Supporting Information for:

Using Microemulsion Phase Behavior as a Predictive Model for Lecithin-Tween 80 Marine Oil Dispersant Effectiveness

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1. Compilation of Phase Separation Data

Sample ID (SID)	Dispersant:Oil:Water Ratio (w/w/w)	L:T Ratio (w/w)	Dispersant Density (g/mL)	Seawater Density (g/mL)	Hexadecane Density (g/mL)	Temperature at Mixing (°C)
1-00	0.5/0/99.5	0:100	1.001	1.0139	--	22
2-00	0.5/4.5/95	0:100	1.001	1.0139	0.773	22
3-00	0.5/14.5/85	0:100	1.001	1.0139	0.773	22
4-00	0.5/24.5/75	0:100	1.001	1.0139	0.773	22
5-00	0.5/34.5/65	0:100	1.001	1.0139	0.773	22
6-00	0.5/44.5/55	0:100	1.001	1.0139	0.773	22
7-00	0.5/54.5/45	0:100	1.001	1.0139	0.773	22
8-00	0.5/64.5/35	0:100	1.001	1.0139	0.773	22
9-00	0.5/74.5/25	0:100	1.001	1.0139	0.773	22
10-00	0.5/84.5/15	0:100	1.001	1.0139	0.773	22
11-00	0.5/94.5/5	0:100	1.001	1.0139	0.773	22
12-00	0.5/99.5/0	0:100	1.001	--	0.773	22
13-00	2/0/98	0:100	0.9952	1.0212	--	21
14-00	2/5/93	0:100	0.9952	1.0212	0.773	21
15-00	2/15/83	0:100	0.9952	1.0212	0.773	21
16-00	2/25/73	0:100	0.9952	1.0212	0.773	21
17-00	2/35/63	0:100	0.9952	1.0212	0.773	21
18-00	2/45/53	0:100	0.9952	1.0212	0.773	21
19-00	2/55/43	0:100	0.9952	1.0212	0.773	21
20-00	2/65/33	0:100	0.9952	1.0212	0.773	21
21-00	2/75/23	0:100	0.9952	1.0212	0.773	21
22-00	2/85/13	0:100	0.9952	1.0212	0.773	21
23-00	2/95/3	0:100	0.9952	1.0212	0.773	21
24-00	2/98/0	0:100	0.9952	--	0.773	21
25-00	5/0/95	0:100	1.001	1.0139	--	22
26-00	5/5/90	0:100	1.001	1.0139	0.773	22
27-00	5/10/85	0:100	1.001	1.0139	0.773	22
28-00	5/20/75	0:100	1.001	1.0139	0.773	22
29-00	5/30/65	0:100	1.001	1.0139	0.773	22
30-00	5/40/55	0:100	1.001	1.0139	0.773	22
31-00	5/50/45	0:100	1.001	1.0139	0.773	22
32-00	5/60/35	0:100	1.001	1.0139	0.773	22
33-00	5/70/25	0:100	1.001	1.0139	0.773	22
34-00	5/80/15	0:100	1.001	1.0139	0.773	22
35-00	5/90/5	0:100	1.001	1.0139	0.773	22
36-00	5/95/0	0:100	1.001	--	0.773	22
37-00	7/0/93	0:100	1.002	1.0139	--	22
38-00	7/5/88	0:100	1.002	1.0139	0.773	22
39-00	7/15/78	0:100	1.002	1.0139	0.773	22
40-00	7/25/68	0:100	1.002	1.0139	0.773	22
41-00	7/35/58	0:100	1.002	1.0139	0.773	22
42-00	7/45/48	0:100	1.002	1.0139	0.773	22
43-00	7/55/38	0:100	1.002	1.0139	0.773	22
44-00	7/65/28	0:100	1.002	1.0139	0.773	22
45-00	7/75/18	0:100	1.002	1.0139	0.773	22
46-00	7/85/8	0:100	1.002	1.0139	0.773	22
47-00	7/93/0	0:100	1.002	--	0.773	22
48-00	10/0/90	0:100	1.0032	1.0139	--	22
49-00	10/10/80	0:100	1.0032	1.0139	0.773	22
50-00	10/20/70	0:100	1.0032	1.0139	0.773	22
51-00	10/30/60	0:100	1.0032	1.0139	0.773	22
52-00	10/40/50	0:100	1.0032	1.0139	0.773	22
53-00	10/50/40	0:100	1.0032	1.0139	0.773	22
54-00	10/60/30	0:100	1.0032	1.0139	0.773	22
55-00	10/70/20	0:100	1.0032	1.0139	0.773	22
56-00	10/80/10	0:100	1.0032	1.0139	0.773	22
57-00	10/90/0	0:100	1.0032	--	0.773	22
58-00	20/0/80	0:100	1.0007	1.0139	--	22
59-00	20/10/70	0:100	1.0007	1.0139	0.773	22
60-00	20/20/60	0:100	1.0007	1.0139	0.773	22
61-00	20/30/50	0:100	1.0007	1.0139	0.773	22
62-00	20/40/40	0:100	1.0007	1.0139	0.773	22
63-00	20/50/30	0:100	1.0007	1.0139	0.773	22
64-00	20/60/20	0:100	1.0007	1.0139	0.773	22
65-00	20/70/10	0:100	1.0007	1.0139	0.773	22
66-00	20/80/0	0:100	1.0007	--	0.773	22

Table S1. Complete sample data for all samples at 0:100 L:T. The information within corresponds to the sample images and ternary phase diagram schematic presented in the main manuscript. All samples created follow the protocol outlined in the main manuscript.

Sample ID (SID)	Dispersant:Oil:Water Ratio (w/w/w)	L:T Ratio (w/w)	Dispersant Density (g/mL)	Seawater Density (g/mL)	Hexadecane Density (g/mL)	Temperature at Mixing (°C)
1-20	0.5/0/99.5	20:80	0.9828	1.0139	--	22
2-20	0.5/4.5/95	20:80	0.9828	1.0139	0.773	22
3-20	0.5/14.5/85	20:80	0.9828	1.0139	0.773	22
4-20	0.5/24.5/75	20:80	0.9828	1.0139	0.773	22
5-20	0.5/34.5/65	20:80	0.9828	1.0139	0.773	22
6-20	0.5/44.5/55	20:80	0.9828	1.0139	0.773	22
7-20	0.5/54.5/45	20:80	0.9828	1.0139	0.773	22
8-20	0.5/64.5/35	20:80	0.9828	1.0139	0.773	22
9-20	0.5/74.5/25	20:80	0.9828	1.0139	0.773	22
10-20	0.5/84.5/15	20:80	0.9828	1.0139	0.773	22
11-20	0.5/94.5/5	20:80	0.9828	1.0139	0.773	22
12-20	0.5/99.5/0	20:80	0.9828	--	0.773	22
13-20	2/0/98	20:80	0.9965	1.0212	--	21
14-20	2/5/93	20:80	0.9965	1.0212	0.773	21
15-20	2/15/83	20:80	0.9965	1.0212	0.773	21
16-20	2/25/73	20:80	0.9965	1.0212	0.773	21
17-20	2/35/63	20:80	0.9965	1.0212	0.773	21
18-20	2/45/53	20:80	0.9965	1.0212	0.773	21
19-20	2/55/43	20:80	0.9965	1.0212	0.773	21
20-20	2/65/33	20:80	0.9965	1.0212	0.773	21
21-20	2/75/23	20:80	0.9965	1.0212	0.773	21
22-20	2/85/13	20:80	0.9965	1.0212	0.773	21
23-20	2/95/3	20:80	0.9965	1.0212	0.773	21
24-20	2/98/0	20:80	0.9965	--	0.773	21
25-20	5/0/95	20:80	0.9963	1.0139	--	22
26-20	5/5/90	20:80	0.9963	1.0139	0.773	22
27-20	5/10/85	20:80	0.9963	1.0139	0.773	22
28-20	5/20/75	20:80	0.9963	1.0139	0.773	22
29-20	5/30/65	20:80	0.9963	1.0139	0.773	22
30-20	5/40/55	20:80	0.9963	1.0139	0.773	22
31-20	5/50/45	20:80	0.9963	1.0139	0.773	22
32-20	5/60/35	20:80	0.9963	1.0139	0.773	22
33-20	5/70/25	20:80	0.9963	1.0139	0.773	22
34-20	5/80/15	20:80	0.9963	1.0139	0.773	22
35-20	5/90/5	20:80	0.9963	1.0139	0.773	22
36-20	5/95/0	20:80	0.9963	--	0.773	22
37-20	7/0/93	20:80	0.9943	1.0139	--	22
38-20	7/5/88	20:80	0.9943	1.0139	0.773	22
39-20	7/15/78	20:80	0.9943	1.0139	0.773	22
40-20	7/25/68	20:80	0.9943	1.0139	0.773	22
41-20	7/35/58	20:80	0.9943	1.0139	0.773	22
42-20	7/45/48	20:80	0.9943	1.0139	0.773	22
43-20	7/55/38	20:80	0.9943	1.0139	0.773	22
44-20	7/65/28	20:80	0.9943	1.0139	0.773	22
45-20	7/75/18	20:80	0.9943	1.0139	0.773	22
46-20	7/85/8	20:80	0.9943	1.0139	0.773	22
47-20	7/93/0	20:80	0.9943	--	0.773	22
48-20	10/0/90	20:80	0.9933	1.0139	--	22
49-20	10/10/80	20:80	0.9933	1.0139	0.773	22
50-20	10/20/70	20:80	0.9933	1.0139	0.773	22
51-20	10/30/60	20:80	0.9933	1.0139	0.773	22
52-20	10/40/50	20:80	0.9933	1.0139	0.773	22
53-20	10/50/40	20:80	0.9933	1.0139	0.773	22
54-20	10/60/30	20:80	0.9933	1.0139	0.773	22
55-20	10/70/20	20:80	0.9933	1.0139	0.773	22
56-20	10/80/10	20:80	0.9933	1.0139	0.773	22
57-20	10/90/0	20:80	0.9933	--	0.773	22
58-20	20/0/80	20:80	0.9903	1.01765	--	22
59-20	20/10/70	20:80	0.9903	1.01765	0.773	22
60-20	20/20/60	20:80	0.9903	1.01765	0.773	22
61-20	20/30/50	20:80	0.9903	1.01765	0.773	22
62-20	20/40/40	20:80	0.9903	1.01765	0.773	22
63-20	20/50/30	20:80	0.9903	1.01765	0.773	22
64-20	20/60/20	20:80	0.9903	1.01765	0.773	22
65-20	20/70/10	20:80	0.9903	1.01765	0.773	22
66-20	20/80/0	20:80	0.9903	--	0.773	22

Table S2. Complete sample data for all samples at 20:80 L:T. The information within corresponds to the sample images and ternary phase diagram schematic presented in the main manuscript. All samples created follow the protocol outlined in the main manuscript.

Sample ID (SID)	Dispersant:Oil:Water Ratio (w/w/w)	L:T Ratio (w/w)	Dispersant Density (g/mL)	Seawater Density (g/mL)	Hexadecane Density (g/mL)	Temperature at Mixing (°C)
1-40	0.5/0/99.5	40:60	0.9895	1.0139	--	21
2-40	0.5/4.5/95	40:60	0.9895	1.0139	0.773	21
3-40	0.5/14.5/85	40:60	0.9895	1.0139	0.773	21
4-40	0.5/24.5/75	40:60	0.9895	1.0139	0.773	21
5-40	0.5/34.5/65	40:60	0.9895	1.0139	0.773	21
6-40	0.5/44.5/55	40:60	0.9895	1.0139	0.773	21
7-40	0.5/54.5/45	40:60	0.9895	1.0139	0.773	21
8-40	0.5/64.5/35	40:60	0.9895	1.0139	0.773	21
9-40	0.5/74.5/25	40:60	0.9895	1.0139	0.773	21
10-40	0.5/84.5/15	40:60	0.9895	1.0139	0.773	21
11-40	0.5/94.5/5	40:60	0.9895	1.0139	0.773	21
12-40	0.5/99.5/0	40:60	0.9895	--	0.773	21
13-40	2/0/98	40:60	0.9935	1.0212	--	21
14-40	2/5/93	40:60	0.9935	1.0212	0.773	21
15-40	2/15/83	40:60	0.9935	1.0212	0.773	21
16-40	2/25/73	40:60	0.9935	1.0212	0.773	21
17-40	2/35/63	40:60	0.9935	1.0212	0.773	21
18-40	2/45/53	40:60	0.9935	1.0212	0.773	21
19-40	2/55/43	40:60	0.9935	1.0212	0.773	21
20-40	2/65/33	40:60	0.9935	1.0212	0.773	21
21-40	2/75/23	40:60	0.9935	1.0212	0.773	21
22-40	2/85/13	40:60	0.9935	1.0212	0.773	21
23-40	2/95/3	40:60	0.9935	1.0212	0.773	21
24-40	2/98/0	40:60	0.9935	--	0.773	21
25-40	5/0/95	40:60	0.986	1.0139	--	22
26-40	5/5/90	40:60	0.986	1.0139	0.773	22
27-40	5/10/85	40:60	0.986	1.0139	0.773	22
28-40	5/20/75	40:60	0.986	1.0139	0.773	22
29-40	5/30/65	40:60	0.986	1.0139	0.773	22
30-40	5/40/55	40:60	0.986	1.0139	0.773	22
31-40	5/50/45	40:60	0.986	1.0139	0.773	22
32-40	5/60/35	40:60	0.986	1.0139	0.773	22
33-40	5/70/25	40:60	0.986	1.0139	0.773	22
34-40	5/80/15	40:60	0.986	1.0139	0.773	22
35-40	5/90/5	40:60	0.986	1.0139	0.773	22
36-40	5/95/0	40:60	0.986	--	0.773	22
37-40	7/0/93	40:60	0.9823	1.0212	--	22
38-40	7/5/88	40:60	0.9823	1.0212	0.773	22
39-40	7/15/78	40:60	0.9823	1.0212	0.773	22
40-40	7/25/68	40:60	0.9823	1.0212	0.773	22
41-40	7/35/58	40:60	0.9823	1.0212	0.773	22
42-40	7/45/48	40:60	0.9823	1.0212	0.773	22
43-40	7/55/38	40:60	0.9823	1.0212	0.773	22
44-40	7/65/28	40:60	0.9823	1.0212	0.773	22
45-40	7/75/18	40:60	0.9823	1.0212	0.773	22
46-40	7/85/8	40:60	0.9823	1.0212	0.773	22
47-40	7/93/0	40:60	0.9823	--	0.773	22
48-40	10/0/90	40:60	0.9753	1.0203	--	23
49-40	10/10/80	40:60	0.9753	1.0203	0.773	23
50-40	10/20/70	40:60	0.9753	1.0203	0.773	23
51-40	10/30/60	40:60	0.9753	1.0203	0.773	23
52-40	10/40/50	40:60	0.9753	1.0203	0.773	23
53-40	10/50/40	40:60	0.9753	1.0203	0.773	23
54-40	10/60/30	40:60	0.9753	1.0203	0.773	23
55-40	10/70/20	40:60	0.9753	1.0203	0.773	23
56-40	10/80/10	40:60	0.9753	1.0203	0.773	23
57-40	10/90/0	40:60	0.9753	--	0.773	23
58-40	20/0/80	40:60	0.9852	1.0139	--	22
59-40	20/10/70	40:60	0.9852	1.0139	0.773	22
60-40	20/20/60	40:60	0.9852	1.0139	0.773	22
61-40	20/30/50	40:60	0.9852	1.0139	0.773	22
62-40	20/40/40	40:60	0.9852	1.0139	0.773	22
63-40	20/50/30	40:60	0.9852	1.0139	0.773	22
64-40	20/60/20	40:60	0.9852	1.0139	0.773	22
65-40	20/70/10	40:60	0.9852	1.0139	0.773	22
66-40	20/80/0	40:60	0.9852	--	0.773	22

Table S3. Complete sample data for all samples at 40:60 L:T. The information within corresponds to the sample images and ternary phase diagram schematic presented in the main manuscript. All samples created follow the protocol outlined in the main manuscript.

Sample ID (SID)	Dispersant:Oil:Water Ratio (w/w/w)	L:T Ratio (w/w)	Dispersant Density (g/mL)	Seawater Density (g/mL)	Hexadecane Density (g/mL)	Temperature at Mixing (°C)
1-60	0.5/0/99.5	60:40	0.9777	1.0139	--	21
2-60	0.5/4.5/95	60:40	0.9777	1.0139	0.773	21
3-60	0.5/14.5/85	60:40	0.9777	1.0139	0.773	21
4-60	0.5/24.5/75	60:40	0.9777	1.0139	0.773	21
5-60	0.5/34.5/65	60:40	0.9777	1.0139	0.773	21
6-60	0.5/44.5/55	60:40	0.9777	1.0139	0.773	21
7-60	0.5/54.5/45	60:40	0.9777	1.0139	0.773	21
8-60	0.5/64.5/35	60:40	0.9777	1.0139	0.773	21
9-60	0.5/74.5/25	60:40	0.9777	1.0139	0.773	21
10-60	0.5/84.5/15	60:40	0.9777	1.0139	0.773	21
11-60	0.5/94.5/5	60:40	0.9777	1.0139	0.773	21
12-60	0.5/99.5/0	60:40	0.9777	--	0.773	21
13-60	2/0/98	60:40	0.982	1.0212	--	21
14-60	2/5/93	60:40	0.982	1.0212	0.773	21
15-60	2/15/83	60:40	0.982	1.0212	0.773	21
16-60	2/25/73	60:40	0.982	1.0212	0.773	21
17-60	2/35/63	60:40	0.982	1.0212	0.773	21
18-60	2/45/53	60:40	0.982	1.0212	0.773	21
19-60	2/55/43	60:40	0.982	1.0212	0.773	21
20-60	2/65/33	60:40	0.982	1.0212	0.773	21
21-60	2/75/23	60:40	0.982	1.0212	0.773	21
22-60	2/85/13	60:40	0.982	1.0212	0.773	21
23-60	2/95/3	60:40	0.982	1.0212	0.773	21
24-60	2/98/0	60:40	0.982	--	0.773	21
25-60	5/0/95	60:40	0.9652	1.01765	--	24
26-60	5/5/90	60:40	0.9652	1.01765	0.773	24
27-60	5/10/85	60:40	0.9652	1.01765	0.773	24
28-60	5/20/75	60:40	0.9652	1.01765	0.773	24
29-60	5/30/65	60:40	0.9652	1.01765	0.773	24
30-60	5/40/55	60:40	0.9652	1.01765	0.773	24
31-60	5/50/45	60:40	0.9652	1.01765	0.773	24
32-60	5/60/35	60:40	0.9652	1.01765	0.773	24
33-60	5/70/25	60:40	0.9652	1.01765	0.773	24
34-60	5/80/15	60:40	0.9652	1.01765	0.773	24
35-60	5/90/5	60:40	0.9652	1.01765	0.773	24
36-60	5/95/0	60:40	0.9652	--	0.773	24
37-60	7/0/93	60:40	0.9755	1.0212	--	21
38-60	7/5/88	60:40	0.9755	1.0212	0.773	21
39-60	7/15/78	60:40	0.9755	1.0212	0.773	21
40-60	7/25/68	60:40	0.9755	1.0212	0.773	21
41-60	7/35/58	60:40	0.9755	1.0212	0.773	21
42-60	7/45/48	60:40	0.9755	1.0212	0.773	21
43-60	7/55/38	60:40	0.9755	1.0212	0.773	21
44-60	7/65/28	60:40	0.9755	1.0212	0.773	21
45-60	7/75/18	60:40	0.9755	1.0212	0.773	21
46-60	7/85/8	60:40	0.9755	1.0212	0.773	21
47-60	7/93/0	60:40	0.9755	--	0.773	21
48-60	10/0/90	60:40	0.9547	1.01765	--	23
49-60	10/10/80	60:40	0.9547	1.01765	0.773	23
50-60	10/20/70	60:40	0.9547	1.01765	0.773	23
51-60	10/30/60	60:40	0.9547	1.01765	0.773	23
52-60	10/40/50	60:40	0.9547	1.01765	0.773	23
53-60	10/50/40	60:40	0.9547	1.01765	0.773	23
54-60	10/60/30	60:40	0.9547	1.01765	0.773	23
55-60	10/70/20	60:40	0.9547	1.01765	0.773	23
56-60	10/80/10	60:40	0.9547	1.01765	0.773	23
57-60	10/90/0	60:40	0.9547	--	0.773	23
58-60	20/0/80	60:40	0.9783	1.0139	--	22
59-60	20/10/70	60:40	0.9783	1.0139	0.773	22
60-60	20/20/60	60:40	0.9783	1.0139	0.773	22
61-60	20/30/50	60:40	0.9783	1.0139	0.773	22
62-60	20/40/40	60:40	0.9783	1.0139	0.773	22
63-60	20/50/30	60:40	0.9783	1.0139	0.773	22
64-60	20/60/20	60:40	0.9783	1.0139	0.773	22
65-60	20/70/10	60:40	0.9783	1.0139	0.773	22
66-60	20/80/0	60:40	0.9783	--	0.773	22

Table S4. Complete sample data for all samples at 60:40 L:T. The information within corresponds to the sample images and ternary phase diagram schematic presented in the main manuscript. All samples created follow the protocol outlined in the main manuscript.

Sample ID (SID)	Dispersant:Oil:Water Ratio (w/w/w)	L:T Ratio (w/w)	Dispersant Density (g/mL)	Seawater Density (g/mL)	Hexadecane Density (g/mL)	Temperature at Mixing (°C)
1-80	0.5/0/99.5	80:20	0.9657	1.0139	--	21
2-80	0.5/4.5/95	80:20	0.9657	1.0139	0.773	21
3-80	0.5/14.5/85	80:20	0.9657	1.0139	0.773	21
4-80	0.5/24.5/75	80:20	0.9657	1.0139	0.773	21
5-80	0.5/34.5/65	80:20	0.9657	1.0139	0.773	21
6-80	0.5/44.5/55	80:20	0.9657	1.0139	0.773	21
7-80	0.5/54.5/45	80:20	0.9657	1.0139	0.773	21
8-80	0.5/64.5/35	80:20	0.9657	1.0139	0.773	21
9-80	0.5/74.5/25	80:20	0.9657	1.0139	0.773	21
10-80	0.5/84.5/15	80:20	0.9657	1.0139	0.773	21
11-80	0.5/94.5/5	80:20	0.9657	1.0139	0.773	21
12-80	0.5/99.5/0	80:20	0.9657	--	0.773	21
13-80	2/0/98	80:20	0.9645	1.0212	--	21
14-80	2/5/93	80:20	0.9645	1.0212	0.773	21
15-80	2/15/83	80:20	0.9645	1.0212	0.773	21
16-80	2/25/73	80:20	0.9645	1.0212	0.773	21
17-80	2/35/63	80:20	0.9645	1.0212	0.773	21
18-80	2/45/53	80:20	0.9645	1.0212	0.773	21
19-80	2/55/43	80:20	0.9645	1.0212	0.773	21
20-80	2/65/33	80:20	0.9645	1.0212	0.773	21
21-80	2/75/23	80:20	0.9645	1.0212	0.773	21
22-80	2/85/13	80:20	0.9645	1.0212	0.773	21
23-80	2/95/3	80:20	0.9645	1.0212	0.773	21
24-80	2/98/0	80:20	0.9645	--	0.773	21
25-80	5/0/95	80:20	0.958	1.01765	--	22
26-80	5/5/90	80:20	0.958	1.01765	0.773	22
27-80	5/10/85	80:20	0.958	1.01765	0.773	22
28-80	5/20/75	80:20	0.958	1.01765	0.773	22
29-80	5/30/65	80:20	0.958	1.01765	0.773	22
30-80	5/40/55	80:20	0.958	1.01765	0.773	22
31-80	5/50/45	80:20	0.958	1.01765	0.773	22
32-80	5/60/35	80:20	0.958	1.01765	0.773	22
33-80	5/70/25	80:20	0.958	1.01765	0.773	22
34-80	5/80/15	80:20	0.958	1.01765	0.773	22
35-80	5/90/5	80:20	0.958	1.01765	0.773	22
36-80	5/95/0	80:20	0.958	--	0.773	22
37-80	7/0/93	80:20	0.9693	1.0212	--	21
38-80	7/5/88	80:20	0.9693	1.0212	0.773	21
39-80	7/15/78	80:20	0.9693	1.0212	0.773	21
40-80	7/25/68	80:20	0.9693	1.0212	0.773	21
41-80	7/35/58	80:20	0.9693	1.0212	0.773	21
42-80	7/45/48	80:20	0.9693	1.0212	0.773	21
43-80	7/55/38	80:20	0.9693	1.0212	0.773	21
44-80	7/65/28	80:20	0.9693	1.0212	0.773	21
45-80	7/75/18	80:20	0.9693	1.0212	0.773	21
46-80	7/85/8	80:20	0.9693	1.0212	0.773	21
47-80	7/93/0	80:20	0.9693	--	0.773	21
48-80	10/0/90	80:20	0.9602	1.01765	--	22
49-80	10/10/80	80:20	0.9602	1.01765	0.773	22
50-80	10/20/70	80:20	0.9602	1.01765	0.773	22
51-80	10/30/60	80:20	0.9602	1.01765	0.773	22
52-80	10/40/50	80:20	0.9602	1.01765	0.773	22
53-80	10/50/40	80:20	0.9602	1.01765	0.773	22
54-80	10/60/30	80:20	0.9602	1.01765	0.773	22
55-80	10/70/20	80:20	0.9602	1.01765	0.773	22
56-80	10/80/10	80:20	0.9602	1.01765	0.773	22
57-80	10/90/0	80:20	0.9602	--	0.773	22
58-80	20/0/80	80:20	0.9583	1.01765	--	22
59-80	20/10/70	80:20	0.9583	1.01765	0.773	22
60-80	20/20/60	80:20	0.9583	1.01765	0.773	22
61-80	20/30/50	80:20	0.9583	1.01765	0.773	22
62-80	20/40/40	80:20	0.9583	1.01765	0.773	22
63-80	20/50/30	80:20	0.9583	1.01765	0.773	22
64-80	20/60/20	80:20	0.9583	1.01765	0.773	22
65-80	20/70/10	80:20	0.9583	1.01765	0.773	22
66-80	20/80/0	80:20	0.9583	--	0.773	22

Table S5. Complete sample data for all samples at 80:20 L:T. The information within corresponds to the sample images and ternary phase diagram schematic presented in the main manuscript. All samples created follow the protocol outlined in the main manuscript.

Sample ID (SID)	Dispersant:Oil:Water Ratio (w/w/w)	L:T Ratio (w/w)	Dispersant Density (g/mL)	Seawater Density (g/mL)	Hexadecane Density (g/mL)	Temperature at Mixing (°C)
1-100	0.5/0/99.5	100:0	0.9545	1.0139	--	21
2-100	0.5/4.5/95	100:0	0.9545	1.0139	0.773	21
3-100	0.5/14.5/85	100:0	0.9545	1.0139	0.773	21
4-100	0.5/24.5/75	100:0	0.9545	1.0139	0.773	21
5-100	0.5/34.5/65	100:0	0.9545	1.0139	0.773	21
6-100	0.5/44.5/55	100:0	0.9545	1.0139	0.773	21
7-100	0.5/54.5/45	100:0	0.9545	1.0139	0.773	21
8-100	0.5/64.5/35	100:0	0.9545	1.0139	0.773	21
9-100	0.5/74.5/25	100:0	0.9545	1.0139	0.773	21
10-100	0.5/84.5/15	100:0	0.9545	1.0139	0.773	21
11-100	0.5/94.5/5	100:0	0.9545	1.0139	0.773	21
12-100	0.5/99.5/0	100:0	0.9545	--	0.773	21
13-100	2/0/98	100:0	0.9562	1.0212	--	21
14-100	2/5/93	100:0	0.9562	1.0212	0.773	21
15-100	2/15/83	100:0	0.9562	1.0212	0.773	21
16-100	2/25/73	100:0	0.9562	1.0212	0.773	21
17-100	2/35/63	100:0	0.9562	1.0212	0.773	21
18-100	2/45/53	100:0	0.9562	1.0212	0.773	21
19-100	2/55/43	100:0	0.9562	1.0212	0.773	21
20-100	2/65/33	100:0	0.9562	1.0212	0.773	21
21-100	2/75/23	100:0	0.9562	1.0212	0.773	21
22-100	2/85/13	100:0	0.9562	1.0212	0.773	21
23-100	2/95/3	100:0	0.9562	1.0212	0.773	21
24-100	2/98/0	100:0	0.9562	--	0.773	21
25-100	5/0/95	100:0	0.96	1.01765	--	23
26-100	5/5/90	100:0	0.96	1.01765	0.773	23
27-100	5/10/85	100:0	0.96	1.01765	0.773	23
28-100	5/20/75	100:0	0.96	1.01765	0.773	23
29-100	5/30/65	100:0	0.96	1.01765	0.773	23
30-100	5/40/55	100:0	0.96	1.01765	0.773	23
31-100	5/50/45	100:0	0.96	1.01765	0.773	23
32-100	5/60/35	100:0	0.96	1.01765	0.773	23
33-100	5/70/25	100:0	0.96	1.01765	0.773	23
34-100	5/80/15	100:0	0.96	1.01765	0.773	23
35-100	5/90/5	100:0	0.96	1.01765	0.773	23
36-100	5/95/0	100:0	0.96	--	0.773	23
37-100	7/0/93	100:0	0.9596	1.0212	--	21
38-100	7/5/88	100:0	0.9596	1.0212	0.773	21
39-100	7/15/78	100:0	0.9596	1.0212	0.773	21
40-100	7/25/68	100:0	0.9596	1.0212	0.773	21
41-100	7/35/58	100:0	0.9596	1.0212	0.773	21
42-100	7/45/48	100:0	0.9596	1.0212	0.773	21
43-100	7/55/38	100:0	0.9596	1.0212	0.773	21
44-100	7/65/28	100:0	0.9596	1.0212	0.773	21
45-100	7/75/18	100:0	0.9596	1.0212	0.773	21
46-100	7/85/8	100:0	0.9596	1.0212	0.773	21
47-100	7/93/0	100:0	0.9596	--	0.773	21
48-100	10/0/90	100:0	0.9563	1.0139	--	22
49-100	10/10/80	100:0	0.9563	1.0139	0.773	22
50-100	10/20/70	100:0	0.9563	1.0139	0.773	22
51-100	10/30/60	100:0	0.9563	1.0139	0.773	22
52-100	10/40/50	100:0	0.9563	1.0139	0.773	22
53-100	10/50/40	100:0	0.9563	1.0139	0.773	22
54-100	10/60/30	100:0	0.9563	1.0139	0.773	22
55-100	10/70/20	100:0	0.9563	1.0139	0.773	22
56-100	10/80/10	100:0	0.9563	1.0139	0.773	22
57-100	10/90/0	100:0	0.9563	--	0.773	22
58-100	20/0/80	100:0	0.9555	1.0139	--	22
59-100	20/10/70	100:0	0.9555	1.0139	0.773	22
60-100	20/20/60	100:0	0.9555	1.0139	0.773	22
61-100	20/30/50	100:0	0.9555	1.0139	0.773	22
62-100	20/40/40	100:0	0.9555	1.0139	0.773	22
63-100	20/50/30	100:0	0.9555	1.0139	0.773	22
64-100	20/60/20	100:0	0.9555	1.0139	0.773	22
65-100	20/70/10	100:0	0.9555	1.0139	0.773	22
66-100	20/80/0	100:0	0.9555	--	0.773	22

Table S6. Complete sample data for all samples at 100:0 L:T. The information within corresponds to the sample images and ternary phase diagram schematic presented in the main manuscript. All samples created follow the protocol outlined in the main manuscript.

Sample Image Subset: Immediately After Mixing

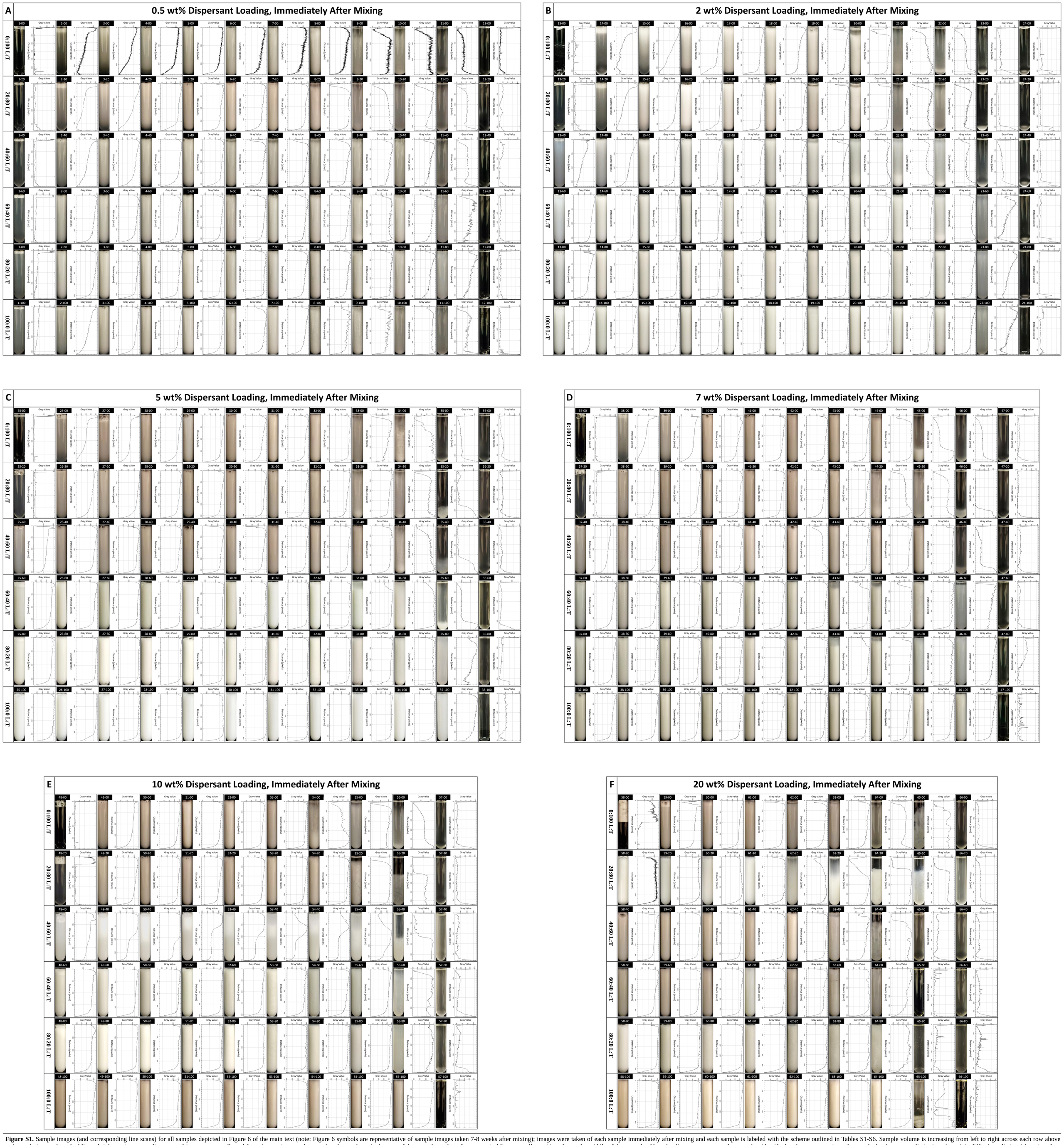


Figure S1. Sample images (and corresponding line scans) for all samples depicted in Figure 6 of the main text (note: Figure 6 symbols are representative of sample images taken 7-8 weeks after mixing); images were taken of each sample immediately after mixing and each sample is labeled with the scheme outlined in Tables S1-S6. Sample volume is increasing from left to right across each row above and sample images have had linear brightness/contrast adjustments. Line scans are collected from the meniscus at the top of each sample to the bottom of the test tube and are from a vertical line generally positioned near the middle of the test tube. Note that line scans were used as a tool to identify the phases present in each test tube but have some limitations (*e.g.*, it is difficult to distinguish an interface between a clear and light yellow phase as both appear as the same color with a black background and glare from the image can cause bright lines to appear across some samples which is reflected in the corresponding line scan). Thus, all information gathered from the line scans was augmented with visual observation. Sample images for 0.5 wt%, 2 wt%, 5 wt%, 7 wt%, 10 wt%, and 20 wt% dispersant loadings can be found in the grids labelled (A), (B), (C), (D), (E), and (F) respectively.

Sample Image Subset: 3-4 Weeks After Mixing

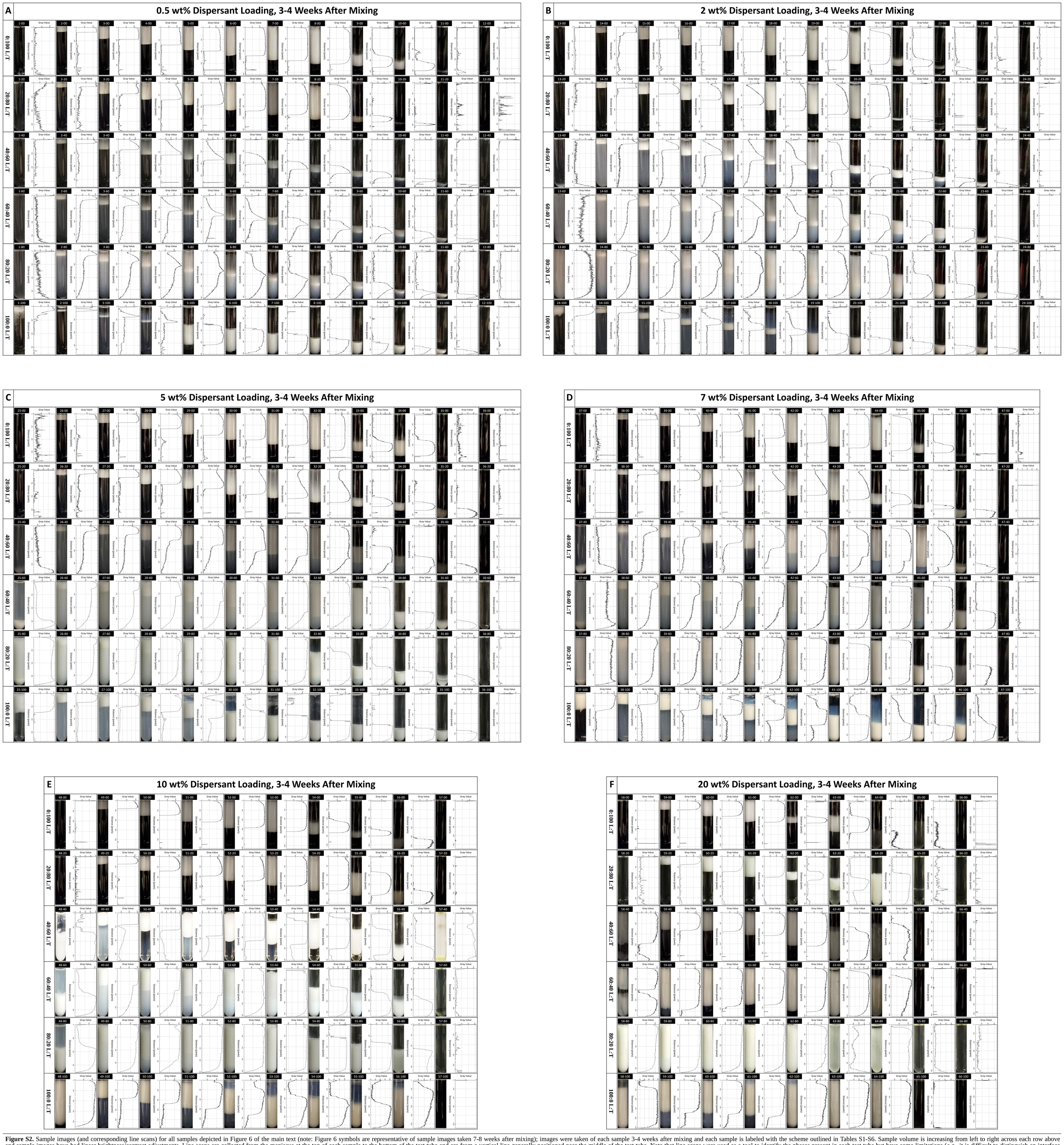
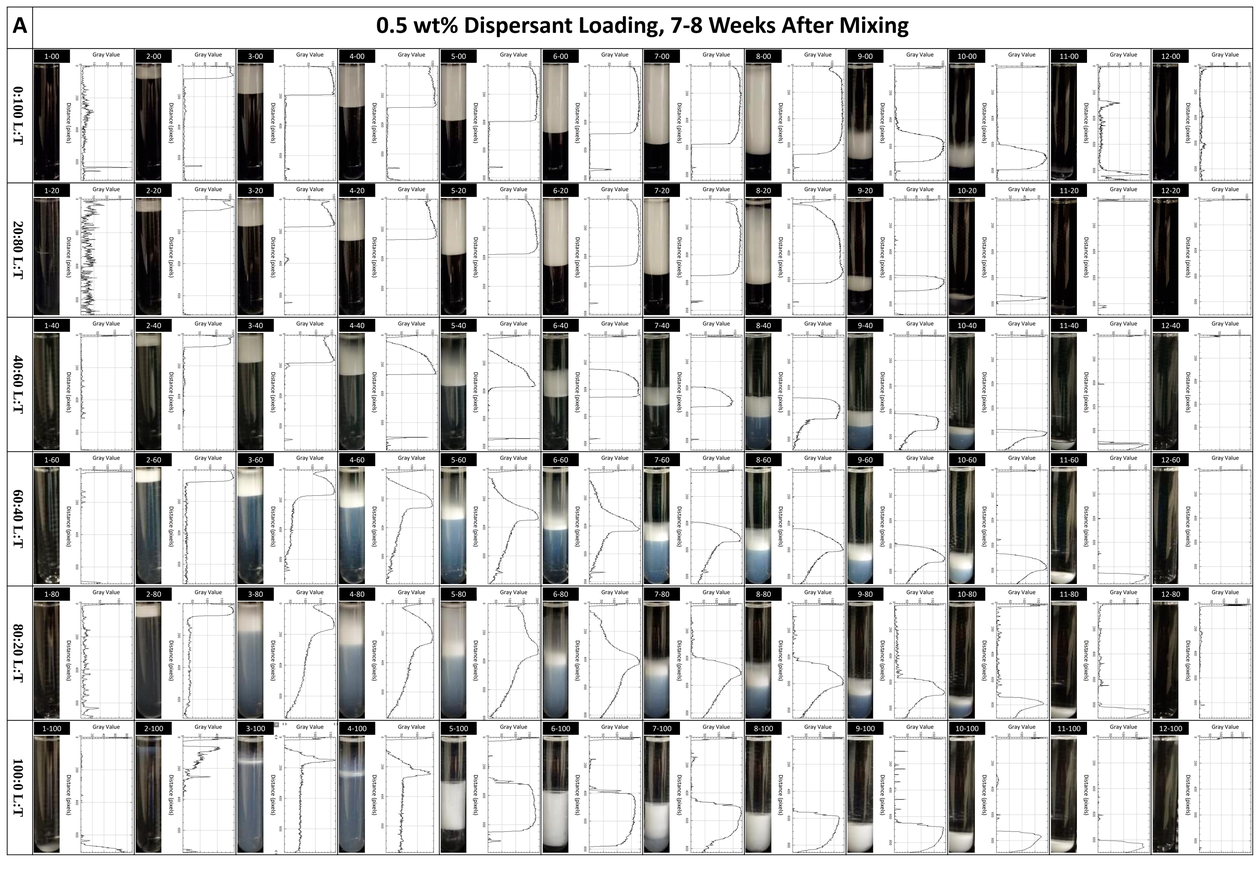
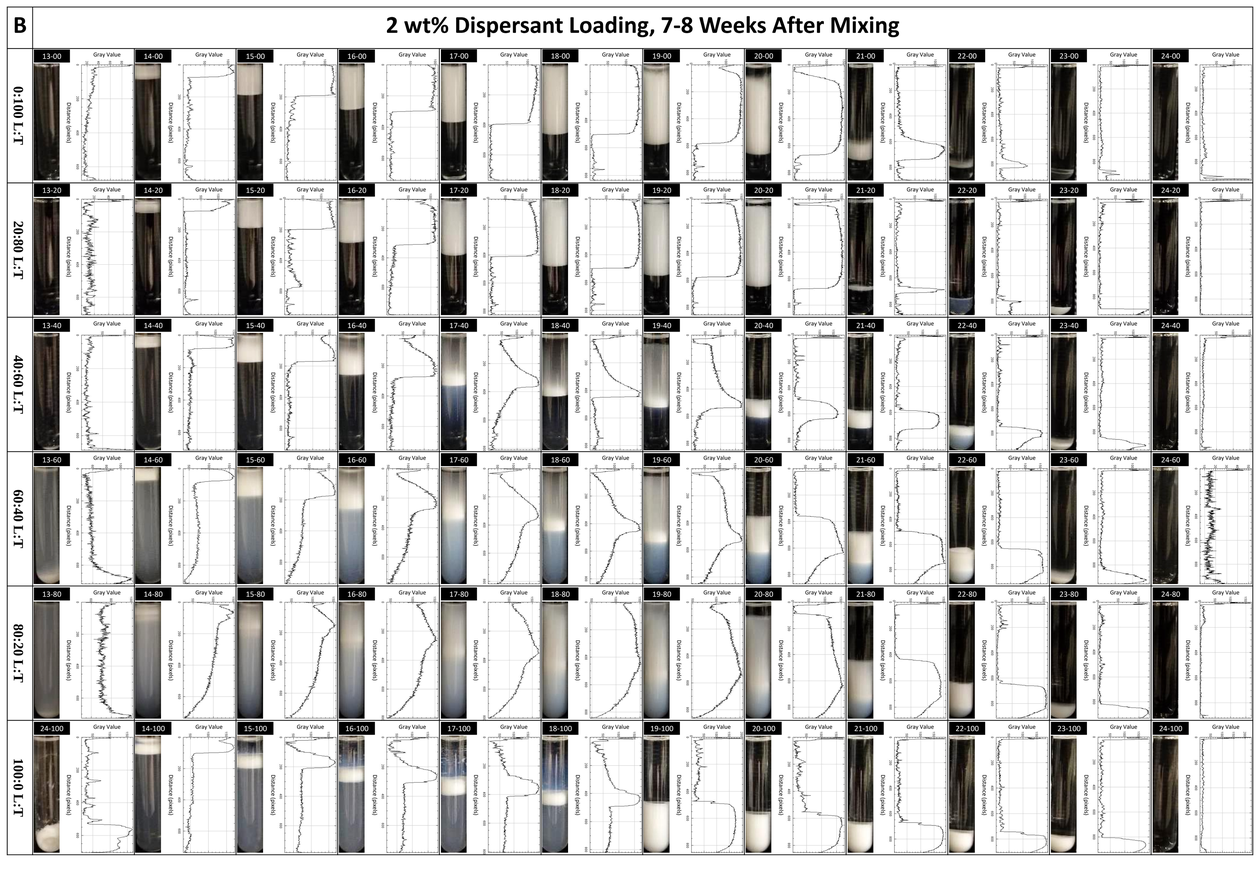
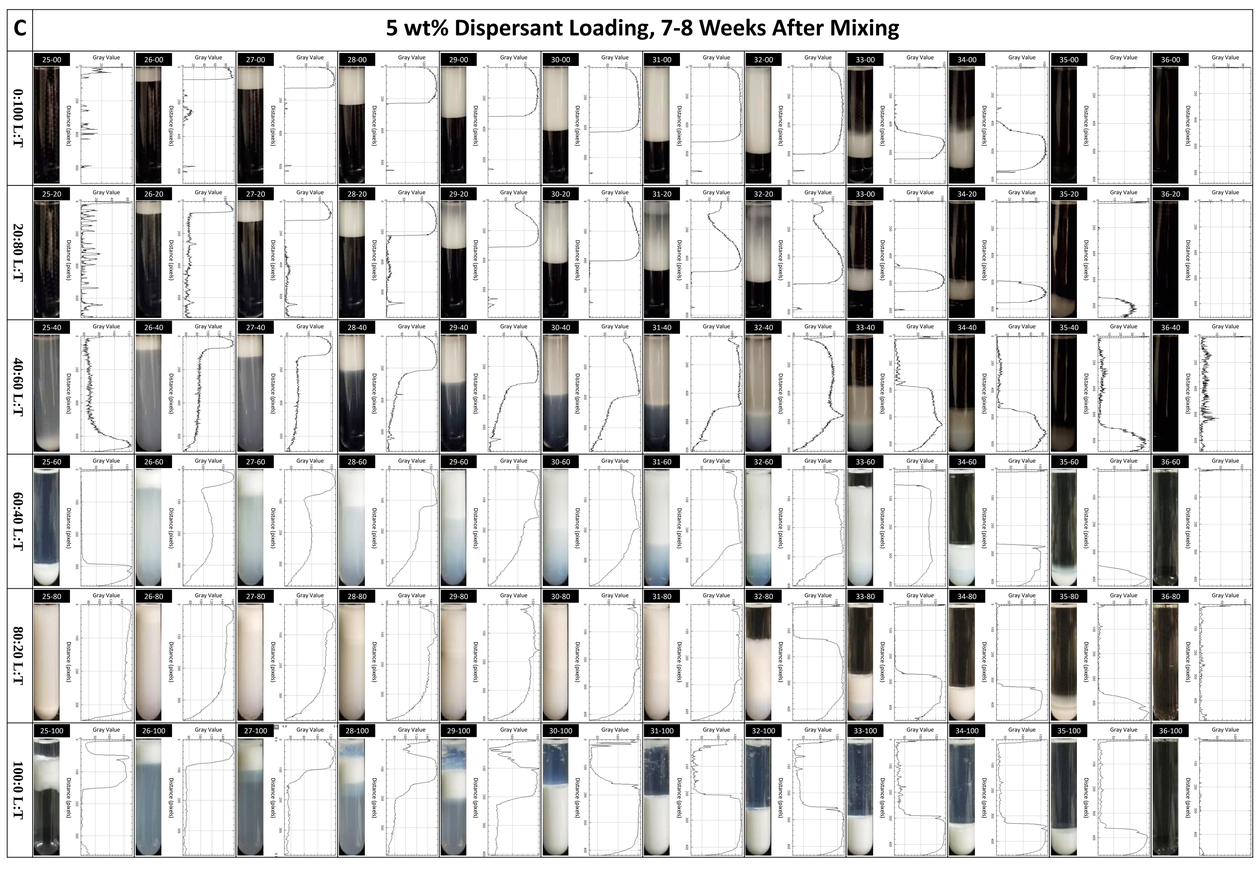


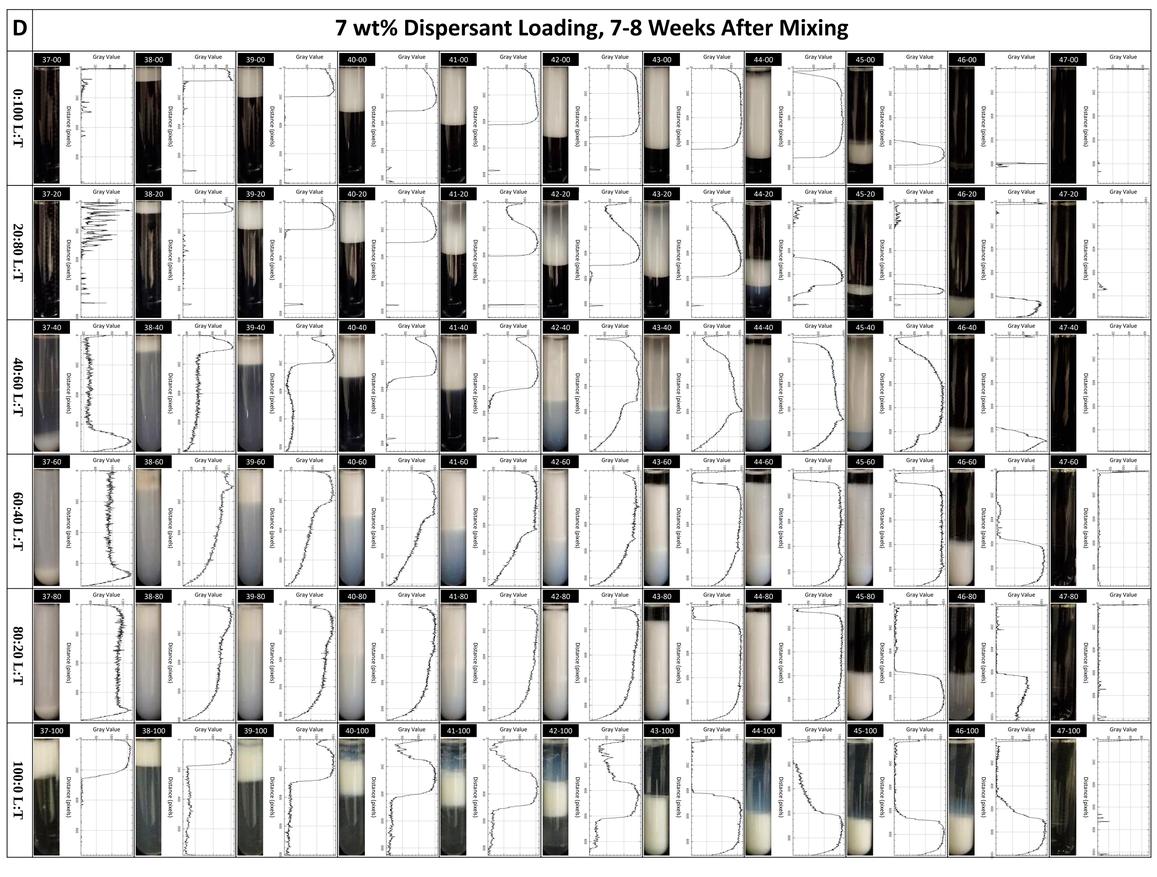
Figure S2. Sample images (and corresponding line scans) for all samples depicted in Figure 6 of the main text (note: Figure 6 symbols are representative of sample images taken 7-8 weeks after mixing); images were taken of each sample 3-4 weeks after mixing and each sample is labeled with the scheme outlined in Tables S1-S6. Sample volume is increasing from left to right across each row above and sample images have had linear brightness/contrast adjustments. Line scans are collected from the meniscus at the top of each sample to the bottom of the test tube and are from a vertical line generally positioned near the middle of the test tube. Note that line scans were used as a tool to identify the phases present in each test tube but have some limitations (*e.g.*, it is difficult to distinguish an interface between a clear and light yellow phase as both appear as the same color with a black background and glare from the image can cause bright lines to appear across some samples which is reflected in the corresponding line scan). Thus, all information gathered from the line scans was augmented with visual observation. Sample images for 0.5 wt%, 2 wt%, 5 wt%, 7 wt%, 10 wt%, and 20 wt% dispersant loadings can be found in the grids labelled (A), (B), (C), (D), (E), and (F) respectively.

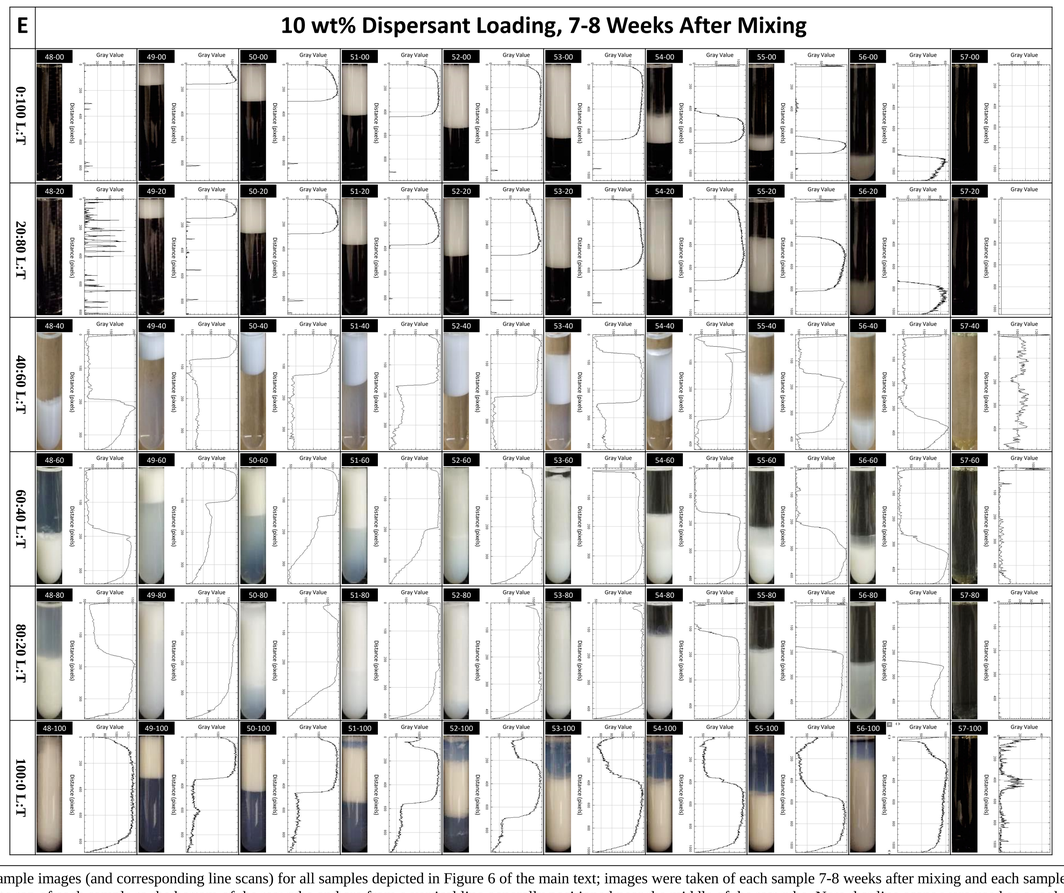
Sample Image Subset: 7-8 Weeks After Mixing











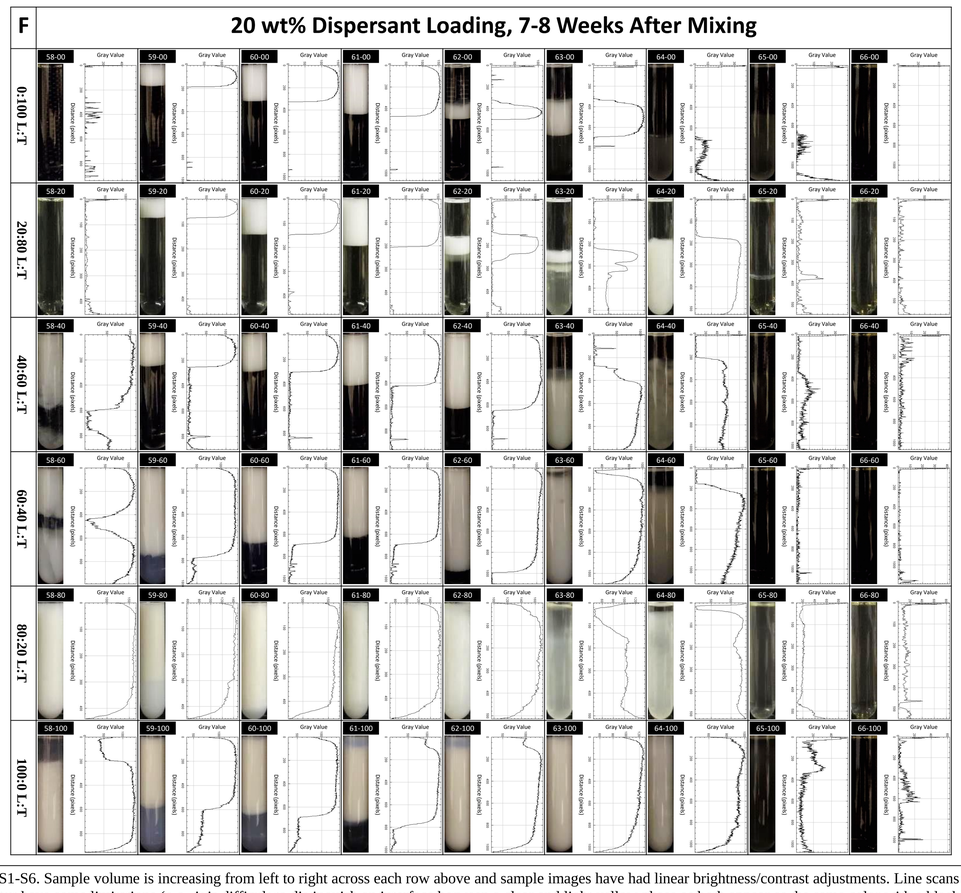


Figure S3. Sample images (and corresponding line scans) for all samples depicted in Figure 6 of the main text; images were taken of each sample 7-8 weeks after mixing and each sample is labeled with the scheme outlined in Tables S1-S6. Sample volume is increasing from left to right across each row above and sample images have had linear brightness/contrast adjustments. Line scans are collected from the meniscus at the top of each sample to the bottom of the test tube and are from a vertical line generally positioned near the middle of the test tube. Note that line scans were used as a tool to identify the phases present in each test tube but have some limitations (*e.g.*, it is difficult to distinguish an interface between a clear and light yellow phase as both appear as the same color with a black background and glare from the image can cause bright lines to appear across some samples which is reflected in the corresponding line scan). Thus, all information gathered from the line scans was augmented with visual observation. Sample images for 0.5 wt%, 2 wt%, 5 wt%, 7 wt%, 10 wt%, and 20 wt% dispersant loadings can be found in the grids labelled (A), (B), (C), (D), (E), and (F) respectively.

2. Comparison with Dye Experiments

EXPERIMENTAL

Sample Preparation. The sample preparation method for these samples is the same as outlined in the main text with the exception of the following step: a qualitative amount of Nile Red (MP Biomedicals) was added to some samples—as observed visually—prior to vortex mixing (~0.3 mg/sample; ~10 mg total for 29 samples seen below). For the samples discussed in Figure S5: upon completion of vortex mixing, a ~1-2 mL aliquot of sample was immediately transferred via pipette from the test tube to a clear, plastic drinking straw (polypropylene) with one end sealed shut using a common hair straightener. Once the aliquot was transferred, the other end of the straw was then sealed using the hair straightener (making sure to not agitate the sample in the straw) and the samples were stored in the dark at room temperature (21-22 °C) until characterized via dynamic light scattering. For this characterization, sample straws were removed from storage and an aliquot sample was extracted from the straw with a syringe and 20-gauge needle (through the sidewall of the straw); sample was then transferred to a vial and labelled. Serial dilutions of these samples were prepared at 1:1, 1:4, 1:8, and 1:16 sample:W (v/v) and each set of samples was filtered using a 0.45 μm GHP syringe filter. 200 μL of filtered sample was then pipetted independently to a specified well on a GrenierBio-One 96 well plate. The hydrodynamic radius (R_h) of each sample was then characterized at 22 °C using a high-throughput plate reader DLS (DynaPro Plate Reader DLS, Wyatt Technologies, Santa Barbara, Ca). Each R_h distribution was calculated using a regularization fit of the correlation function. The data presented is 1:0 sample:W; the rest of the raw data can be found in the GRIIDC dataset (https://data.gulfresearchinitiative.org (doi: 10.7266/n7-1pwn-md30)).

RESULTS AND DISCUSSION

The purpose of these experiments was to demonstrate that the addition of Nile Red dye to samples during sample preparation can (1) help define the phases that are present in a given sample (while having a limited impact on the final phase behavior of said sample) and (2) help determine what is present in a given phase (viz. is a phase bulk synthetic seawater or hexadecane? Does it contain microstructures?).

Comparing the dye samples seen in Figure S4A with the same dye-less samples (same L:T ratio, dispersant loading, and O:W ratio) found in the main text (Figure 4), we observe that for the 100:0 L:T dispersant samples the observed phase behavior is nearly identical across the board. For the samples with 20:80 L:T dispersant, there is a slight variation in the observed phase behavior between the dyed and dye-less subsets. In the dye-less subset, the 3-phase behavior is observed for samples at an O:W ratio from 55:43-75:23, with the sample at 85:13 having a lens at the OWI and thus being labeled a 2+ sample. In the dye subset, the samples exhibiting 3-phase behavior are seen at O:W ranging from 65:33 through 85:13. However, these differences are reasonable given the small top phase observed for the dye-less sample at O:W of 55:43 and the lens for the sample at O:W of 85:13—a small difference in sample composition could easily result in this shift, and the synthetic seawater used for these samples did have different experimental densities. It is worth noting that in the dye-less subset, samples from 15:83-45:53 have a gradient at the top of each test tube that is not found in the subset of samples with dye; this behavior disappears with time (~ 5 weeks; see associated dataset https://data.gulfresearchinitiative.org (doi: 10.7266/n7-1pwn-md30) and the samples over this O:W range exhibit the same behavior as seen in the dyed samples. With this in mind, we confirm that samples can

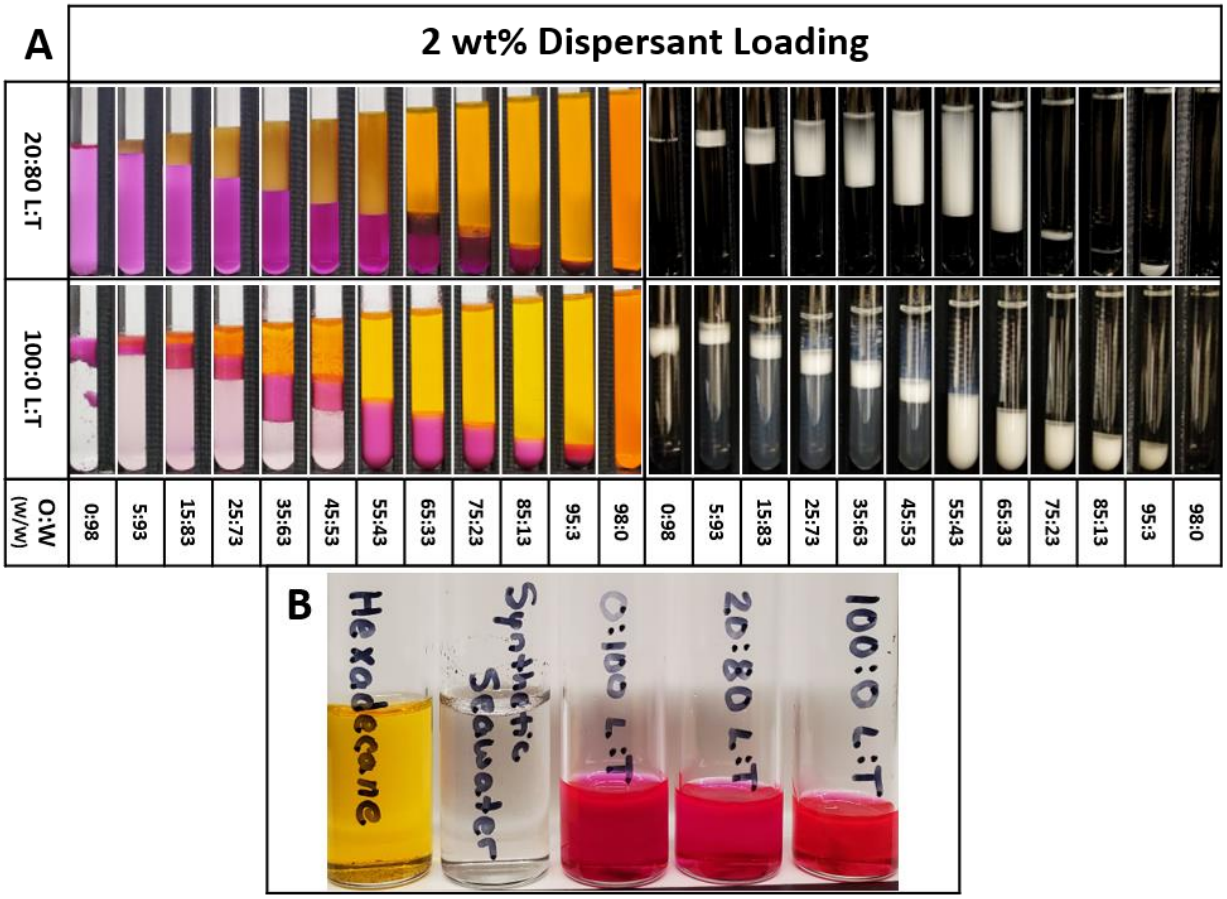


Figure S4. A) 20:80 and 100:0 L:T samples with 2 wt% dispersant loading; images taken 18 days after mixing (dyed) and 3 weeks after mixing (dye-less). Notice how distinct the various phases are with the use of Nile Red dye. The dyed samples presented theoretically have the same DOW composition as the dye-less samples presented here and in the main text; however, the experimental density of the synthetic seawater used for these samples was different than that used for those in the main text. We posit that this is likely why there is a slight deviation in phase behavior between these samples. B) Vials containing components as labelled with the addition of Nile Red dye. This information, in conjunction with the observations from the above LT sample vials (A), provides the basis for the phase designations noted in Figure 3 of the main text.

be made with dye (if desired) to help distinguish phases in each sample without having a significant impact on the observed phase behavior of a given sample. Further, there appears to be no significant difference in the microstucture size distributions for samples created with and without dye (Figure S5), suggesting again that the Nile Red dye used in these studies does not have a significant impact on the experimental outcome of phase behavior studies.

For some samples, it is possible to predict phase composition based on the L:T dispersant and O:W ratios (e.g. SID 13-00 (Figure 3 in main text) will create micelles since Tween 80 forms micelles in water; SID 24-100 will create reverse micelles since lecithin forms reverse micelles in oil). In most circumstances, however, this is not the case and the use of a dye such as Nile Red can help fill in knowledge gaps. For example, examine SID 29-20 from the main text (Figure 3; note: these sample images can also be found in Figure S3). SID 29-20 is

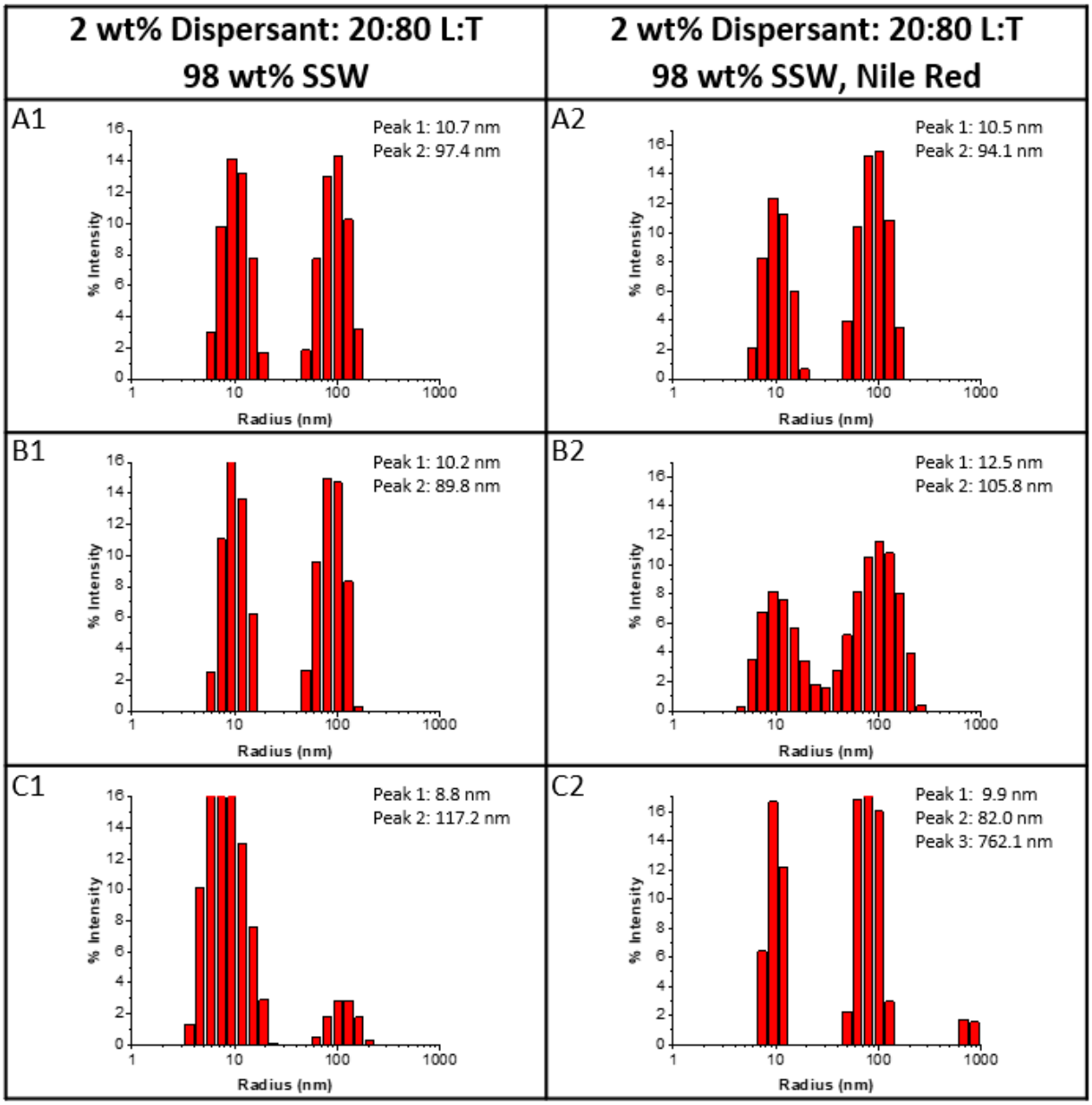


Figure S5. (A1-C1) DHS samples with 2 wt% dispersant (20:80 L:T) and 98 wt% SSW. These three samples are experimentally identical. (A2-C2) These samples have the same DHS composition as A1-C1 but include the addition of a qualitative amount of Nile Red in the sample preparation procedure (outlined above); they are also experimentally identical.

labelled as a 2+ phase—a visually cloudy white phase at the top of the test tube that is an O/W emulsion that includes a gradient, and a clear bottom phase. Given the known composition of this sample (Table S2), it makes sense that the bottom phase is synthetic seawater, but it is not possible to know if there are any microstructures present in that aqueous layer. Comparing this sample to sample images from Figure S4, we know that (1) SSW itself does not solubilize Nile Red, (2) dispersant formulations across all L:T ratios produce a pink solution, and (3) samples with the same L:T and similar phase behavior have a pink bottom phase. With this information, we can predict that the bottom phase in SID 29-20 (and similarly SID 20-20; Figure 3, Figure S3) is a surfactant-containing synthetic seawater mixture with microstructures. Finally, using the lever rule

and principles of ternary phase diagrams in conjunction with sample data presented in Figure S5 (20:80 L:T, 2 wt% dispersant, 0:98 O:W) we can deduce that these phases are a combination of micelles (~10 nm in radius) as well as other microstructures (as denoted in Figure 3). A similar approach can be used to determine the composition of hexadecane phases (SID 19-100, 20-20 and 19-60; Figure 3 and S3), though it is more difficult to visually judge the inclusion of surfactant in these orange phases.

These examples demonstrate that the addition of Nile Red dye can be used to help determine the composition of different phases in the samples—in particular, to detect the presence of microstructures in visually clear phases.

Lastly, a brief discussion of sample 19-100 and 41-00 and the phases designated W/O and O/W respectively (Figure 3 and S3). On first glance, it appears that these samples are labelled incorrectly, however, an understanding of sedimentation and creaming suggests otherwise. For sample 19-100, the cloudy white phase sediments with time to the bottom, suggesting that it is in fact a conglomerate of large W/O emulsions that are unstable (as opposed to a mass of O/W emulsions). For sample 49-00, the reverse process occurs and the white phase creams to the top of the test tube with time, evidence that these structures are unstable O/W emulsions. Similar justification is used for all samples in the study, and the progression can be observed by comparing samples in Figure S1 to Figure S2 and S3.

3. Long-Term Phase Separation Data

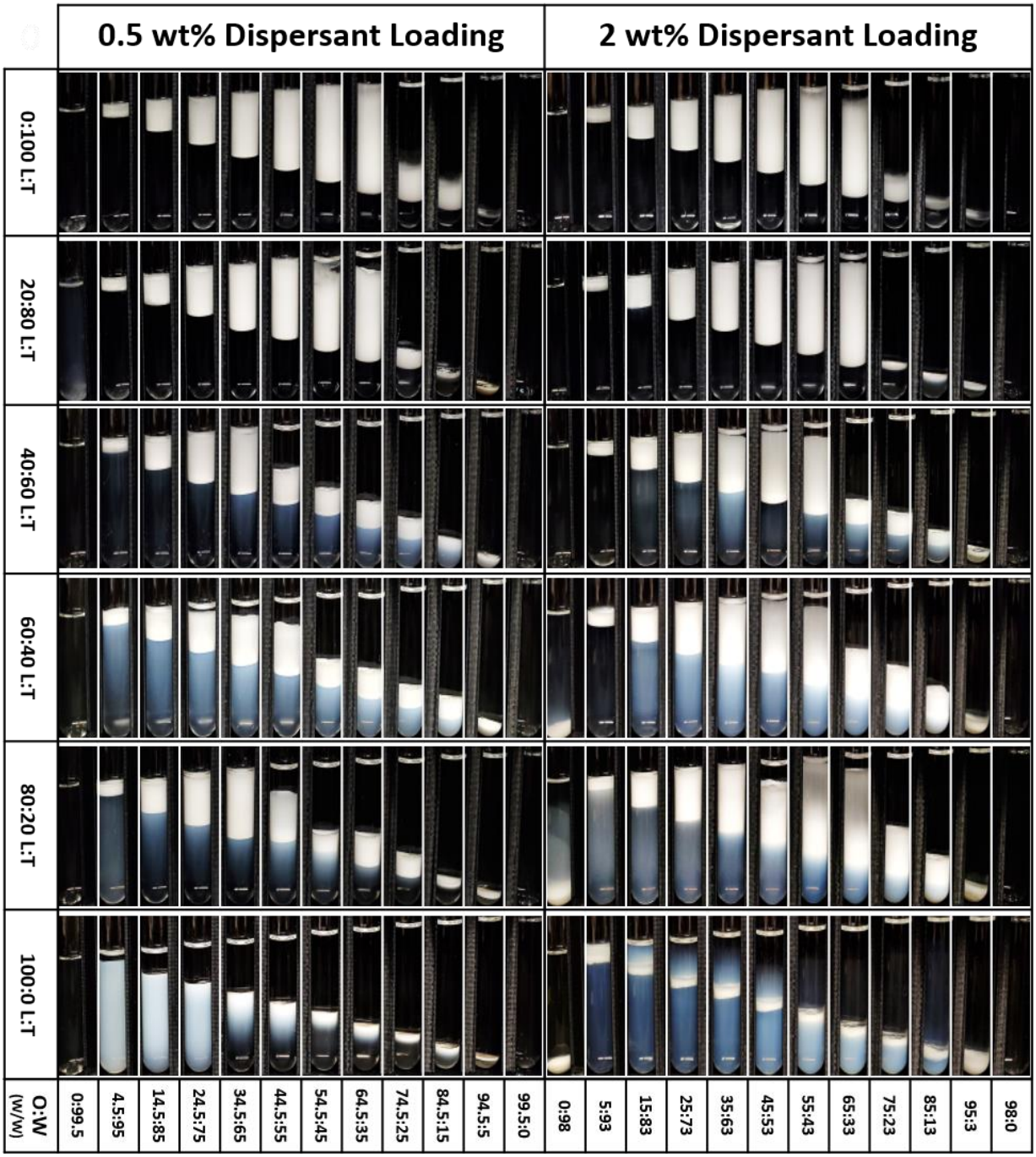


Figure S6. Sample images taken 8-10* months after mixing. Note the nearly identical phase behavior for samples at 40:60, 60:40, and 80:20 L:T after this time period. The noticeable difference between this subset of samples is the turbidity of the bottom phase as the LT effectiveness increases—the most effective LT blends (60:40, 80:20) visually appears to produce emulsions that are more stable than at 40:60 months after mixing. This observation suggests that emulsion stability has at least a secondary role in overall dispersant effectiveness and complements microemulsion behavior. It is worth mentioning that on these timescales the 3-phase region for 100:0 L:T sets is nearly as expansive as that at 40:60, 60:40, and 80:20. However, the difference between the 3-phase region in these samples compared to the 3 prior is the proportion of the middle phase, which is much smaller, which could have a role in its reduced dispersant effectiveness (less oil and water are being imbibed into the middle phase). Note: the samples above are the same as the ones shown in Figure 3 and Figure 7 in the main text. *Images for 0:100 and 20:80 L:T at 0.5 wt% dispersant loading were taken 6-7 months after mixing.

4. Laser Diffraction Data

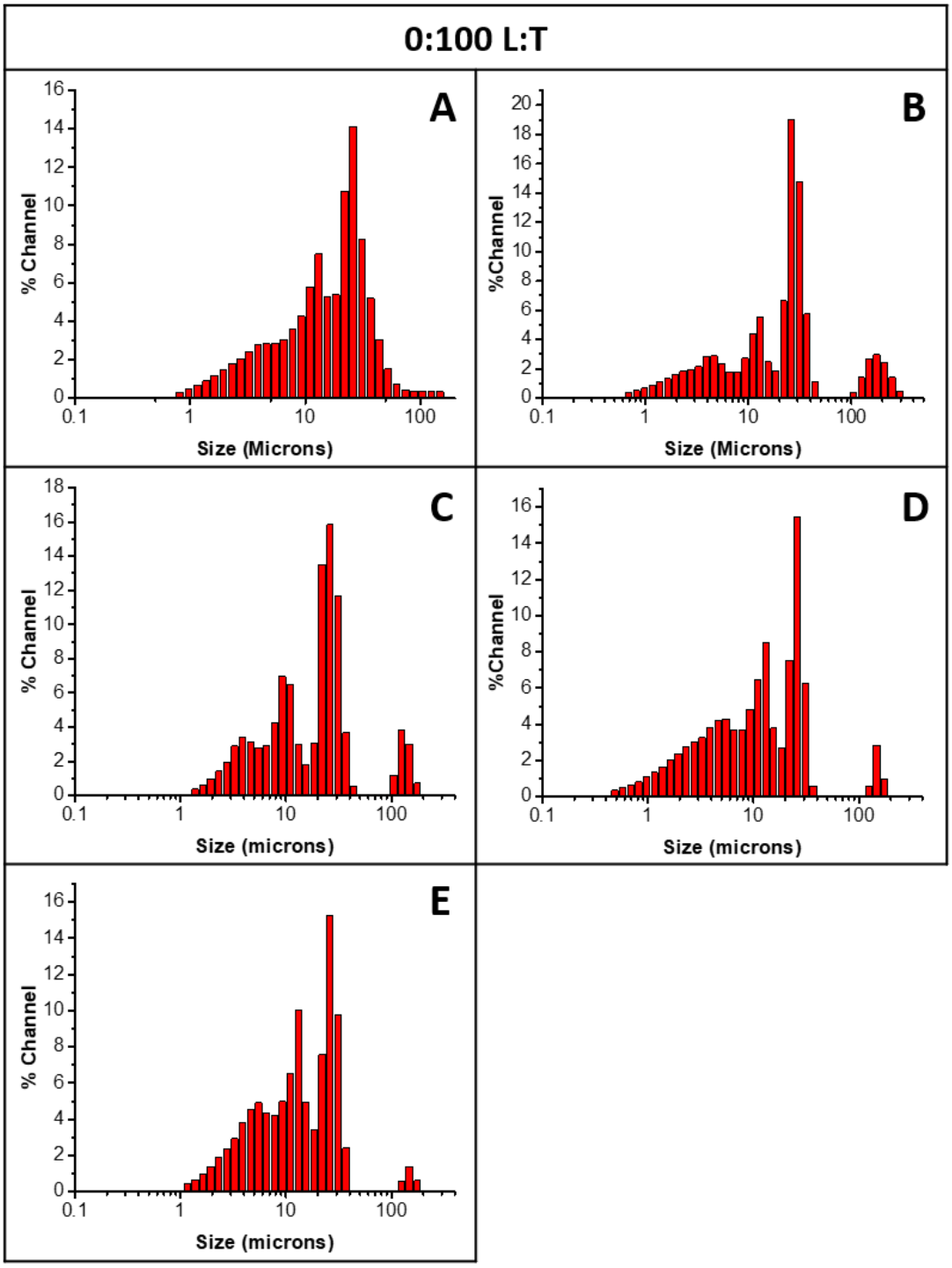


Figure S7. Representative volume-average size distributions for 5 separate samples with a 0:100 L:T dispersant. Note: the data presented is one representative run (out of 5 runs per sample). The data presented in Figure 5 of the main text is the average of the 5 medians from each samples' corresponding composite graph. For reference: (A) LUB-121, (B) LUB-122, (C) LUB-123, (D) LUB-124, and (E) LUB-125. Data for all runs can be found in the associated Gulf of Mexico Research Initiative Information & Data Cooperative (GRIIDC) at https://data.gulfresearchinitiative.org (doi: 10.7266/n7-1pwn-md30).

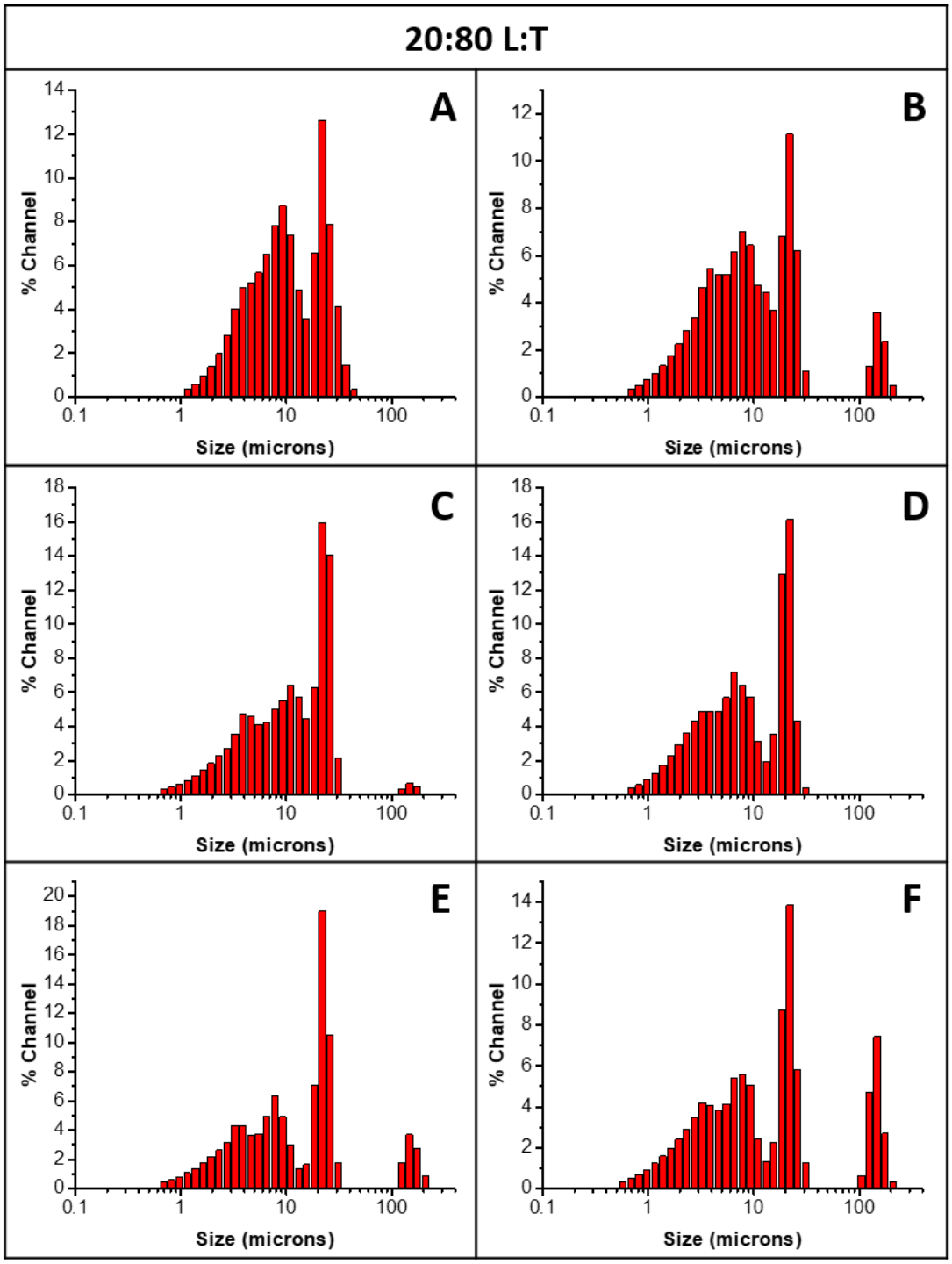


Figure S8. Representative volume-average size distributions for 6 separate samples with a 20:80 L:T dispersant. Note: the data presented is one representative run (out of 5 runs per sample). The data presented in Figure 5 of the main text is the average of the 6 medians from each samples' corresponding composite graph. For reference: (A) LUB-145, (B) LUB-146, (C) LUB-147, (D) LUB-148, (E) LUB-149, and (F) LUB-150. Data for all runs can be found in the associated Gulf of Mexico Research Initiative Information & Data Cooperative (GRIIDC) at https://data.gulfresearchinitiative.org (doi: 10.7266/n7-1pwn-md30).

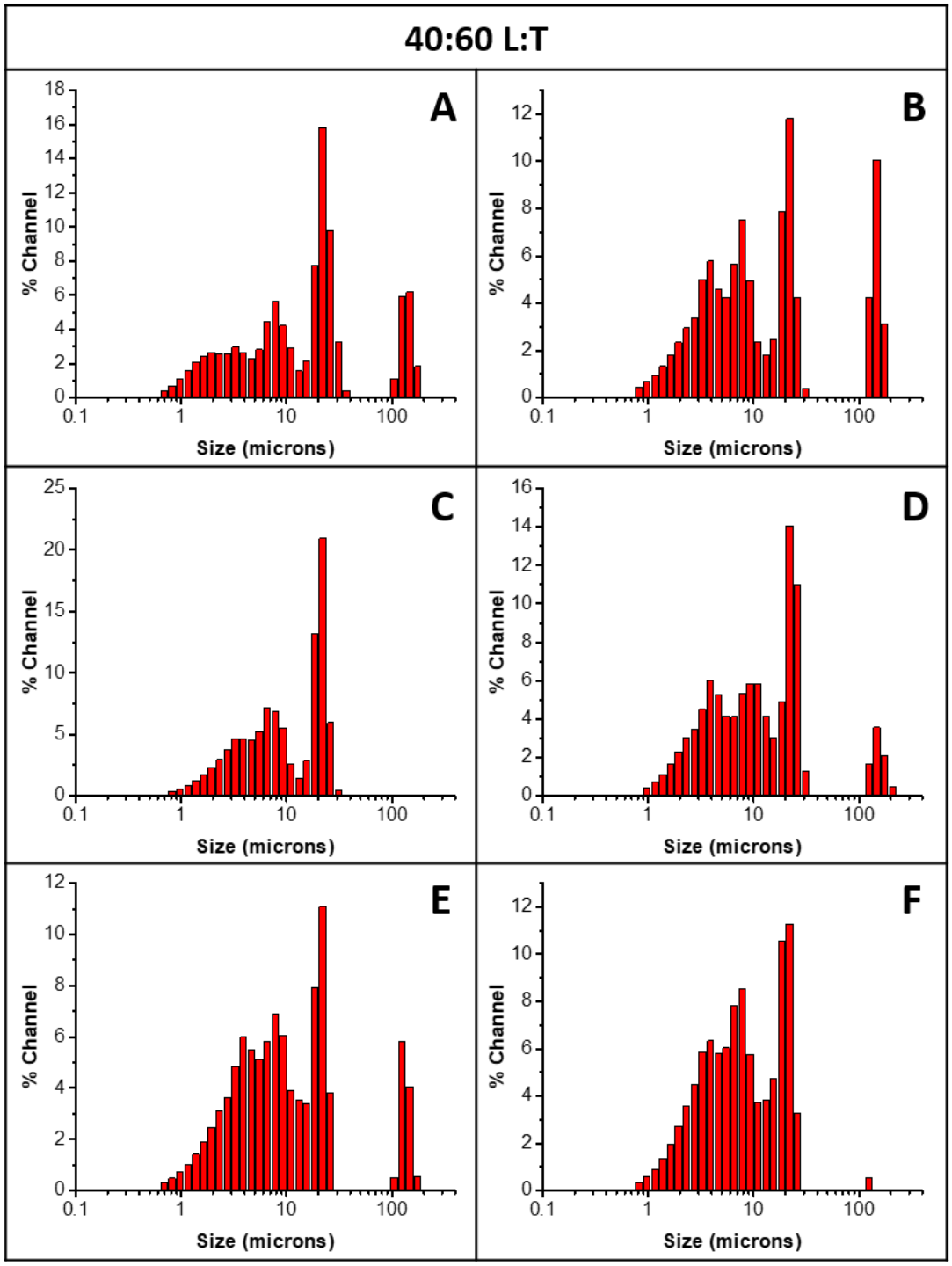


Figure S9. Representative volume-average size distributions for 6 separate samples with a 40:60 L:T dispersant. Note: the data presented is one representative run (out of 5 runs per sample). The data presented in Figure 5 of the main text is the average of the 6 medians from each samples' corresponding composite graph. For reference: (A) LUB-151, (B) LUB-152, (C) LUB-153, (D) LUB-154, (E) LUB-155, and (F) LUB-156. Data for all runs can be found in the associated Gulf of Mexico Research Initiative Information & Data Cooperative (GRIIDC) at https://data.gulfresearchinitiative.org (doi: 10.7266/n7-1pwn-md30).

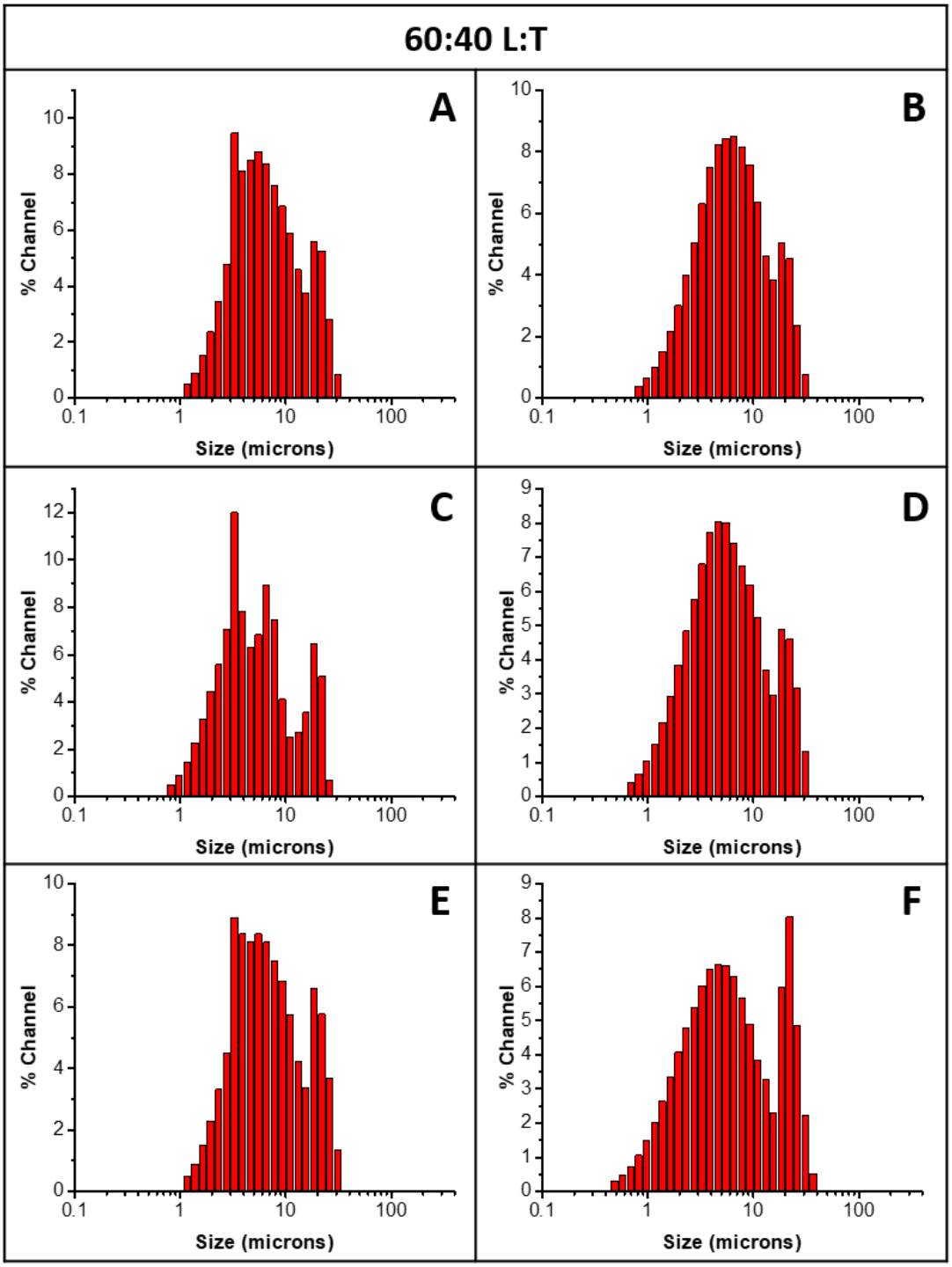


Figure S10. Representative volume-average size distributions for 6 separate samples with a 60:40 L:T dispersant. Note: the data presented is one representative run (out of 5 runs per sample). The data presented in Figure 5 of the main text is the average of the 6 medians from each samples' corresponding composite graph. For reference: (A) LUB-157, (B) LUB-158, (C) LUB-159, (D) LUB-160, (E) LUB-161, and (F) LUB-162. Data for all runs can be found in the associated Gulf of Mexico Research Initiative Information & Data Cooperative (GRIIDC) at https://data.gulfresearchinitiative.org (doi: 10.7266/n7-1pwn-md30).

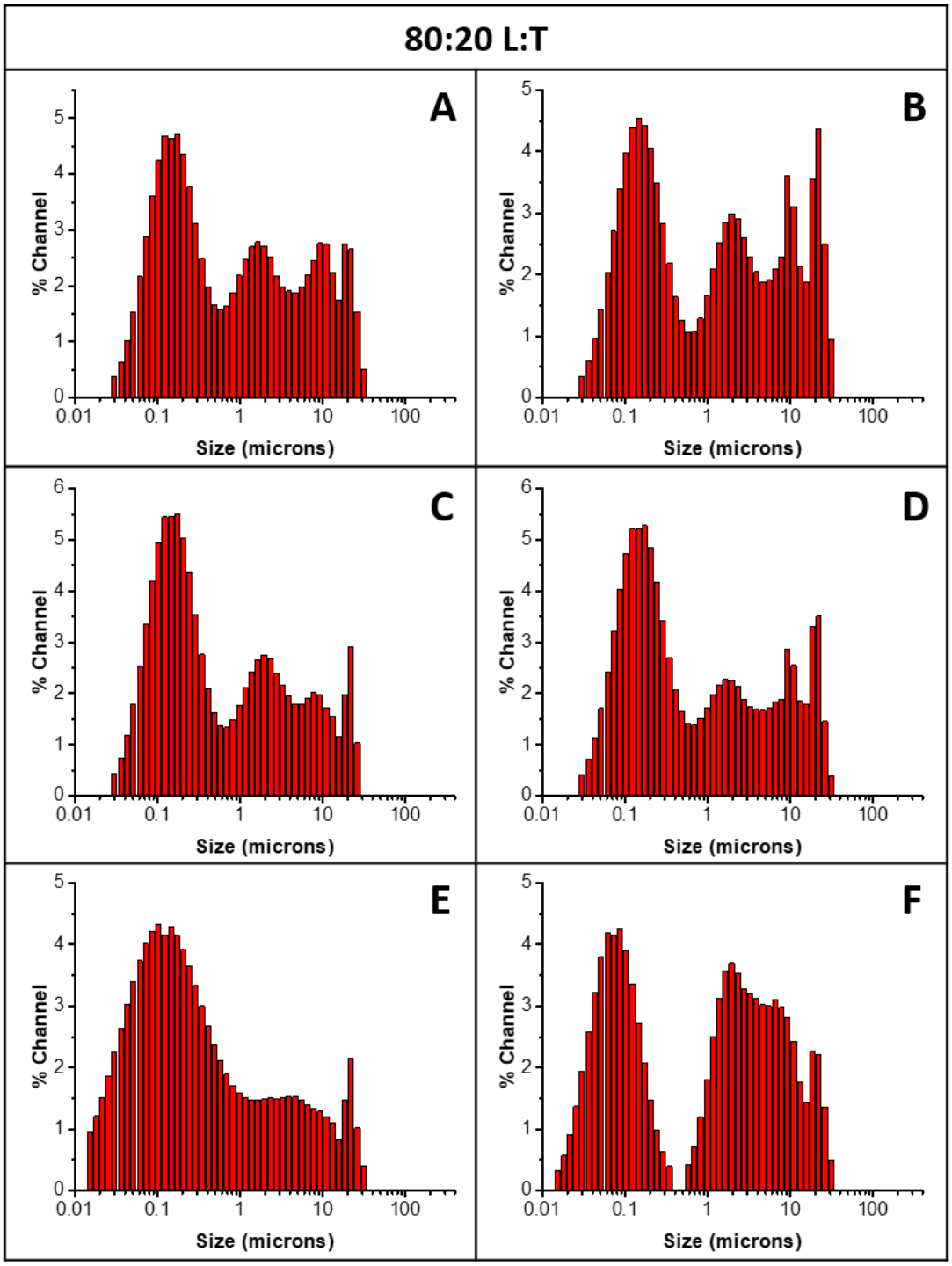


Figure S11. Representative volume-average size distributions for 6 separate samples with a 80:20 L:T dispersant. Note: the data presented is one representative run (out of 5 runs per sample). The data presented in Figure 5 of the main text is the average of the 6 medians from each samples' corresponding composite graph. For reference: (A) LUB-163, (B) LUB-164, (C) LUB-165, (D) LUB-166, (E) LUB-167, and (F) LUB-168. Data for all runs can be found in the associated Gulf of Mexico Research Initiative Information & Data Cooperative (GRIIDC) at https://data.gulfresearchinitiative.org (doi: 10.7266/n7-1pwn-md30).

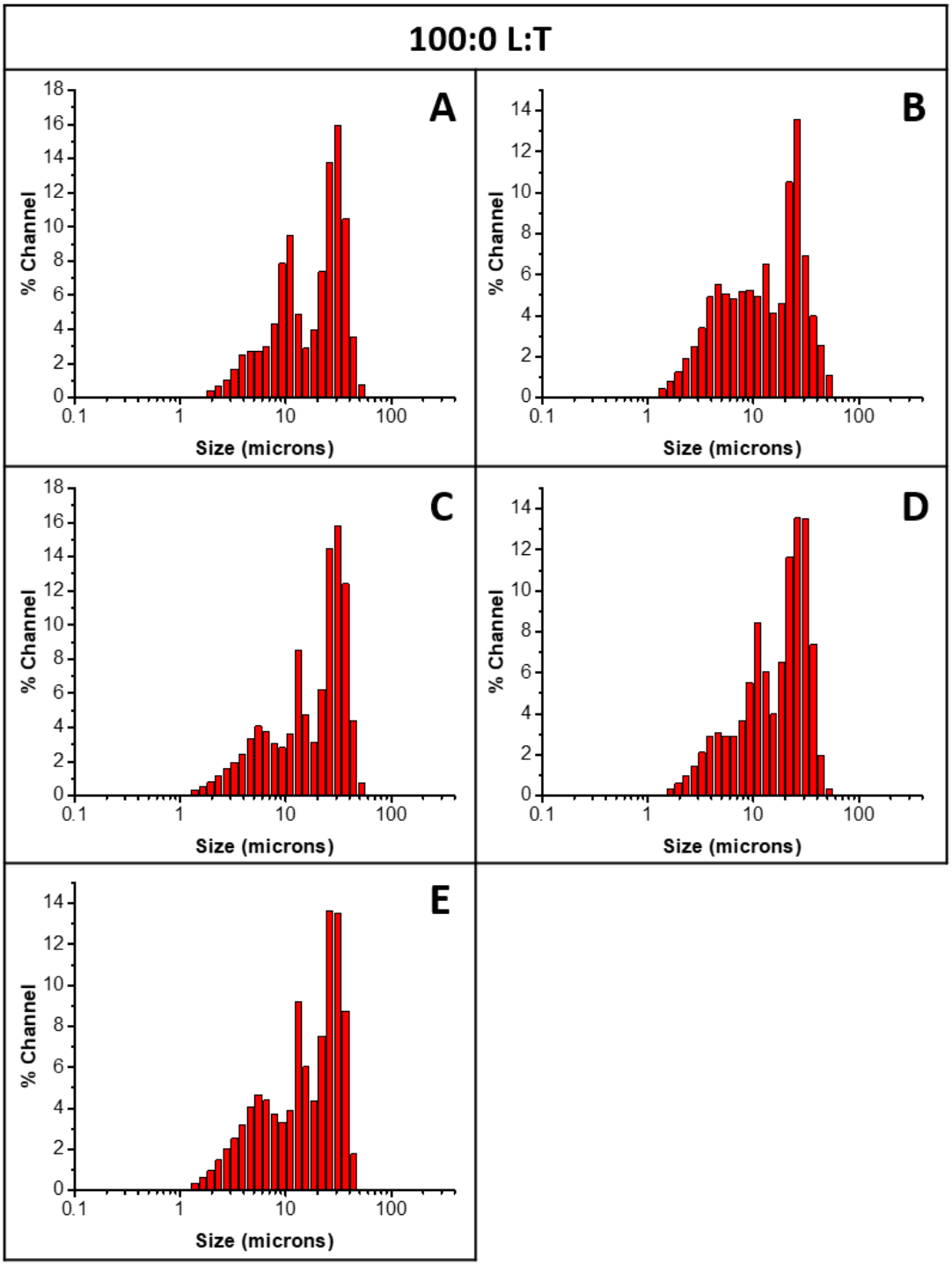


Figure S12. Representative volume-average size distributions for 5 separate samples with a 100:0 L:T dispersant. Note: the data presented is one representative run (out of 5 runs per sample). The data presented in Figure 5 of the main text is the average of the 5 medians from each samples' corresponding composite graph. For reference: (A) LUB-169, (B) LUB-170, (C) LUB-171, (D) LUB-172, (E) LUB-174, and (F) LUB-175. LUB-173 was omitted as it produced a distribution noticeably different from the other tested samples. Data for all runs can be found in the associated Gulf of Mexico Research Initiative Information & Data Cooperative (GRIIDC) at https://data.gulfresearchinitiative.org (doi: 10.7266/n7-1pwn-md30).