▲ values of η_{sp}/c ; ● values of $\ln \eta_r/c$.	141
Figure 4.4	The $^1\text{H-NMR}$ spectra of ENR at ambient temperature (A) and heated at 170°C for 30 minutes (B).	144
Figure 4.5	Random chain scission at ester groups in PHA.	147
Figure 4.6	Molecular structure of mcl-PHA as could be determined from $^1\text{H-NMR}$ spectrum	150
Figure 4.7	$^1\text{H-NMR}$ spectrum of mcl-PHA derived from oleic acid: at ambient temperature (A) and heated at 170°C for 30 minutes (B).	151
Figure 4.8	Hydrolysis in mcl-PHA.	152
Figure 4.9	FTIR spectrum of ENR	154

Figure 4.10	FTIR spectrum of mcl-PHA	154
Figure 4.11	FTIR spectra of ENR (A); mcl-PHA (B); P ₁₀ blend at ambient temperature (C), and after reacting at 170°C for 30 minutes (D).	156
Figure 4.12	FTIR spectra of P ₁₀ reacted 30 minutes at different temperatures: 30°C (A); 50°C (B); 70°C (C); 100°C (D); 130°C (E); 150°C (F), and 170°C (G).	158
Figure 4.13	FTIR spectra of P ₁₀ reacted at 170°C under different heating durations: 10 minutes (A); 20 minutes (B); 30 minutes (C).	159
Figure 4.14	The ¹ H-NMR spectra of P ₁₀ blends, reacted for 30 minutes at: ambient temperature (A) and 170°C (B).	161
Figure 4.15	A plausible reaction mechanism in ENR and mcl-PHA.	162
Figure 4.16	FTIR spectra of ENR/PHA blends of varied mcl-PHA composition: P ₁₀ (A); P ₃₀ (B); P ₅₀ (C); P ₇₀ (D), and P ₉₀ (E).	164
Figure 4.17	DSC thermogram for P ₁₀ reacted at 170°C for 30 minutes	166
Figure 1	DSC thermogram for ENR 50	187
Figure 2	DSC thermogram for alkyd A4	187
Figure 3	DSC thermogram for A4 _{0.5} reacted at ambient temperature for 3 hours	188
Figure 4	DSC thermogram for A4 _{1.0} reacted at ambient temperature for 3 hours	188
Figure 5	DSC thermogram for A4 _{1.5} reacted at ambient temperature for 3 hours	189
Figure 6	DSC thermogram for A4 _{1.0} reacted at ambient temperature for 1 hour	189
Figure 7	DSC thermogram for A4 _{1.0} reacted at ambient temperature for 2 hours	190

Figure 8	DSC thermogram for A4 _{1.0} reacted at ambient temperature for 3 hours	190
Figure 9	DSC thermogram for A4 _{1.0} reacted at ambient temperature for 4 hours	191
Figure 10	DSC thermogram for A4 _{1.0} reacted at ambient temperature for 5 hours	191
Figure 11	DSC thermogram for A4 _{1.0} reacted at ambient temperature for 6 hours	192
Figure 12	DSC thermogram for mcl-PHA	193
Figure 13	DSC thermogram for mcl-PHA after heated at 170°C for 30 minutes	193
Figure 14	DSC thermogram for P ₃₀ after reacted at 170°C for 30 minutes	194
Figure 15	DSC thermogram for P ₅₀ after reacted at 170°C for 30 minutes	194
Figure 16	DSC thermogram for P ₇₀ after reacted at 170°C for 30 minutes	195
Figure 17	DSC thermogram for P ₉₀ after reacted at 170°C for 30 minutes	195