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# **APPENDICES**

## APPENDIX A

### Experimental Data of Section 4.1 EACN determination of TEL

**Table A-1 Solubilization parameter (*SP*) of hexane in AOT/Tween80 surfactant system**

NaCl (wt%)	Solubilization Parameter for oil ( <i>SP<sub>o</sub></i> )					Solubilization Parameter for water ( <i>SP<sub>w</sub></i> )				
	1	2	3	Average	SD	1	2	3	Average	SD
1.8	7.122	7.444	7.090	7.218	0.196	16.045	16.607	15.996	16.216	0.340
1.9	7.942	7.910	7.958	7.937	0.025	11.511	12.025	12.508	12.015	0.498
2.0	8.071	8.280	8.778	8.376	0.363	8.633	9.244	9.325	9.067	0.378
2.3	11.447	11.865	12.267	11.859	0.410	6.222	6.720	6.415	6.452	0.251

**Table A-2 Solubilization parameter (*SP*) of octane in AOT/Tween80 surfactant system**

NaCl (wt%)	Solubilization Parameter for oil ( <i>SP<sub>o</sub></i> )					Solubilization Parameter for water ( <i>SP<sub>w</sub></i> )				
	1	2	3	Average	SD	1	2	3	Average	SD
2.4	5.225	5.627	5.579	5.477	0.219	12.154	12.074	12.042	12.090	0.058
2.5	5.900	5.305	5.402	5.536	0.319	10.080	10.016	10.546	10.214	0.290
2.6	6.013	6.173	6.366	6.184	0.177	8.939	8.746	8.858	8.848	0.097
2.7	6.608	6.318	6.463	6.463	0.145	7.845	8.360	8.231	8.146	0.268
3.0	7.781	7.781	7.685	7.749	0.056	6.415	6.511	6.704	6.543	0.147

**Table A-3 Solubilization parameter (*SP*) of decane in AOT/Tween80 surfactant system**

NaCl (wt%)	Solubilization Parameter for oil ( <i>SP<sub>o</sub></i> )					Solubilization Parameter for water ( <i>SP<sub>w</sub></i> )				
	1	2	3	Average	SD	1	2	3	Average	SD
2.9	3.842	3.666	3.569	3.692	0.139	11.591	11.415	11.447	11.484	0.094
3.0	3.360	3.505	4.164	3.676	0.428	10.241	10.144	9.775	10.053	0.246
3.5	3.987	4.662	3.810	4.153	0.450	6.495	6.286	6.591	6.458	0.156
3.8	5.145	4.694	5.659	5.166	0.483	5.112	4.598	4.678	4.796	0.277

**Table A-4 Solubilization parameter (*SP*) of pentane in AOT/AMA surfactant system**

NaCl (wt%)	Solubilization Parameter for oil ( <i>SP<sub>o</sub></i> )					Solubilization Parameter for water ( <i>SP<sub>w</sub></i> )				
	1	2	3	Average	SD	1	2	3	Average	SD
1.2	4.614	4.791	4.711	4.705	0.089	11.302	10.948	11.125	11.125	0.177
1.4	5.370	5.096	5.289	5.252	0.140	6.222	6.206	6.013	6.147	0.116
1.5	6.206	6.222	6.222	6.216	0.009	5.466	5.514	5.546	5.509	0.040
1.6	5.498	5.611	5.964	5.691	0.243	4.341	4.341	4.357	4.346	0.009
1.8	6.945	6.752	7.138	6.945	0.193	2.990	3.071	2.894	2.985	0.089
2.0	9.517	9.743	9.630	9.630	0.113	2.974	2.958	2.974	2.969	0.009



**Table A-5 Solubilization parameter (*SP*) of hexane in AOT/AMA surfactant system**

NaCl (wt%)	Solubilization Parameter for oil ( <i>SP<sub>o</sub></i> )					Solubilization Parameter for water ( <i>SP<sub>w</sub></i> )				
	1	2	3	Average	SD	1	2	3	Average	SD
1.4	4.630	4.646	4.678	4.652	0.025	13.810	13.778	13.730	13.772	0.040
1.5	4.260	4.453	4.212	4.309	0.128	8.601	8.601	8.521	8.574	0.046
2.0	5.418	5.402	5.466	5.429	0.033	4.035	4.067	4.035	4.046	0.019
2.5	9.276	9.196	9.244	9.239	0.040	2.974	3.022	2.974	2.990	0.028

**Table A-6 Solubilization parameter (*SP*) of octane in AOT/AMA surfactant system**

NaCl (wt%)	Solubilization Parameter for oil ( <i>SP<sub>o</sub></i> )					Solubilization Parameter for water ( <i>SP<sub>w</sub></i> )				
	1	2	3	Average	SD	1	2	3	Average	SD
1.9	2.926	2.942	2.990	2.953	0.033	7.090	7.074	7.138	7.101	0.033
2.0	2.604	2.669	2.588	2.621	0.043	6.447	6.479	6.463	6.463	0.016
2.5	2.910	2.894	2.990	2.931	0.052	4.662	4.807	4.839	4.769	0.094
3.4	4.711	4.759	4.791	4.753	0.040	3.022	2.958	3.087	3.022	0.064
3.8	4.952	4.775	5.000	4.909	0.119	2.540	2.588	2.460	2.529	0.065

**Table A-7 Relationship between  $\ln S^*$  vs oils' EACN of two surfactant systems**

		Surfactant Systems			
		AOT/Tween80		AOT/AMA	
Hydrocarbon oils	EACN	$S^*$	$\ln S^*$	$S^*$	$\ln S^*$
Pentane	5			1.49	0.40
Hexane	6	2.04	0.71	1.85	0.62
Octane	8	2.84	1.04	2.94	1.08
Decane	10	3.76	1.32		
<b>Equations</b>		$\ln S^* = 0.1529 \text{ EACN} - 0.1959$		$\ln S^* = 0.2273 \text{ EACN} - 0.7419$	

**Table A-8 Solubilization parameter ( $SP$ ) of TEL in hexane at molar ratio of 0.2: 0.8 in AOT/Tween80 surfactant system**

NaCl	$SP_o$	$SP_w$
1.8	7.781	15.369
1.9	6.688	12.717
2.0	9.003	9.952
2.1	10.755	8.296
2.2	11.206	8.617
2.3	14.550	6.881

**Table A-9 Solubilization parameter ( $SP$ ) of TEL in hexane at molar ratio of 0.2: 0.8 in AOT/AMA surfactant system**

NaCl	$SP_o$	$SP_w$
1.5	1.688	8.810
1.7	3.682	6.511
2.0	4.341	4.357
2.2	4.694	3.473
2.5	3.311	2.604

## APPENDIX B

### Experimental Data of Section 4.2 DBTDC preparation for TEL surrogate

**Table B-1 Solubilization parameter (*SP*) of DBTDC in octane at molar ratio of 0.011: 0.989 in AOT/AMA surfactant system**

NaCl	<i>SP<sub>o</sub></i>	<i>SP<sub>w</sub></i>
1.5	2.363	5.000
2.0	2.315	3.183
2.5	3.617	2.299
3.0	3.730	1.817
3.5	4.550	1.125
4.0	5.675	1.206

**Table B-2 Solubilization parameter (*SP*) of DBTDC in octane at molar ratio of 0.050: 0.950 in AOT/AMA surfactant system**

NaCl	<i>SP<sub>o</sub></i>	<i>SP<sub>w</sub></i>
0.5	1.141	2.813
1.0	1.817	2.186
1.5	2.058	1.849
2.0	2.669	1.367

**Table B-3 Solubilization parameter (*SP*) of DBTDC in decane at molar ratio of 0.035: 0.965 in AOT/AMA surfactant system**

NaCl	<i>SP<sub>o</sub></i>	<i>SP<sub>w</sub></i>
1.5	0.997	3.424
2.0	0.932	2.942
2.5	1.752	1.752
3.0	0.997	3.424

**Table B-4 Solubilization parameter (*SP*) of DBTDC in decane at molar ratio of 0.038: 0.962 in AOT/AMA surfactant system**

<b>NaCl</b>	<b><i>SP<sub>o</sub></i></b>	<b><i>SP<sub>w</sub></i></b>
1.2	1.640	2.460
1.6	1.752	2.219
2.0	1.768	2.138
2.5	1.833	1.688
2.8	1.817	1.672

**Table B-5 Solubilization parameter (*SP*) of DBTDC in decane at molar ratio of 0.042: 0.958 in AOT/AMA surfactant system**

<b>NaCl</b>	<b><i>SP<sub>o</sub></i></b>	<b><i>SP<sub>w</sub></i></b>
0.5	1.785	2.733
1.0	1.881	2.299
1.5	1.640	1.961
2.0	1.672	1.527
2.5	2.154	1.334
3.0	1.929	0.981
3.5	1.881	0.836

**Table B-6 Solubilization parameter (*SP*) of DBTDC in decane at molar ratio of 0.050: 0.950 in AOT/AMA surfactant system**

<b>NaCl</b>	<b><i>SP<sub>o</sub></i></b>	<b><i>SP<sub>w</sub></i></b>
0.5	1.576	2.412
1.0	1.672	1.897
1.5	1.833	1.720
3.0	2.106	1.013
3.5	2.122	0.788

## APPENDIX C

### Experimental Data of Section 4.3 Phase behavior study

**Table C-1 Observation on phase behavior of various surfactant systems investigated in this study**

Surfactant System (wt%)	NaCl (wt%)	Winsor Type	Note
<i>Single surfactant</i> 4% AMA	0	I	
	1	I	
	2.4	I	
	2.5	I <sub>sp</sub>	
	2.6	III	
	3	III	
	5	III	
	7	III	
4% Dowfax8390	0	-*	pp
	1	-	pp
	3	-	pp
	5	-	pp
	7	-	pp
4% Tween80	0	-	
	1	-	
	3	-	
	5	-	
	7	-	
4% Alfoterra167-7PO	0	-	pp
	1	-	pp
	3	-	pp
	5	-	pp
	7	-	pp



Table C-1 (Continue).

Surfactant System (wt%)	NaCl (wt%)	Winsor Type	Note
<i>Mixed surfactants</i> 2.4% AMA / 1.6% Dowfax 8390	0	I	
	1	I	
	3	I	
	5	I	
	7	I	
3.2% AMA / 0.8% Dowfax 8390	0	I	
	1	I	
	3	I	
	5	I	
	7	III	
3.6% AMA / 0.4% Dowfax 8390	0	I	
	1	I	
	3	I	
	4.2	I	
	4.3	I <sub>sp</sub>	
	4.4	III	
	4.5	III <sub>mob</sub>	
	5	III <sub>mob</sub>	
7	III <sub>mob</sub>		
2% AMA / 2% Tween80	0	-	
	1	-	
	3	I <sub>sp</sub>	
	3.1	III	
	3.2	III	
	5	III	
	7	III <sub>mob</sub>	

**Table C-1 (Continue).**

Surfactant System (wt%)	NaCl (wt%)	Winsor Type	Note
0.8% Dowfax8390/3.2% Tween80	0	I	pp
	1	I	pp
	3	I	pp
	5	I	pp
	7	I	pp
1.6% Dowfax8390/2.4% Tween80	0	I	pp
	1	I	pp
	3	I	pp
	5	I	pp
	7	I	pp

**Note:** This experiment was conducted at room temperature (24-28 °C) where:

\* indicates that microemulsion could not form.

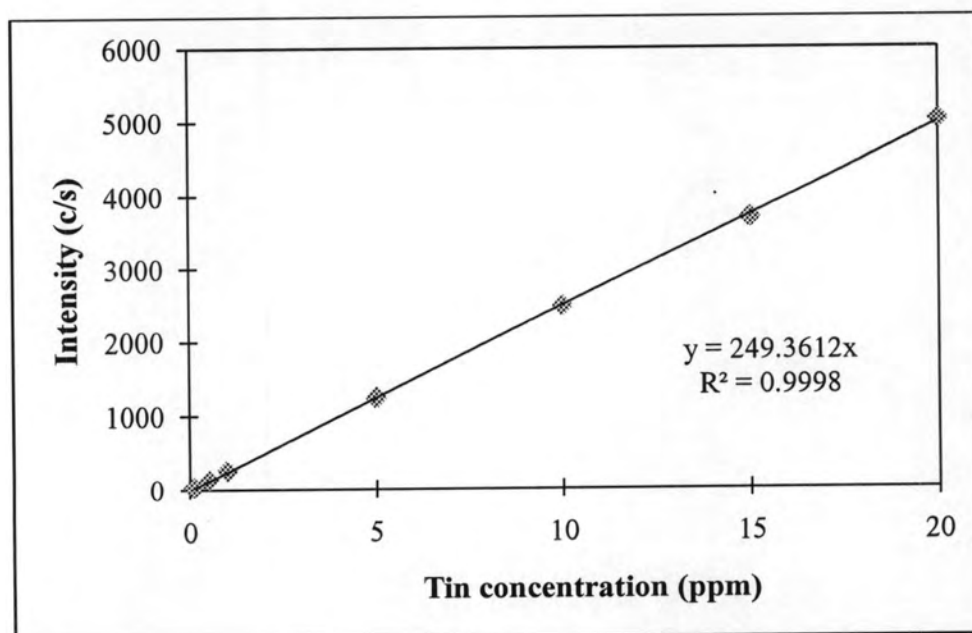
$I_{sp}$  indicates the Winsor type I with the supersolubilization condition could be investigated.

$I_{mob}$  indicates the Winsor type I with the oil mobilization could be found.

pp indicates the precipitation of oil and surfactant(s) could be found.

**APPENDIX D****Experimental Data of Section 4.4 Solubilization study****Table D-1 Standard curve of tin measured by ICP-AES**

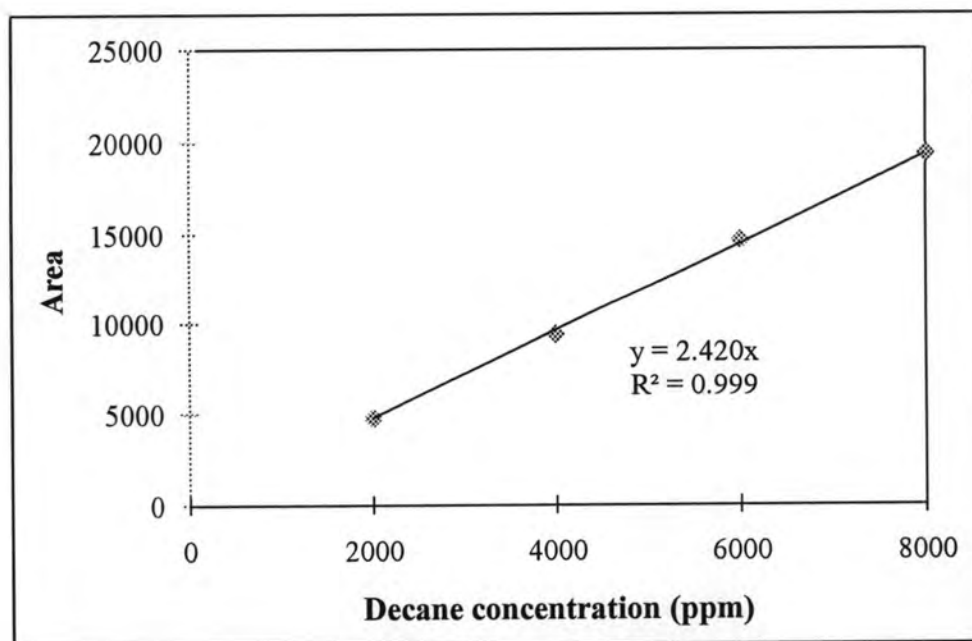
Tin Standard (ppm)	Intensity (c/s)
0.1	35.5
0.5	135.9
1	270.6
5	1246.9
10	2483.3
15	3695.7
20	5024.5

**Figure D-1 Standard curve of tin measured by ICP-AES**

**Table D-2 Standard curve of decane in 4 wt% AMA and 2.5 wt% NaCl system measured by GC-FID**

Decane Standard (ppm)	Area			
	1	2	Average	SD
2000	4514.3	5047.5	4780.9	7.89
4000	9023.0	9808.4	9415.7	5.90
6000	14569.0	14852.6	14710.8	1.36
8000	19186.0	19552.7	19369.4	1.34

**Note:** Extraction of decane in AMA surfactant system by hexane.

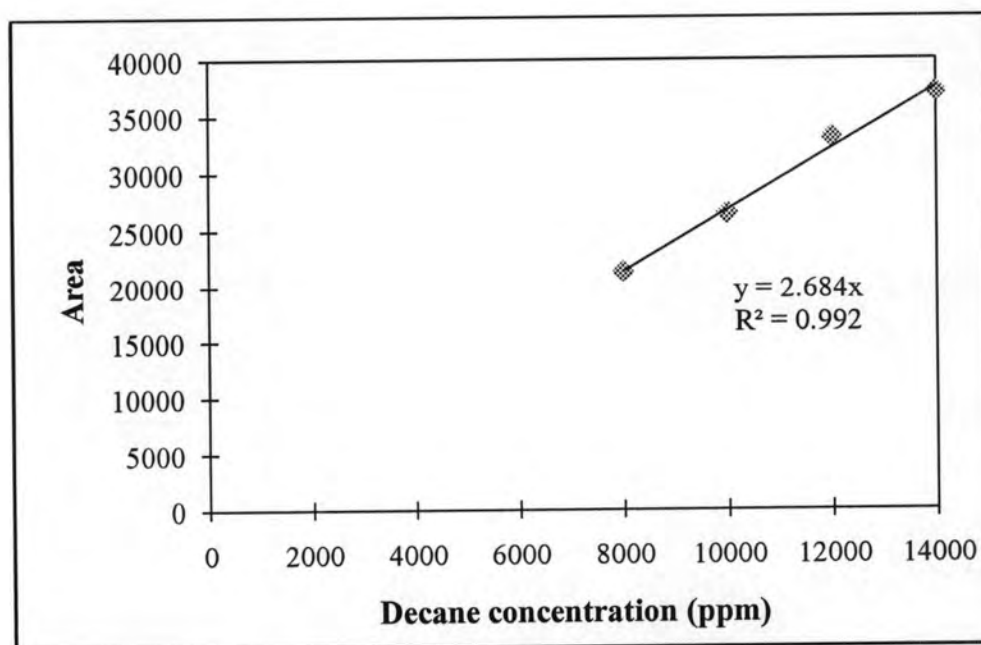


**Figure D-2 Standard curve of decane in 4 wt% AMA and 2.5 wt% NaCl system measured by GC-FID**

**Table D-3 Standard curve of decane in surfactant mixture of 3.6 wt% AMA, 0.4 wt% Dowfax8390 and 4.3 wt% NaCl measured by GC-FID**

Decane Standard (ppm)	Area			
	1	2	Average	SD
8000	21978.5	20798.2	21388.4	3.90
10000	26791.8	26200.0	26495.9	1.58
12000	32588.1	33608.1	33098.1	2.18
14000	36028.9	38183.9	37106.4	4.11

**Note:** Extraction of decane in AMA/Dowfax8390 surfactant system by hexane.



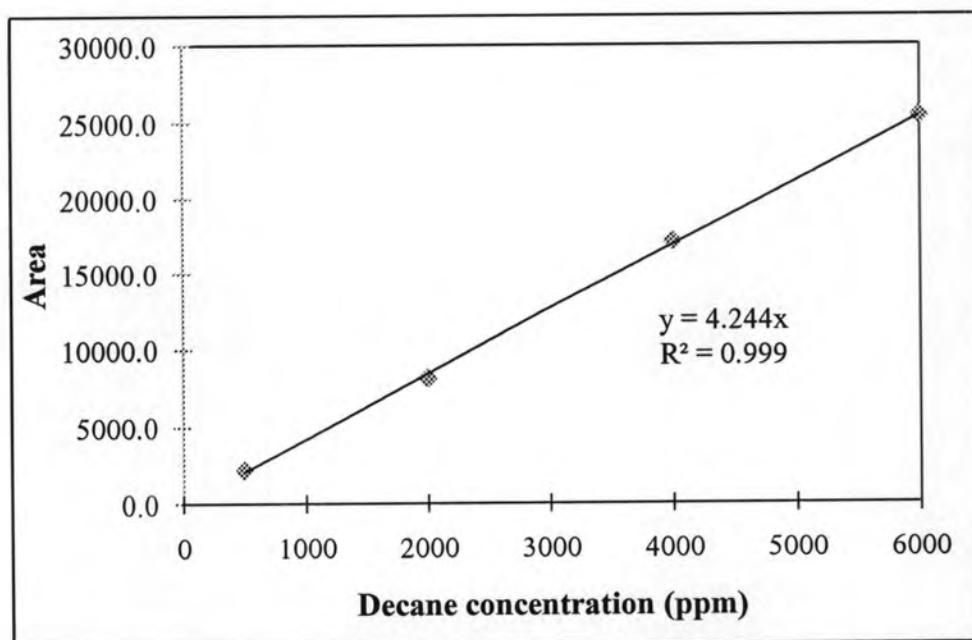
**Figure D-3 Standard curve of decane in surfactant mixture of 3.6 wt% AMA, 0.4 wt% Dowfax8390 and 4.3 wt% NaCl measured by GC-FID**



**Table D-4 Standard curve of decane in surfactant mixture of 2 wt% AMA, 2 wt% Tween80 and 3 wt% NaCl measured by GC-FID**

Decane Standard (ppm)	Area			
	1	2	Average	SD
500	2207.7	2227.5	2217.6	0.63
2000	8147.9	8212.4	8180.2	0.56
4000	16877.0	17412.8	17144.9	2.21
6000	25258.1	25647.2	25452.7	1.08

**Note:** Extraction of decane in AMA/Tween80 surfactant system by dichloromethane.



**Figure D-4 Standard curve of decane in surfactant mixture of 2 wt% AMA, 2 wt% Tween80 and 3.0 wt% NaCl measured by GC-FID**

**Table D-5 Mass of tin solubilization in each surfactant system at total 4 wt% concentration measured by ICP-AES**

Systems	Tin concentration (ppm)						Mass (mg)
	1	2	3	Average	SD	%RSD	
AMA	1505.00	1493.50	1478.13	1492.21	13.48	0.90	7.46
AMA/Dowfax	1501.50	1548.00	1548.38	1532.63	26.96	1.76	7.66
AMA/Tween	1393.63	1385.13	1430.63	1403.13	24.19	1.72	7.02

**Table D-6 Mass of decane solubilization in each surfactant system at total 4 wt% concentration obtained from solvent extraction and measured by GC-FID**

Systems	Area			Average	Concentration (ppm)	SD	%RSD	Mass (mg)
	1	2	3					
AMA	25156.70	28111.70	30235.50	27834.63	11501.91	2550.71	9.16	57.51
AMA/Dowfax	41652.30	44324.00	39817.60	41931.30	15622.69	2266.12	5.40	78.11
AMA/Tween	20774.60	19941.90	20042.50	20253.00	4772.15	454.51	2.24	23.86

**Note:** In Single AMA and AMA/Dowfax surfactant systems were extracted by hexane.

In AMA/Tween surfactant system was extracted by dichloromethane.

## APPENDIX E

### Experimental Data of Section 4.5 Column study

#### Terms Notification

- (i) The volume of TEL surrogate oil entrapment (Pabute, 2005)

$$A = x - (y + z)$$

where A = Volume of residual TEL surrogate oil in the column (mL)

x = Volume of TEL surrogate oil before the contamination procedure  
(total oil introduced to the column) (mL)

y = Volume of TEL surrogate oil after the contamination procedure  
(exiting column during PCE flooding) (mL)

z = Volume of the free phase of TEL surrogate oil leaving the column  
during water flushing (mL)

- (ii) %Residual saturation ( $S_N$ )

$$S_N = (A / B) \times 100$$

where A = Volume of residual TEL surrogate oil in the column (mL)

B = Volume of pore space (mL)

**Table E-1 Tin concentration and weight at different pore volumes of column study flushing with single 4 wt% AMA and 2.5 wt% NaCl**

No.	PV	Solubilization of tin			Mobilization
		ppm	mg	Accumulative mass (mg)	
1	0.5	11.93	0.09	0.14	✓
2	1.0	105.11	0.79	1.37	✓
3	1.5	195.37	1.48	3.99	✓
4	2.0	208.90	1.58	7.09	✓
5	2.5	191.44	1.45	10.05	✓
6	3.0	161.18	1.22	12.60	-*
7	3.5	125.50	0.95	14.64	-
8	4.0	80.55	0.61	16.02	-
9	4.5	45.49	0.34	16.84	-
10	5.0	36.79	0.28	17.43	-
11	5.5	39.49	0.30	18.02	-
12	6.0	36.91	0.28	18.59	-
13	6.5	39.92	0.30	19.18	-
14	7.0	40.27	0.30	19.79	-
15	7.5	41.21	0.31	20.41	-
16	8.0	42.74	0.32	21.05	-
17	8.5	44.46	0.34	21.71	-
18	9.0	44.59	0.34	22.39	-
19	9.5	44.76	0.34	23.06	-
20	10.0	53.83	0.41	23.84	-
21	10.5	57.41	0.43	24.70	-
22	11.0	74.30	0.56	25.76	-
23	11.5	74.13	0.56	26.88	-
24	12.0	73.64	0.56	27.99	-
25	12.5	66.76	0.50	29.03	-
26	13.0	57.99	0.44	29.94	-
27	13.5	65.87	0.50	30.91	-
28	14.0	73.80	0.56	31.99	-
29	14.5	65.57	0.50	33.01	-
30	15.0	62.33	0.47	33.97	-
31	15.5	57.92	0.44	34.86	-
32	16.0	60.91	0.46	35.77	-
33	16.5	50.06	0.38	36.57	-
34	17.0	46.80	0.35	37.29	-
35	17.5	43.35	0.33	37.96	-
36	18.0	37.84	0.29	38.55	-
37	18.5	45.35	0.34	39.21	-

Table E-1 (Continue).

No.	PV	Solubilization of tin			Mobilization
		ppm	mg	Accumulative mass (mg)	
38	19.0	40.59	0.31	39.84	-
39	19.5	31.73	0.24	40.35	-
40	20.0	29.06	0.22	40.80	-
41	20.5	28.83	0.22	41.24	-
42	21.0	28.46	0.22	41.67	-
43	21.5	23.51	0.18	42.04	-
44	22.0	24.70	0.19	42.41	-
45	22.5	22.93	0.17	42.77	-
46	23.0	25.50	0.19	43.14	-
47	23.5	22.09	0.17	43.49	-
48	24.0	21.83	0.17	43.82	-
49	24.5	20.87	0.16	44.14	-
50	25.0	22.07	0.17	44.47	-
51	25.5	19.15	0.14	44.77	-
52	26.0	18.06	0.14	45.05	-
53	26.5	17.74	0.13	45.32	-
54	27.0	16.71	0.13	45.57	-
55	27.5	17.79	0.13	45.84	-
56	28.0	16.41	0.12	46.09	-
57	28.5	14.81	0.11	46.32	-
58	29.0	15.48	0.12	46.55	-
59	29.5	13.22	0.10	46.76	-
60	30.0	14.02	0.11	46.97	-
61	31.0	13.28	0.10	47.38	-
62	32.0	12.04	0.09	47.76	-
63	33.0	12.37	0.09	48.13	-
64	34.0	10.62	0.08	48.47	-
65	35.0	14.09	0.11	48.86	-
66	36.0	11.25	0.09	49.23	-
67	37.0	9.50	0.07	49.54	-
68	38.0	8.88	0.07	49.81	-
69	39.0	8.17	0.06	50.07	-
70	40.0	8.85	0.07	50.33	-

**Note:** ✓ indicates that free phase oil mobilization could observe.

\* indicates that free phase oil mobilization could not observe.



**Table E-2 Tin concentration and weight at different pore volumes of column study flushing with surfactant mixture of 3.6 wt% AMA, 0.4 wt% Dowfax8390 and 4.3 wt% NaCl**

No.	PV	Solubilization of tin			Mobilization
		ppm	mg	Accumulative mass (mg)	
1	0.5	20.70	0.16	0.23	✓
2	1.0	163.73	1.24	2.17	✓
3	1.5	217.23	1.64	5.25	✓
4	2.0	190.22	1.44	8.23	✓
5	2.5	162.43	1.23	10.79	✓
6	3.0	147.73	1.12	13.08	-*
7	3.5	113.58	0.86	14.93	-
8	4.0	85.98	0.65	16.33	-
9	4.5	56.78	0.43	17.30	-
10	5.0	44.61	0.34	18.02	-
11	5.5	41.04	0.31	18.65	-
12	6.0	43.14	0.33	19.30	-
13	6.5	38.77	0.29	19.90	-
14	7.0	41.10	0.31	20.51	-
15	7.5	42.18	0.32	21.15	-
16	8.0	40.87	0.31	21.77	-
17	8.5	39.23	0.30	22.37	-
18	9.0	37.85	0.29	22.95	-
19	9.5	41.08	0.31	23.56	-
20	10.0	41.02	0.31	24.18	-
21	10.5	59.36	0.45	25.01	-
22	11.0	60.34	0.46	25.91	-
23	11.5	48.93	0.37	26.70	-
24	12.0	51.26	0.39	27.46	-
25	12.5	45.36	0.34	28.17	-
26	13.0	46.51	0.35	28.87	-
27	13.5	45.21	0.34	29.56	-
28	14.0	44.07	0.33	30.23	-
29	14.5	43.84	0.33	30.89	-
30	15.0	42.02	0.32	31.54	-
31	15.5	42.24	0.32	32.17	-
32	16.0	42.49	0.32	32.81	-
33	16.5	55.72	0.42	33.61	-
34	17.0	47.71	0.36	34.36	-
35	17.5	31.45	0.24	34.90	-
36	18.0	28.97	0.22	35.34	-

Table E-2 (Continue).

No.	PV	Solubilization of tin			Mobilization
		ppm	mg	Accumulative mass (mg)	
37	18.5	25.55	0.19	35.74	-
38	19.0	20.17	0.15	36.07	-
39	19.5	18.99	0.14	36.36	-
40	20.0	18.61	0.14	36.64	-
41	20.5	18.76	0.14	36.93	-
42	21.0	18.03	0.14	37.20	-
43	21.5	20.38	0.15	37.50	-
44	22.0	15.25	0.12	37.75	-
45	22.5	16.44	0.12	37.99	-
46	23.0	13.99	0.11	38.21	-
47	23.5	13.81	0.10	38.42	-
48	24.0	13.10	0.10	38.62	-
49	24.5	12.76	0.10	38.82	-
50	25.0	12.40	0.09	39.01	-
51	25.5	10.08	0.08	39.17	-
52	26.0	11.87	0.09	39.34	-
53	26.5	12.23	0.09	39.53	-
54	27.0	9.72	0.07	39.68	-
55	27.5	11.35	0.09	39.85	-
56	28.0	13.84	0.10	40.05	-
57	28.5	8.77	0.07	40.20	-
58	29.0	10.95	0.08	40.36	-
59	29.5	8.32	0.06	40.49	-
60	30.0	8.15	0.06	40.62	-
61	31.0	8.15	0.06	40.86	-
62	32.0	8.06	0.06	41.11	-
63	33.0	14.26	0.11	41.47	-
64	34.0	14.04	0.11	41.89	-
65	35.0	12.51	0.09	42.29	-
66	36.0	12.88	0.10	42.68	-
67	37.0	11.99	0.09	43.05	-
68	38.0	10.81	0.08	43.39	-
69	39.0	11.70	0.09	43.73	-
70	40.0	10.72	0.08	44.07	-

**Note:** ✓ indicates that free phase oil mobilization could observe.

\* indicates that free phase oil mobilization could not observe.

**Table E-3 Tin concentration and weight at different pore volumes of column study flushing with surfactant mixture of 2 wt% AMA, 2 wt% Tween80 and 3 wt% NaCl**

No.	PV	Solubilization of tin			Mobilization
		ppm	mg	Accumulative mass (mg)	
1	0.5	26.01	0.20	0.29	✓
2	1.0	150.38	1.14	2.10	✓
3	1.5	162.90	1.23	4.51	✓
4	2.0	145.36	1.10	6.78	✓
5	2.5	110.39	0.83	8.58	✓
6	3.0	105.78	0.80	10.20	✓
7	3.5	99.77	0.75	11.73	-*
8	4.0	89.43	0.68	13.12	-
9	4.5	83.76	0.63	14.41	-
10	5.0	74.13	0.56	15.56	-
11	5.5	72.94	0.55	16.67	-
12	6.0	69.97	0.53	17.74	-
13	6.5	66.24	0.50	18.76	-
14	7.0	69.00	0.52	19.79	-
15	7.5	69.39	0.52	20.84	-
16	8.0	72.92	0.55	21.93	-
17	8.5	76.87	0.58	23.07	-
18	9.0	79.94	0.60	24.27	-
19	9.5	79.11	0.60	25.47	-
20	10.0	81.49	0.62	26.69	-
21	10.5	75.82	0.57	27.86	-
22	11.0	84.23	0.64	29.10	-
23	11.5	85.56	0.65	30.39	-
24	12.0	83.43	0.63	31.66	-
25	12.5	88.28	0.67	32.98	-
26	13.0	68.59	0.52	34.09	-
27	13.5	83.80	0.63	35.30	-
28	14.0	82.61	0.62	36.55	-
29	14.5	84.24	0.64	37.82	-
30	15.0	93.68	0.71	39.20	-
31	15.5	100.60	0.76	40.69	-
32	16.0	96.95	0.73	42.17	-
33	16.5	82.48	0.62	43.48	-
34	17.0	75.06	0.57	44.64	-
35	17.5	66.33	0.50	45.67	-
36	18.0	58.31	0.44	46.59	-

Table E-3 (Continue).

No.	PV	Solubilization of tin			Mobilization
		ppm	mg	Accumulative mass (mg)	
37	18.5	52.07	0.39	47.40	-
38	19.0	46.60	0.35	48.12	-
39	19.5	43.35	0.33	48.79	-
40	20.0	40.28	0.30	49.41	-
41	20.5	35.69	0.27	49.97	-
42	21.0	34.83	0.26	50.50	-
43	21.5	33.30	0.25	51.01	-
44	22.0	30.65	0.23	51.48	-
45	22.5	34.22	0.26	51.98	-
46	23.0	28.84	0.22	52.44	-
47	23.5	26.85	0.20	52.85	-
48	24.0	25.67	0.19	53.25	-
49	24.5	24.62	0.19	53.62	-
50	25.0	25.19	0.19	54.00	-
51	25.5	22.12	0.17	54.35	-
52	26.0	21.68	0.16	54.68	-
53	26.5	23.25	0.18	55.02	-
54	27.0	24.55	0.19	55.39	-
55	27.5	28.69	0.22	55.81	-
56	28.0	19.89	0.15	56.14	-
57	28.5	19.10	0.14	56.43	-
58	29.0	20.62	0.16	56.74	-
59	29.5	19.35	0.15	57.04	-
60	30.0	21.15	0.16	57.35	-
61	31.0	17.67	0.13	57.92	-
62	32.0	16.66	0.13	58.44	-
63	33.0	15.99	0.12	58.93	-
64	34.0	15.23	0.12	59.40	-
65	35.0	14.88	0.11	59.85	-
66	36.0	13.56	0.10	60.28	-
67	37.0	13.47	0.10	60.69	-
68	38.0	12.22	0.09	61.07	-
69	39.0	12.31	0.09	61.44	-
70	40.0	13.54	0.10	61.84	-

**Note:** ✓ indicates that free phase oil mobilization could observe.

\* indicates that free phase oil mobilization could not observe.

## BIOGRAPHY

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