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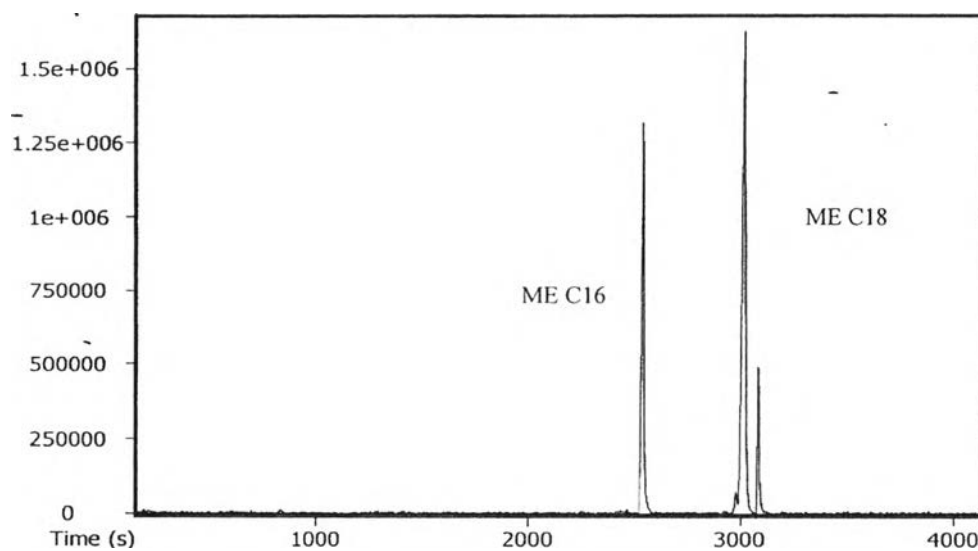
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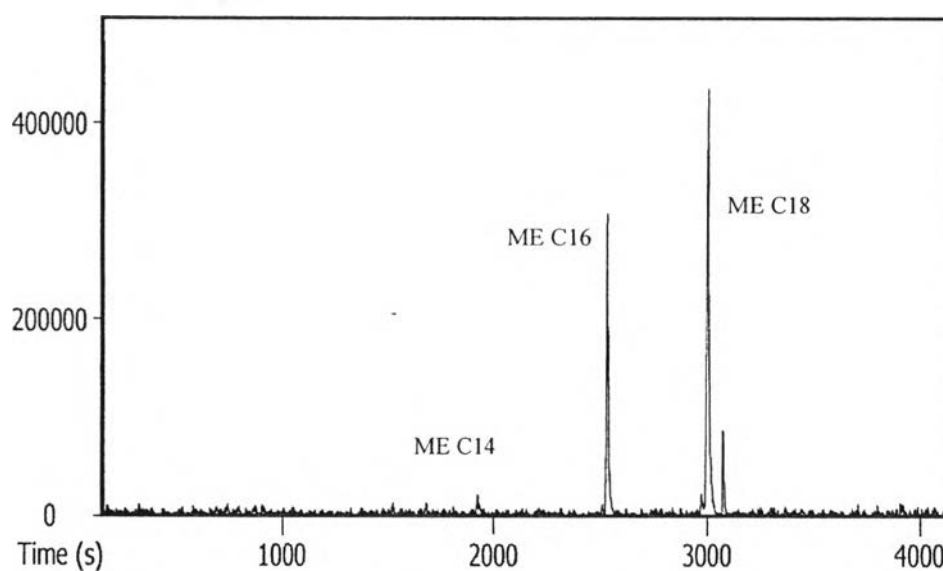
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## APPENDICES

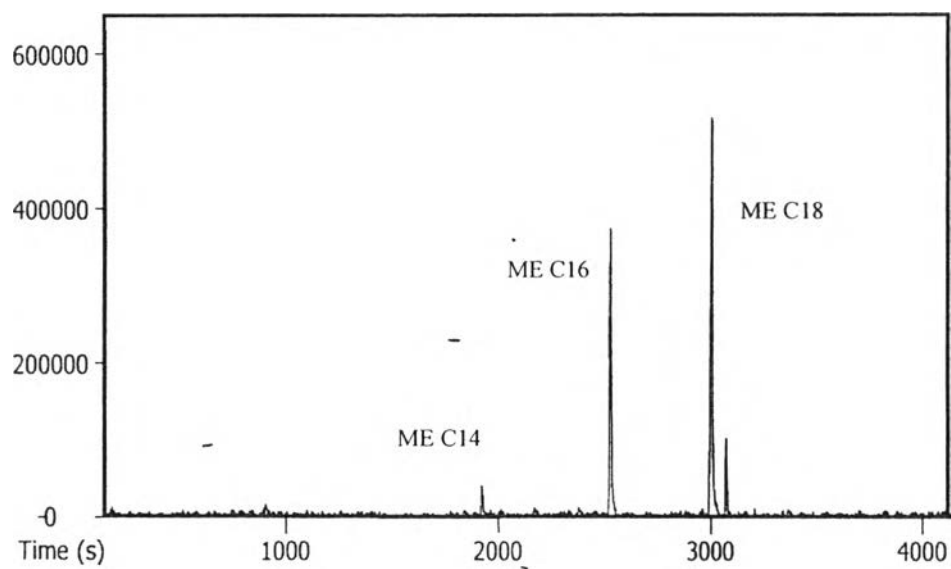
### Appendix A Total Ion Chromatography of Methyl Ester and Unreacted Methyl Ester



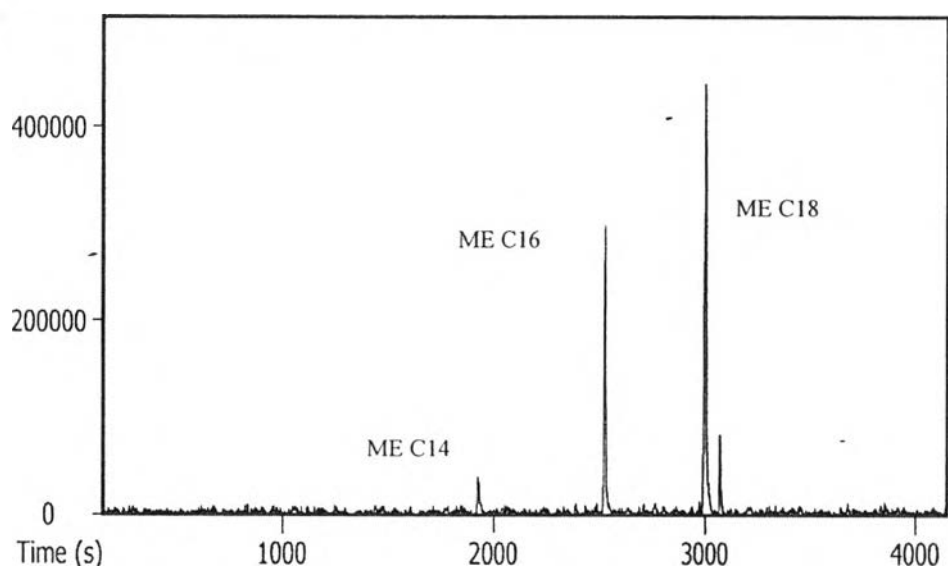
**Figure A1** Total ion chromatography of methyl ester.



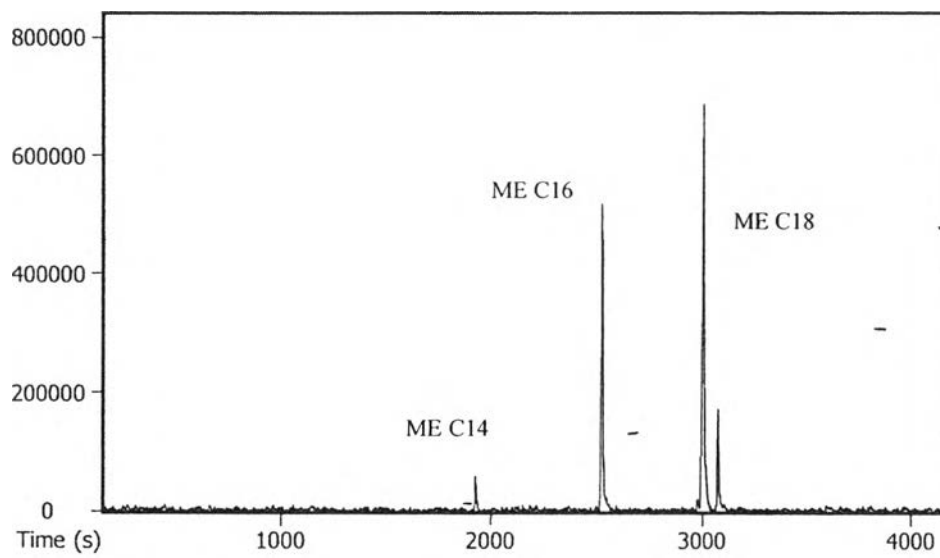
**Figure A2** Total ion chromatography of unmethyl ester from the UV/O<sub>2</sub> system.



**Figure A3** Total ion chromatography of unmethyl ester from the  $O_3/O_2$  system.



**Figure A4** Total ion chromatography of unmethyl ester from the  $UV/O_3/O_2$  system.



**Figure A5** Total ion chromatography of unmethyl ester from the UV/O<sub>3</sub> system.

**Table A1** Methyl ester and unreacted methyl ester compositions from GC-MS analysis

Component	White ME		unME UV/O <sub>2</sub>		unME O <sub>3</sub> /O <sub>2</sub>		unME UV/O <sub>3</sub> /O <sub>2</sub>		unME UV/O <sub>3</sub>	
	Time (min)	Composition (wt%)	Time (min)	Composition (wt%)	Time (min)	Composition (wt%)	Time (min)	Composition (wt%)	Time (min)	Composition (wt%)
C12:0	1295	0.00	1297	0.51	1297	1.08	1297	1.22	1296	1.28
C14:0	1922	0.00	1922	4.57	1922	6.98	1922	7.97	1922	0.38
C16:0	2552	36.01	2525	46.81	2525	45.13	2524	43.00	2527	50.78
C18:2	3034	0.51	2973	0.80	2973	0.56	2974	0.62	2974	0.19
C18:1	3095	45.34	3003	43.98	3003	33.45	3002	34.98	3006	38.88
C18:0	3096	18.14	3075	3.33	3075	12.80	3075	12.22	3076	8.49



## Appendix B Experimental Condition and Conversion Calculation

**Table B1** Experimental conditions and conversion calculation of the effect of different reactants and initiators

System	Time (h)	SO <sub>2</sub> (ml/min)	Total volume SO <sub>2</sub> (ml)	O <sub>2</sub> (ml/min)	Total volume O <sub>2</sub> (ml)	O <sub>3</sub> (l/min)	Total volume O <sub>3</sub> (l)	Starting ME (g)	Reactor Outlet (g)	Unreacted ME (g)	Conversion (%wt/wt)	
1	UV/O <sub>2</sub>	4	100	24000	100	24000	0	0	172.17	182.26	159.34	7.45
2	O <sub>3</sub> /O <sub>2</sub>	4	100	24000	100	24000	0.5	120	172.22	183.99	160.34	6.90
3	UV/O <sub>3</sub> /O <sub>2</sub>	4	100	24000	100	24000	0.5	120	172.87	183.05	149.50	13.52
4	UV/O <sub>3</sub>	4	100	24000	0	0	0.5	120	172.75	182.89	166.51	3.61

**Table B2** Experimental conditions and conversion calculation of the effect of reaction time

System	Time (h)	SO <sub>2</sub> (ml/min)	Total volume SO <sub>2</sub> (ml)	O <sub>2</sub> (ml/min)	Total volume O <sub>2</sub> (ml)	O <sub>3</sub> (l/min)	Total volume O <sub>3</sub> (l)	Starting ME (g)	Reactor Outlet (g)	Unreacted ME (g)	Conversion (%w/w)	Total product	
												(g)	
5	1UV/O <sub>3</sub> /O <sub>2</sub>	1	100	6000	100	6000	0.5	30	172.63	177.30	164.51	4.70	5.91
6	2UV/O <sub>3</sub> /O <sub>2</sub>	2	100	12000	100	12000	0.5	60	172.32	180.10	154.71	10.22	12.99
7	3UV/O <sub>3</sub> /O <sub>2</sub>	4	100	24000	100	24000	0.5	120	172.87	183.05	149.50	13.52	17.45
8	4UV/O <sub>3</sub> /O <sub>2</sub>	6	100	36000	100	36000	0.5	180	172.37	186.18	146.98	14.73	20.8

## Appendix C Liquid Chromatography Analysis

**Table C1** Liquid chromatography analysis of effect of reaction time

System	Reaction Time (h)	Disulfonates			Monosulfonates			% Composition		Ratio Mono/Di
		Time (min)	Area	Height	Time (min)	Area	Height	% Di sulfonate	%MONO sulfonate	
$\alpha$ -MES C18	-	-	-	-	5.42	22747592	1052709	-	-	-
5	1	4.69	695038	20487	5.74	8128127	235925	7.88	92.12	11.69
6	2	4.65	745103	22074	5.70	8086646	285762	8.44	91.56	10.85
7	4	4.61	2829715	92969	5.60	22264419	630573	11.28	88.72	7.87
8	6	4.55	1931967	51341	6.08	10179423	242454	15.95	84.05	5.27

## CURRICULUM VITAE

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1. Tulathammakit, H.; and Kitiyanan, B. (2014, April 22) Synthesis of Methyl Ester Sulfonate Surfactant from Methyl Ester. Proceedings of the 5<sup>th</sup> Research Symposium on Petrochemical and Materials Technology and the 20<sup>th</sup> PPC Symposium on Petroleum, Petrochemicals, and Polymers, Bangkok, Thailand.
2. Tulathammakit, H.; and Kitiyanan, B. (2014, August 23-27) Synthesis of Methyl Ester Sulfonate Surfactant from Palm Oil Methyl Ester by Using UV or Ozone as an Initiator. Proceedings of the 17th Conference Process Integration, Modelling and Optimisation for Energy Saving and Pollution Reduction (PRES 2014), Prague, Czech Republic.

**Presentation:**

1. Tulathammakit, H.; and Kitiyanan, B. (2014, May 15-18) Synthesis of Methyl Ester Sulfonate Surfactant from Palm Oil Methyl Ester by Using UV or Ozone as an Initiator. Poster Presentation of European Biotechnology Congress 2014, Lecce, Italy.