REFERENCES

1. Young, R.J. Plastics and Rubber International, 1984, vol.9, No1, 29.
2. Kirk-Othmer Encyclopedia of Chemical Technology 3thed., vol.18, 1982, 755-793.
3. Kaufman, F.B. **Research Report**, IBM T.J. Watson Research Center RC 8643(#37765) **1981**.
4. Anson, F.C.; Ohsaka, T.; Saveant, J.M. J. Am. Chem. Soc., **1983**, 105, 4883.
5. Arai, G.; Koike, T.; Yasumori, I. Chem. Lett., **1986**, 867.
6. Gandalupe, A.R.; Abruna, H.D. Anal. Chem., **1985**, 57, 142.
7. Oyama, No; Anson, F.C. J. Am. Chem. Soc., **1979**, 101, 3450.
8. Lane, R.F.; Hubbard, A.T. Anal. Chem., **1976**, 48, 1287.
9. Abruna, H.D.; Bard, A.J. J. Am. Chem. Soc., **1981**, 103, 6898.
10. Hughes, R.C. J. Chem. Phys., **1973**, 58, 2212.
11. Hoegl, H. J. Phys. Chem., **1965**, 69, 755.
12. Faulkner, L.R. C&EN Feb 27, **1984**.
13. Kaufman, F.B.; Schroeder, A.H.; Ergler, E.M.; Patel, V.V. Appl. Phys. Lett., **1980**, 36, 422.

14. Tsumura, A.; Koezuka, H.; Tsunada, S.; Ando, T. Chem. Lett., **1986**, 863.

15. Schneemeyer, L.F.; Wrighton, M.S. J. Am. Chem. Soc., **1979**, 101, 6496.

16. Fan, F.F.; Bard, A.J. J. Am. Chem. Soc., **1979**, 101, 6139.

17. Okahata, Y.; Takenouchi, K. J. Am. Soc. Chem. Commu. **1986**, 558.

18. Reuben, B.; Sjoberg, K. Chemtech May 1981, 315.

19. Dehmlow, E.V.; Dehmlow, S.S.Phase Transfer Catalysis Verlag Chemie, Basel, 1980.

20. Starks, C.M.; Liotta, C.Phase Transfer Catalysis Academic Press New York, 1978.

21. Nishikubo, T.; Iizawa, T.; Kobayashi, K.; Masuda, Y.; Okawara, M. Macromolecules, **1983**, 722

22. Iizawa, T.; Nishikubo, T.; Masuda, Y.;Okawara, M. Macromolecules, **1984**, 992

23. Sittattrakul, A. **Ph.D. Dissertation**, Louisiana State University, **1985**.

24. Pittman, C.U. J. Paint Technology, **1967**, 39, 585.

25. Page, J.A.; Wilkinson, G. J. Am. Chem. Soc., **1952**, 74, 6149.

26. Curphey, T.J.; Santer, J.O.; Rosenblum, M.; Richards, J.H. J. Am. Chem. Soc., **1960**, 82, 5249.

27. Richards, J.H. Ferrocene Photochemistry in Symposium

on Metallocenes, J. Paint Technology, 1967, 39, 569.

28. Fry, A.J.; Lui, R.S.H.; Hammond, G.S. J. Am. Chem. Soc., 1966, 88, 4781.

29. Schmitt, R.G.; Hirt, R.C. American Cyanimid Co., Air Force WADC Technical Reports, 59-354; 60-704; 61-298.

30. McIlhenny, R.C.; Honigstein, S.A. Air Force Report Nos. AF MLTR-65-294, AD 476623, Contr. No. AF-33-(615)-1964.

31. Pittman, C.U.; Goo, M.; Lai, J.; Vanderpool, D.; Prados, R. Macromolecules, 1970, 3, 746.

32. Nakahira, T.; Minami, C.; Iwabuchi, S.; Kojima, K. Makromol. Chem., 1979, 180, 2245.

33. Tsubakiyama, K.; Matsuo, T.; Sasaki, T.; Yoshida, K.; Araki, K. J. Polym. Sci., Polym. Chem. Ed., 1979, 17, 1829.

34. Tsubakiyama, K.; Matsuo, T.; Sasaki, T.; Yoshida, K.; Fujimura, T.; Araki, K. J. Polym. Sci., Polym. Chem. Ed., 1979, 17, 173.

35. Sukhinin, V.S.; Vses, Zh. Khim. O-va, 1979, 24, 400; Chem. Abstr., 1979, 91, 193391.

36. Simionescu, C.; Lixandru, T.; Tataru, L.; Mazilu, I. (Institutul Politechnic Iasi), Rom. Pat. 63714, 1978 Jun. 15; Chem. Abstr., 1979, 91, 212018.

37. Pittman, C.U.; Lin, C.C. J. Polym. Sci., Polym. Chem. Ed., 1979, 17, 271.

38. Dautartas, M.F.; Evans, J.F. J. Electroanal. Chem. Interfacial Electrochem., 1980, 109, 301.

39. Nowak, R.J.; Schultz, F.A.; Umana, M; Lam, R; Murray, R.W. Anal. Chem., 1980, 52, 315.

40. Korshak, V.V.; Ezhova, T.M.; Alekseeva, V.P.; Sosin, S.L. Dokl. Akad. Nauk BSSR, 1980, 251, 1413.

41. Vodopyanova, A.E.; Losev, Yu.P.; Paushkin, Ya. M.; Savosteenko, E.S. Dokl. Akad. Nauk BSSR, 1980, 24, 1101.

42. Gulimov, V.I.; Vishnyakova, T.P.; Vlasova, I.D.; Tabasaranskaya, T.Z. Vysokomol. Soedin., Ser. B, 1981, 23, 633.

43. Reed, S.F. J. Polym. Sci., Polym. Chem. Ed., 1981, 19, 1867.

44. Sanechika, K.; Yamamoto, T.; Yamamoto, A. Polym. J. (Tokyo), 1981, 13, 255.

45. Kaufman, F.B. IBM J. Res. Dev., 1981, 25, 303.

46. Merz, A.; Bard, A.J. J. Am. Chem. Soc., 1978, 100, 3222.

47. Daum, P.; Murray, R.W. J. Phys. Chem., 1981, 85, 389.

48. Rolison, D.R.; Umana, M.; Burgmayer, D.; Murray, R.W.

Inorg. Chem., 1981, 20, 2996.

49. Schroeder, A.H.; Kaufman, F.B.; Patel, V.; Engler, E.M. J. Electroanal. Chem., 1980, 113, 193.

50. Peerce, P.J.; Bard, A.J. J. Electroanal. Chem., 1980, 114, 89.

51. Peerce, P.J.; Bard, A.J. J. Electroanal. Chem., 1980, 112, 97.

52. Santhanam, K.S.V.; Jespersen, N.; Bard, A.J. J. Am. Chem. Soc., 1977, 98, 274.

53. Corfield, G.C.; Brooks, J.S.; Plimley, S. ACS Symp. Ser., 1982, 195, 123.

54. Tataru, L.; Daranga, M.; Vata, M.; Lixandru, T.; Siminonescu, C. J. Therm. Anal., 1981, 22, 259.

55. Tataru, L.; Vata, M., Mazilu, I.; Lixandru, T.; Siminoneseu, C. Angew, Makromol. Chem., 1981,10, 19.

56. Siminoescu, C.; Lixandru, T.; Tataru, L.; Mazilu, I.; Vata, M. J. Organometal. Chem., 1982, 238, 363.

57. Corfield, G.C.; Brooks, J.S.; Plimley, S.; Cunliffe, A.V. Proc. IUPAC, I.U.P.A.C., Macromol. Symp., 1982, 28th , 12; Chem. Abatr., 1983, 99, 140684.

58. Dautartas, M.F. Diss. Abstr. Int. B, 1982, 43, 126.

59. Chishti, A.S.; Jablonski, C.R. Makromol. Chem.,

1983, 184, 1837.

60. Yamamoto, T.; Sanechika, K.; Yamamoto, A.; Katada, M.; MOtoyama, I.; Sano, H. Inorg. Chim. Acta., 1983, 73, 75.

61. Sosin, S.L.; Alekseeva, V.P.; Litvinova, M.D.; Ezhova, T.M.; Shevchenko, Yu. V. Dokl. Akad. Nauk SSSR., 1981, 271, 871.

62. Diaz-Barrios, A.; Rengel, A. J. Polym. Sci., Polym. Chem. Ed., 1984, 22, 519.

63. Kojima, K.; Sasaki, K.; Nakahira, T.; Iwabuchi, S. Kenkyu Hokoku-Asahi. Garasu Kogyo Gijutsu Shoreikai, 1983, 42, 219; Chem. Abstr., 1984, 100, 137425.

64. Kojima, K.; Sasaki, K.; Nakahira, T.k; Iwabuchi, S. Kogakubu Kenkyn Hokoku (Chiba Diagaku), 1983, 35,73; Chem. Abstr., 1984,100, 106534.

65. Shirota, Y.; Kakuta, T; Mikawa, H. Makromol. Chem., Rapid Commun., 1984,5, 337.

66. Chien, J.C.W.; Gooding, R.D.; Lillya, C.P. Polym. Mater. Sci. Eng., 1983,49, 107.

67. Amato, J.S.; Karady, S; Sletzinger, M.; Weinstock, L.M. Synthesis, 1979, 970.

68. Rosenberg, H.M.; Riber, C.J. Macrochem., 1962, 6, 103.

APPENDIXES

APPENDIX A

Concentration calculation of chloromethyl methyl ether(CMME)

The concentration of CMME was calculated by considering the peak intensity obtained from the integration of ^1H NMR spectrum of CMME. The chemical reaction is shown in the following equation.

$$CH_3OCH_2OCH_3 + CH_3COCl \xrightarrow{CH_3OH} ClCH_2OCH_3 + CH_3COOCH_3$$

abbriviation	DMM	ACC	CMME	MAT
(ppm)	4.5		5.45	
intensity	1		9.5	

$$\text{conversion} = \frac{9.5 \times 100}{(1+9.5)}$$

$$= 90.5\%$$

CMME in MAT = 184 mL (186.6 g)

DMM used = 111 mL (1.25 mol)

density = 0.859 g/mL

$$\text{mole of CMME} = \frac{1.25 \times 90.5}{100}$$

= 1.13 mole in solution 184 mL

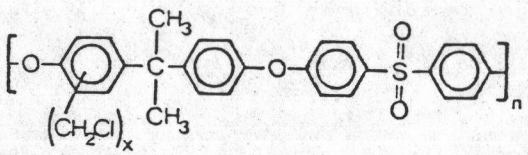
$$\text{concentration of CMME} = \frac{1000 \times 1.13}{184}$$

= 6.14 M

APPENDIX B

Calculation of elements in POLYMER 1

Structure of POLYMER 1



Formular weight of polymer

atom	atomic weight	numbers	atom wt.x numbers
C	12.011	27+X	12.011x(27+X)
H	1.0079	22+X	1.0079x(22+X)
O	15.9994	4	63.9976
S	32.06	1	32.06
Cl	35.45	X	35.45xX
Formular weight of polymer			442.5284 + 48.4719X

From elemental analysis X= 1.6 then

Formular weight of polymer = 442.5284+48.47198x1.6

= 520.08344

$$\%C = \frac{343.5146 \times 100}{520.08344} = 66.05$$

$$\%H = \frac{23.78644 \times 100}{520.08344} = 4.57$$

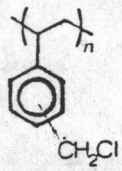
$$\%O = \frac{63.9976 \times 100}{520.08344} = 12.31$$

$$\%Cl = \frac{56.7248 \times 100}{520.08344} = 10.91$$

APPENDIX C

Calculation of elements in POLYMER 2

Structure of POLYMER 2



Formular weight of polymer

atom	atomic weight	numbers	atom wt.x numbers
C	12.011	9	108.099
H	1.0079	9	9.0711
O	15.9994	2.49	39.8385
Cl	35.45	1	35.45
	Formular weight of polymer		152.6201

$$\%C = \frac{108.099 \times 100}{152.6201} = 70.83$$

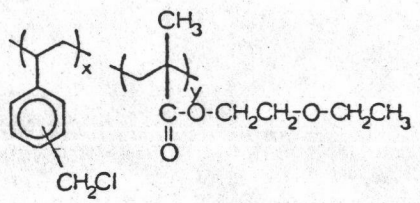
$$\%H = \frac{9.0711 \times 100}{152.6201} = 5.94$$

$$\%Cl = \frac{35.45 \times 100}{152.6201} = 23.23$$

APPENDIX D

Calculation of elements in POLYMER 3

Structure of POLYMER 3



Formular weight of polymer

atom	atomic weight	numbers	atom wt.x numbers
C	12.011	9X+8Y	12.011x(9X+8Y)
H	1.0079	9X+14Y	1.0079x(9X+14Y)
O	15.9994	3Y	15.9994x3Y
Cl	35.45	X	35.45xX
Formular weight of polymer			152.6201X + 158.1968Y

X+Y = 1 and if X=Y= 0.50 then

Formular weight of polymer = 152.6201x0.5+158.1968x0.5

= 155.40845

$$\%C = \frac{(108.099 \times 0.5 + 96.088 \times 0.5) \times 100}{155.40845} = 65.69$$

$$\%H = \frac{(9.0711 \times 0.5 + 14.1106 \times 0.5) \times 100}{155.40845} = 7.46$$

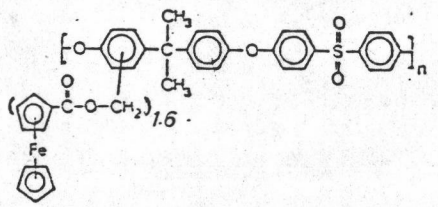
$$\%O = \frac{(47.9982 \times 0.5) \times 100}{155.40845} = 15.44$$

$$\%Cl = \frac{(23.23 \times 0.5) \times 100}{155.40845} = 11.41$$

APPENDIX E1

%Fe (theoretical) in product of POLYMER 1

Structure of product (conversion = 100%)



Formular weight of product

atom	atomic weight	numbers	atom wt.x numbers
C	12.011	46.2	554.9082
H	1.0079	38	38.3002
O	15.9994	7.2	115.19568
S	32.06	1	32.06
Fe	55.847	1.6	89.3552
	Formular weight of product		829.81928

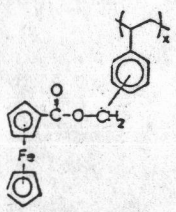
$$\%Fe\ (theoretical) = \frac{89.3552 \times 100}{829.81928}$$

$$= 10.77$$

APPENDIX E2

%Fe (theoretical) in product of POLYMER 2

Structure of product (conversion = 100%)



Formular weight of product

atom	atomic weight	numbers	atom wt.x numbers
C	12.011	20	240.220
H	1.0079	18	18.142
O	15.9994	2	31.999
Fe	55.847	1	55.847
	Formular weight of product		346.208

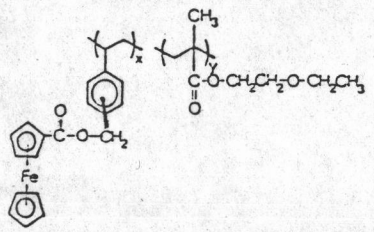
$$\%Fe\ (theoretical) = \frac{55.847 \times 100}{346.208}$$

$$= 16.131$$

APPENDIX E3

%Fe (theoretical) in product of POLYMER 3

Structure of product (conversion = 100%)



Formular weight of product

atom	atomic weight	numbers	atom wt.x numbers
C	12.011	14.12	169.5953
H	1.0079	16.04	16.1667
O	15.9994	2.49	39.8385
Fe	55.847	0.51	28.4819
	Formular weight of product		254.0824

$$\%Fe\ (theoretical) = \frac{28.4819 \times 100}{254.0824}$$

$$= 11.209$$

APPENDIX F

The calculation example for % yield, % Fe (experiment) and % conversion

1. weight of POLYMER 1 used 0.10 g.
2. weight of the ester product
   after record purification 0.12 g.
   theoretical product weight 0.252 g.

$$\% \text{ yield} = \frac{0.12}{0.252} \times 100 = 47.6$$

3. weight of the ester product
   used for digestion 0.0053 g.

comparison with the external standard (calibration curve)

Fe concentration $= 4.036 \times 10^{-5}$ M

$$\text{mole of Fe} = \frac{50}{100} \times \frac{50}{1,000} \times 4.036 \times 10^{-5} = 1.009 \times 10^{-5}$$

$$\text{gram of Fe} = 1.009 \times 10^{-6} \times 55.847 = 5.635 \times 10^{-4}$$

$$\% \text{ Fe (experiment)} = \frac{5.635}{0.0053} \times 10^{-4} \times 100 = 10.63$$

% Fe (theoretical) = 10.77

$$\% \text{ conversion or degree of esterification} = \frac{10.63}{10.77} \times 100 = 98.7$$

VITA

Mr. Sarawoot Lerdmaleewong was born on April 13, 1964 in Udonthani, Thailand. He received his B.Sc.(1^{st} Honrs) in Chemistry from the Faculty of Science, Srinakharintaravirot University in 1983. After graduating, he worked as a Quality Control Chemist in the lube oil laboratory of Mobil Oil Thailand for half a year. Since 1984, he has been a graduate student in the Department of Petro-Polymer (Interprogram), Chulalongkorn University. He works now as a Institution Hygine & Cleaning Chemist in the laboratory of the Southeast Asia Research & Traning Center of Henkel Thai Ltd.