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APPENDICES

APPENDIX A: EXPERIMENTAL DATA OF PHASE BEHAVIOR STUDY

| | | | |
|--------------------------|--|-----------------------------------|-------------|
| Dowfax8390 concentration | = 80 - 625 mM | Initial oil/water volume ratio | = 1/1 |
| Temperature | = 24 °C, 35 °C , 45 °C | Ratio of Dowfax8390/octanoic acid | = 0.75, 1.0 |
| Electrolyte | = CaCl ₂ and CaCl ₂ + MgCl ₂ .6H ₂ O | | |

Determination of phase volume of excess water, middle phase and excess PCE.

- I at 24 °C and Ratio of Dowfax8390/octanoic acid = 0.75 (section 4.1.1 and Figure A.1 - A.2)
 - at 24 °C and Ratio of Dowfax8390/octanoic acid = 1.0 (section 4.1.2 and Figure A.5)
 - at 24 °C and Ratio of Dowfax8390/octanoic acid = 0.75, 1.0, mixed electrolyte system (section 4.1.3 and Figure A.7, and A.9)
- II at 24 °C, 35 °C, 45 °C and Ratio of Dowfax8390/octanoic acid = 0.75, 1.0 single electrolyte (section 4.1.4 and Figure A.3 - A.4, and A.6)
 - at 24 °C, 35 °C, 45 °C and Ratio of Dowfax8390/octanoic acid = 0.75, 1.0 mixed electrolyte (section 4.1.4 and Figure A.8, and A.10)

Table A-1 Data of sample preparation, R = 0.75, CaCl₂ scan, 24 °C, 35 °C, 45 °C

| Dowfax8390, mM | Dowfax8390, g | octanoic acid, g | octanoic acid, mL | PCE, g | (Dowfax + octanoic acid), (wt)% | CaCl ₂ added in each tube, g |
|-------------------|------------------|---------------------|----------------------|--------|------------------------------------|---|
| 80 | 0.22 | 0.30 | 0.33 | 7.58 | 4.15 | 1.1,1.2,1.25,1.3,1.4,1.45,1.5,1.57,1.6 |
| 120 | 0.34 | 0.45 | 0.49 | 7.32 | 6.37 | 1.0,1.1,1.2,1.25,1.3,1.4,1.5,1.55,1.6 |
| 220 | 0.62 | 0.82 | 0.90 | 6.65 | 12.34 | 0.8,0.9,1.0,1.1,1.25,1.4,1.5,1.6 |
| 280 | 0.78 | 1.05 | 1.15 | 6.25 | 16.26 | 0.75,0.8,0.9,1.1,1.3,1.4,1.5 |
| 340 | 0.95 | 1.27 | 1.39 | 5.85 | 20.47 | 0.65,0.7,0.8,0.9,1.1,1.2,1.3,1.4 |
| 440 | 1.23 | 1.64 | 1.81 | 5.19 | 28.22 | 0.55,0.6,0.9,1.1 |
| 500 | 1.40 | 1.87 | 2.05 | 4.79 | 33.38 | 0.5,0.55,0.6,0.7 |
| 520 | 1.46 | 1.94 | 2.13 | 4.65 | 35.20 | 0.1,0.2,0.4,0.5 |
| 580 | 1.62 | 2.17 | 2.38 | 4.25 | 40.95 | 0.025,0.05,0.4,0.5 |
| 625 | 1.75 | 2.33 | 2.56 | 3.95 | 45.61 | 0,0.025,0.4,0.5 |

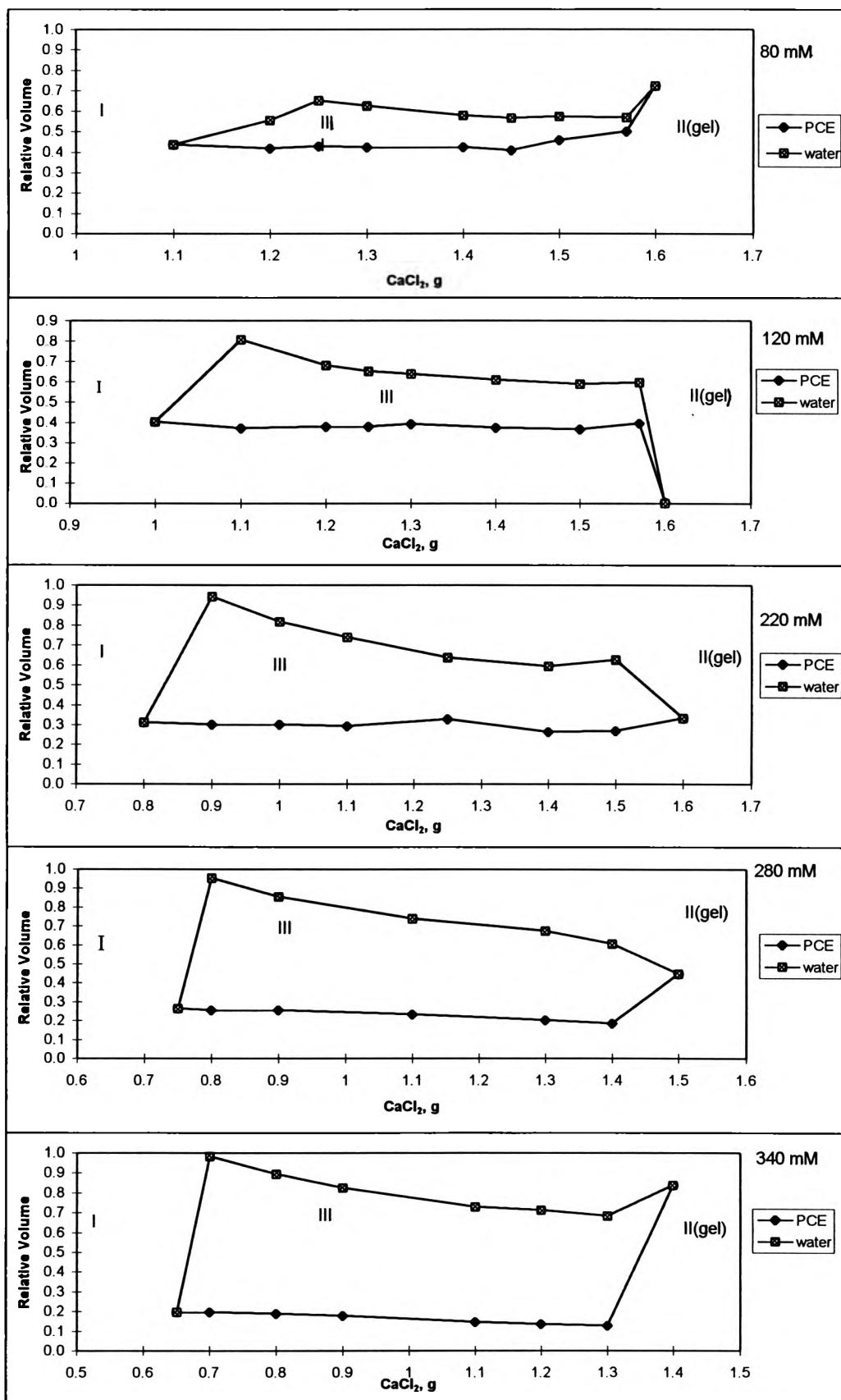


Figure A.1 Relative volume of the microemulsion, 80 - 340 mM Dowfax8390, R = 0.75, 24 °C.

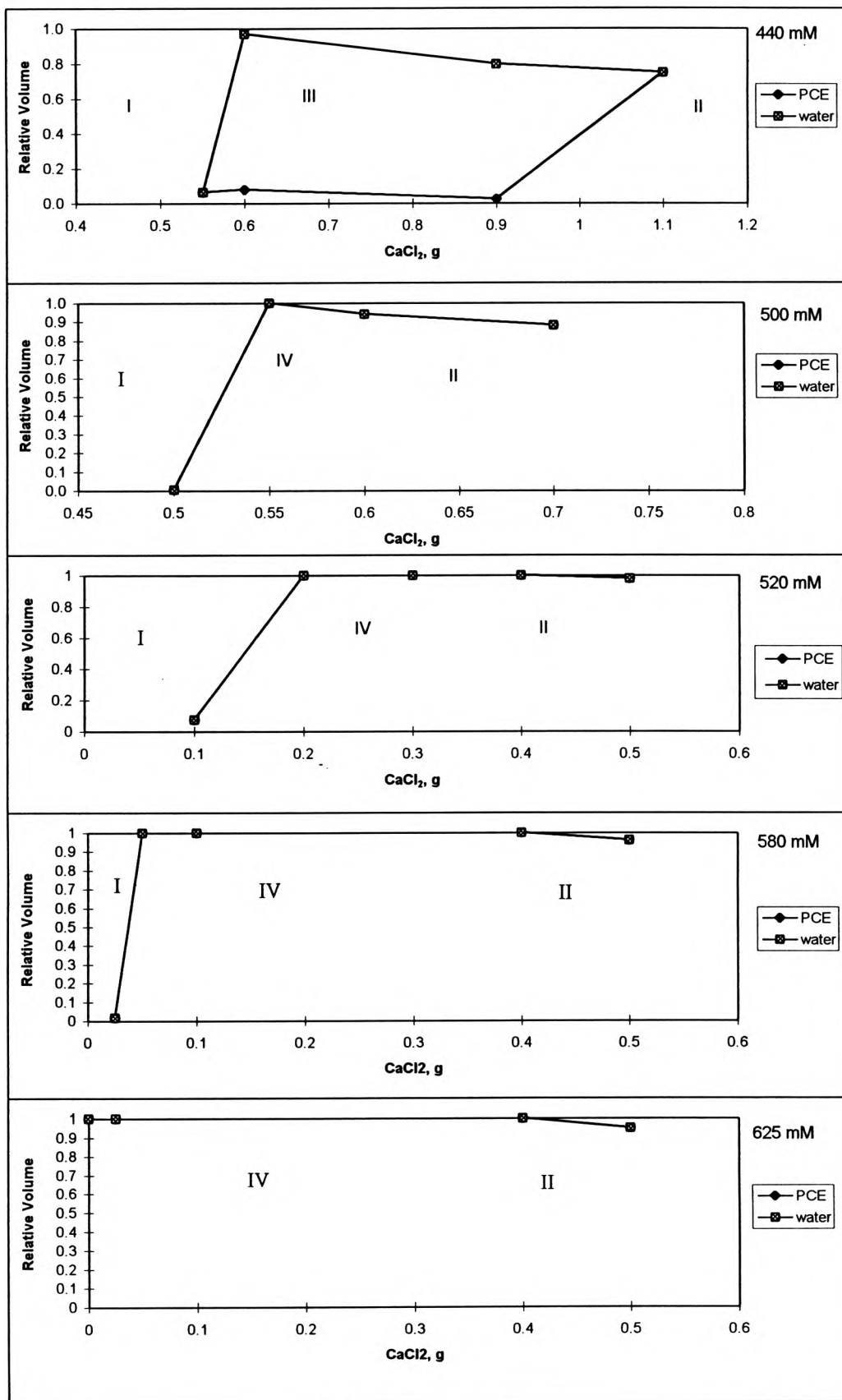


Figure A.2 Relative volume of the microemulsion, 440 - 625 mM Dowfax8390, $R = 0.75$, 24 °C.

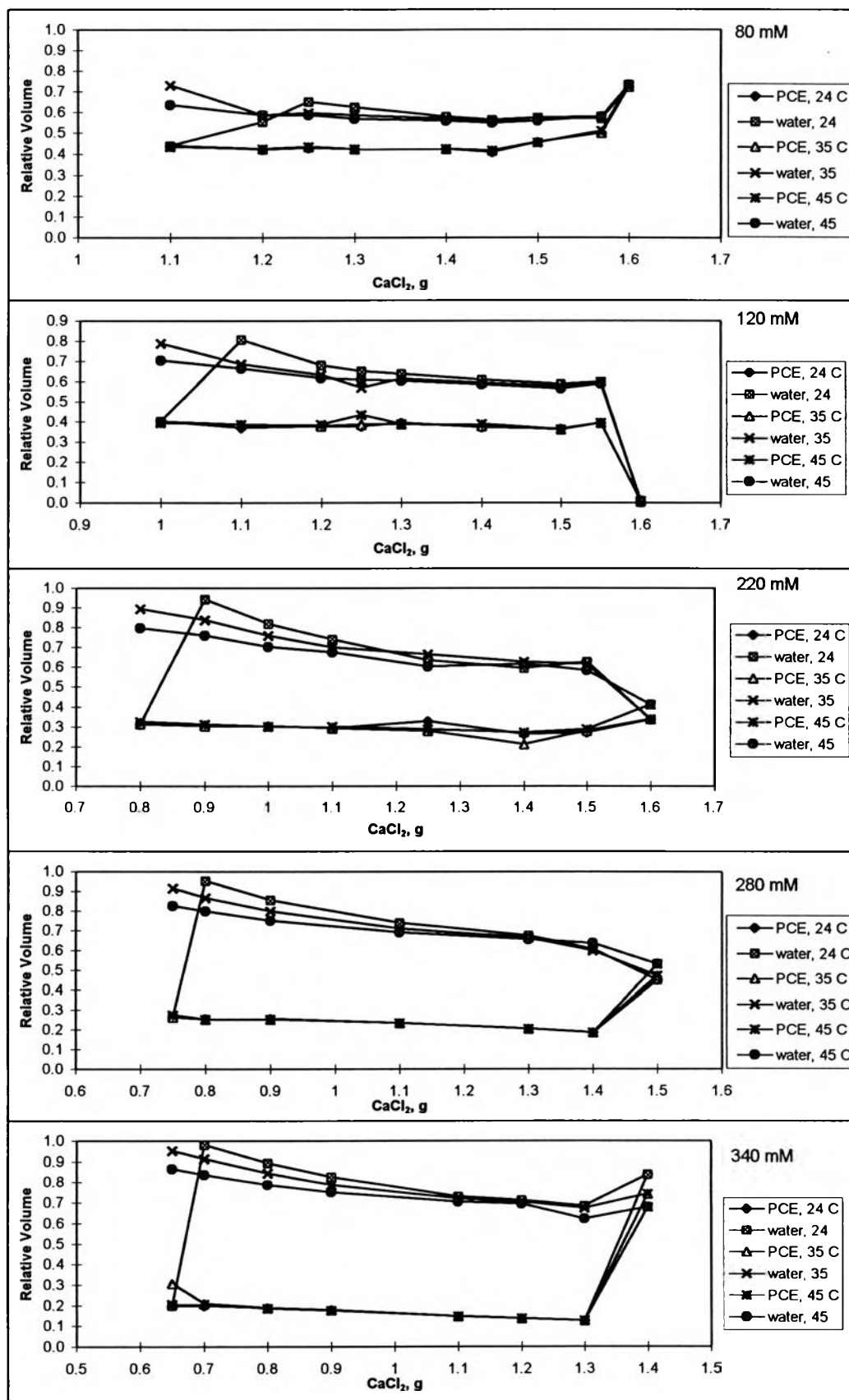


Figure A.3 Relative volume of the microemulsion, 80 - 340 mM Dowfax8390, $R = 0.75$, 24 °C - 45 °C.

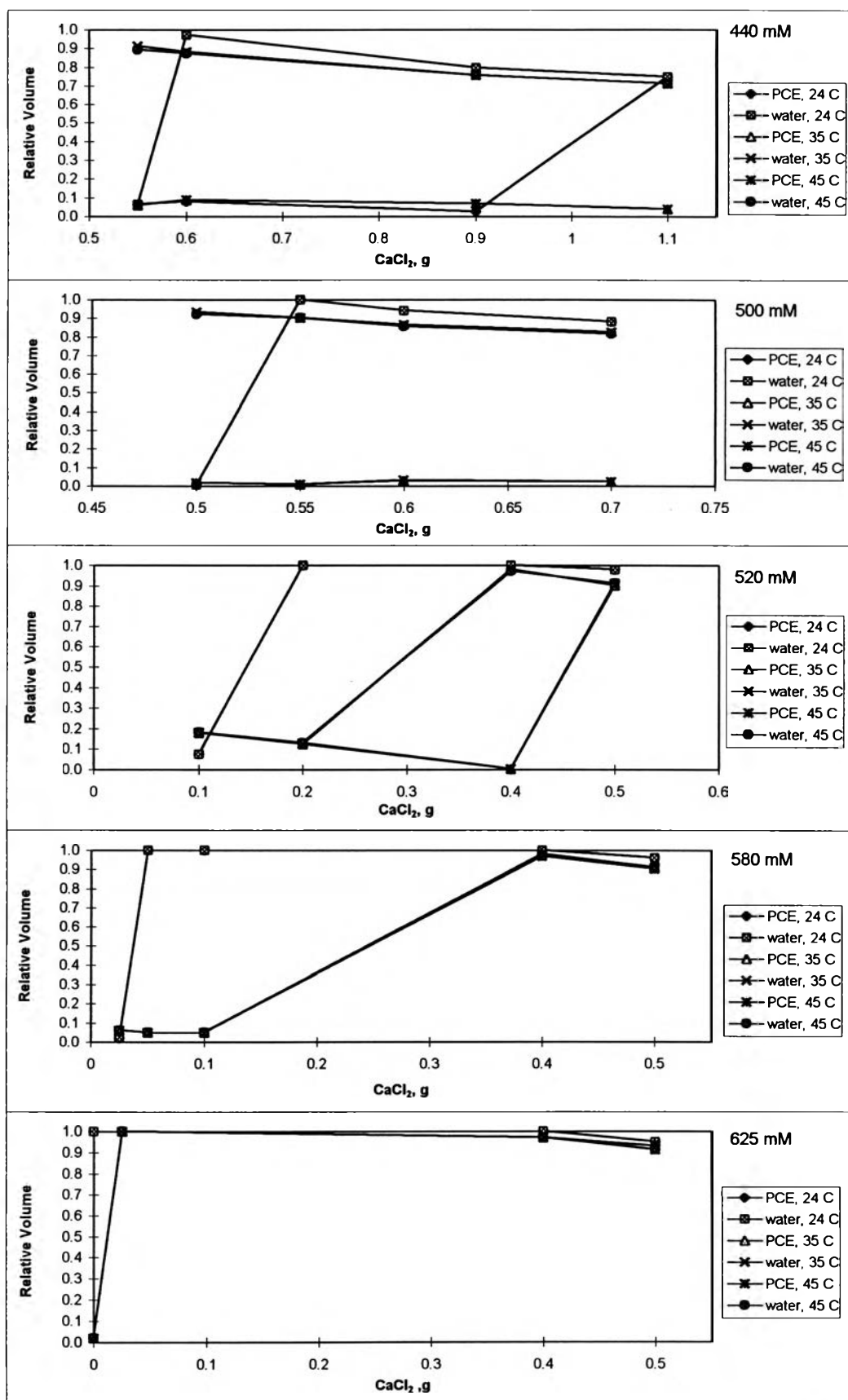


Figure A.4 Relative volume of the microemulsion, 440-625 mM Dowfax8390, $R = 0.75$, 24 °C - 45 °C.

Table A-2 Ranges of CaCl₂ produce Type III or Type IV microemulsion, R = 0.75, CaCl₂ scan, 24 °C, 35 °C, 45 °C

| Dowfax 8390 (wt%) | CaCl ₂ (24 °C) ^a | | | | CaCl ₂ (35 °C) ^b | | | | CaCl ₂ (45 °C) ^b | | | |
|-------------------------|--|------|------------------|-------|--|-------------------|------------------|-------|--|-------------------|------------------|-------|
| | ending type I | | starting type II | | present of type III | | starting type II | | present of type III | | starting type II | |
| | g | % | g | % | g | % | g | % | g | % | g | % |
| 4.15 | 1.1 | 8.74 | 1.6 | 12.72 | 1.1 | 8.74 | 1.6 | 12.72 | 1.1 | 8.74 | 1.6 | 12.72 |
| 6.37 | 1.0 | 8.12 | 1.6 | 12.99 | 1.0 | 8.12 | 1.6 | 12.99 | 1.0 | 8.12 | 1.6 | 12.99 |
| 12.34 | 0.8 | 6.87 | 1.6 | 13.73 | 0.8 | 6.87 | 1.6 | 13.73 | 0.8 | 6.87 | 1.6 | 13.73 |
| 16.26 | 0.75 | 6.67 | 1.5 | 13.33 | 0.75 | 6.67 | 1.5 | 13.33 | 0.75 | 6.67 | 1.5 | 13.33 |
| 20.47 | 0.65 | 5.99 | 1.4 | 12.90 | 0.65 | 5.99 | 1.4 | 12.90 | 0.65 | 5.99 | 1.4 | 12.90 |
| 28.22 | 0.55 | 5.40 | 1.1 | 10.80 | 0.55 | 5.40 | 1.1 | 10.80 | 0.55 | 5.40 | 1.1 | 10.80 |
| 33.38 | 0.5 | 5.11 | 0.6 | 6.13 | 0.5 | 5.11 | 0.6 | 6.13 | 0.5 | 5.11 | 0.6 | 6.13 |
| 35.20 | 0.1 | 1.04 | 0.5 | 5.18 | 0.1 ^c | 1.04 ^c | 0.5 | 5.18 | 0.1 ^c | 1.04 ^c | 0.5 | 5.18 |
| 40.95 | 0.025 | 0.27 | 0.5 | 5.40 | 0.1 ^c | 1.08 ^c | 0.4 | 4.32 | 0.1 ^c | 1.08 ^c | 0.4 | 4.32 |
| 45.61 | 0 | 0 | 0.5 | 5.58 | 0 | 0 | 0.4 | 4.47 | 0.025 | 0.28 | 0.4 | 4.47 |

a : Type III occur below 33.38% (Dowfax8390 + octanoic acid) and type IV occur at 33.38% and above.

b : Type IV occur at 35.20% and above.

c : Last point of type I.

Table A-2a Dowfax8390 = 80 mM, Ratio of Dowfax8390 to octanoic acid = 0.75

| | Relative volume | | | | | | | | |
|--------------------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|
| | 24°C | | | 35°C | | | 45°C | | |
| CaCl ₂ (g) | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE |
| 1.1 | 0.437 | 0.000 | 0.563 | 0.437 | 0.291 | 0.272 | 0.433 | 0.202 | 0.365 |
| 1.2 | 0.419 | 0.133 | 0.448 | 0.423 | 0.163 | 0.413 | 0.423 | 0.163 | 0.413 |
| 1.25 | 0.427 | 0.223 | 0.350 | 0.433 | 0.163 | 0.404 | 0.433 | 0.154 | 0.413 |
| 1.3 | 0.423 | 0.202 | 0.375 | 0.423 | 0.163 | 0.413 | 0.423 | 0.144 | 0.433 |
| 1.4 | 0.423 | 0.154 | 0.423 | 0.423 | 0.144 | 0.433 | 0.423 | 0.135 | 0.442 |
| 1.45 | 0.048 | 0.155 | 0.437 | 0.413 | 0.144 | 0.442 | 0.413 | 0.135 | 0.452 |
| 1.5 | 0.456 | 0.117 | 0.427 | 0.456 | 0.117 | 0.427 | 0.452 | 0.106 | 0.442 |
| 1.57 | 0.500 | 0.067 | 0.433 | 0.500 | 0.077 | 0.423 | 0.510 | 0.067 | 0.423 |
| 1.6 | 0.721 | 0.000 | 0.279 | 0.721 | 0.000 | 0.279 | 0.731 | 0.000 | 0.269 |

Table A-2b Dowfax 8390 = 120 mM, Ratio of Dowfax8390 to octanoic acid = 0.75

| | Relative volume | | | | | | | | |
|--------------------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|
| | 24°C | | | 35°C | | | 45°C | | |
| CaCl ₂ (g) | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE |
| 1.1 | 0.402 | 0.000 | 0.598 | 0.398 | 0.388 | 0.214 | 0.394 | 0.308 | 0.298 |
| 1.2 | 0.369 | 0.437 | 0.194 | 0.385 | 0.298 | 0.317 | 0.385 | 0.279 | 0.337 |
| 1.25 | 0.379 | 0.301 | 0.320 | 0.379 | 0.252 | 0.369 | 0.385 | 0.231 | 0.385 |
| 1.3 | 0.379 | 0.272 | 0.350 | 0.385 | 0.183 | 0.433 | 0.433 | 0.173 | 0.394 |
| 1.4 | 0.392 | 0.245 | 0.363 | 0.388 | 0.223 | 0.388 | 0.388 | 0.214 | 0.398 |
| 1.45 | 0.373 | 0.235 | 0.392 | 0.379 | 0.214 | 0.408 | 0.388 | 0.194 | 0.417 |
| 1.5 | 0.365 | 0.221 | 0.413 | 0.362 | 0.210 | 0.429 | 0.362 | 0.200 | 0.438 |
| 1.57 | 0.394 | 0.202 | 0.404 | 0.394 | 0.202 | 0.404 | 0.394 | 0.192 | 0.413 |
| 1.6 | 0.005 | 0.000 | 0.995 | 0.005 | 0.000 | 0.995 | 0.008 | 0.000 | 0.992 |

Table A-2c Dowfax 8390 = 220 mM, Ratio of Dowfax8390 to octanoic acid = 0.75

| | Relative volume | | | | | | | | |
|--------------------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|
| | 24°C | | | 35°C | | | 45°C | | |
| CaCl ₂ (g) | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE |
| 0.8 | 0.311 | 0.000 | 0.689 | 0.314 | 0.578 | 0.108 | 0.324 | 0.471 | 0.206 |
| 0.9 | 0.301 | 0.641 | 0.058 | 0.301 | 0.534 | 0.165 | 0.311 | 0.447 | 0.243 |
| 1.0 | 0.301 | 0.515 | 0.184 | 0.301 | 0.456 | 0.243 | 0.298 | 0.404 | 0.298 |
| 1.1 | 0.291 | 0.447 | 0.262 | 0.291 | 0.408 | 0.301 | 0.298 | 0.375 | 0.327 |
| 1.25 | 0.327 | 0.308 | 0.365 | 0.279 | 0.385 | 0.337 | 0.286 | 0.314 | 0.400 |
| 1.4 | 0.262 | 0.330 | 0.408 | 0.212 | 0.413 | 0.375 | 0.269 | 0.346 | 0.385 |
| 1.5 | 0.269 | 0.056 | 0.375 | 0.279 | 0.337 | 0.385 | 0.286 | 0.295 | 0.419 |
| 1.6 | 0.333 | 0.000 | 0.667 | 0.336 | 0.000 | 0.664 | 0.410 | 0.000 | 0.590 |

Table A-2d Dowfax 8390 = 280 mM, Ratio of Dowfax8390 to octanoic acid = 0.75

| | Relative volume | | | | | | | | |
|--------------------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|
| | 24°C | | | 35°C | | | 45°C | | |
| CaCl ₂ (g) | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE |
| 0.75 | 0.262 | 0.000 | 0.738 | 0.626 | 0.650 | 0.087 | 0.272 | 0.553 | 0.175 |
| 0.8 | 0.255 | 0.696 | 0.049 | 0.252 | 0.612 | 0.136 | 0.252 | 0.544 | 0.204 |
| 0.9 | 0.255 | 0.598 | 0.147 | 0.252 | 0.544 | 0.204 | 0.252 | 0.495 | 0.252 |
| 1.1 | 0.233 | 0.505 | 0.262 | 0.233 | 0.476 | 0.291 | 0.233 | 0.456 | 0.311 |
| 1.3 | 0.202 | 0.471 | 0.327 | 0.202 | 0.462 | 0.337 | 0.202 | 0.452 | 0.346 |
| 1.4 | 0.183 | 0.423 | 0.394 | 0.183 | 0.413 | 0.404 | 0.183 | 0.452 | 0.365 |
| 1.5 | 0.448 | 0.000 | 0.552 | 0.471 | 0.000 | 0.529 | 0.529 | 0.000 | 0.471 |

Table A-2e Dowfax 8390 = 340 mM, Ratio of Dowfax8390 to octanoic acid = 0.75

| | Relative volume | | | | | | | | |
|--------------------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|
| | 24°C | | | 35°C | | | 45°C | | |
| CaCl ₂ (g) | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE |
| 0.65 | 0.196 | 0.000 | 0.804 | 0.304 | 0.647 | 0.049 | 0.204 | 0.660 | 0.136 |
| 0.7 | 0.196 | 0.784 | 0.020 | 0.206 | 0.706 | 0.088 | 0.204 | 0.631 | 0.165 |
| 0.8 | 0.186 | 0.706 | 0.108 | 0.186 | 0.657 | 0.157 | 0.184 | 0.602 | 0.214 |
| 0.9 | 0.176 | 0.647 | 0.176 | 0.175 | 0.612 | 0.214 | 0.173 | 0.577 | 0.250 |
| 1.1 | 0.146 | 0.583 | 0.272 | 0.146 | 0.573 | 0.282 | 0.144 | 0.558 | 0.298 |
| 1.2 | 0.135 | 0.577 | 0.288 | 0.135 | 0.567 | 0.298 | 0.135 | 0.558 | 0.308 |
| 1.3 | 0.125 | 0.558 | 0.317 | 0.125 | 0.548 | 0.327 | 0.124 | 0.495 | 0.381 |
| 1.4 | 0.837 | 0.000 | 0.163 | 0.740 | 0.000 | 0.260 | 0.676 | 0.000 | 0.324 |

Table A-2f Dowfax 8390 = 440 mM, Ratio of Dowfax8390 to octanoic acid = 0.75

| | Relative volume | | | | | | | | |
|--------------------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|
| | 24°C | | | 35°C | | | 45°C | | |
| CaCl ₂ (g) | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE |
| 0.55 | 0.064 | 0.000 | 0.936 | 0.059 | 0.853 | 0.088 | 0.058 | 0.835 | 0.107 |
| 0.6 | 0.079 | 0.891 | 0.030 | 0.088 | 0.794 | 0.118 | 0.088 | 0.784 | 0.127 |
| 0.9 | 0.024 | 0.772 | 0.204 | 0.068 | 0.689 | 0.243 | 0.068 | 0.689 | 0.243 |
| 1.1 | 0.748 | 0.000 | 0.252 | 0.038 | 0.673 | 0.288 | 0.038 | 0.673 | 0.288 |

Table A-2g Dowfax 8390 = 500 mM, Ratio of Dowfax8390 to octanoic acid = 0.75

| | Relative volume | | | | | | | | |
|--------------------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|
| | 24°C | | | 35°C | | | 45°C | | |
| CaCl ₂ (g) | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE |
| 0.5 | 0.005 | 0.000 | 0.995 | 0.018 | 0.913 | 0.069 | 0.018 | 0.904 | 0.078 |
| 0.55 | 0.000 | 1.000 | 0.000 | 0.010 | 0.892 | 0.098 | 0.010 | 0.892 | 0.098 |
| 0.6 | 0.941 | 0.000 | 0.059 | 0.029 | 0.833 | 0.137 | 0.031 | 0.823 | 0.146 |
| 0.7 | 0.881 | 0.000 | 0.119 | 0.024 | 0.800 | 0.176 | 0.023 | 0.792 | 0.184 |

Table A-2h Dowfax 8390 = 520 mM, Ratio of Dowfax8390 to octanoic acid = 0.75

| | Relative volume | | | | | | | | |
|--------------------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|
| | 24°C | | | 35°C | | | 45°C | | |
| CaCl ₂ (g) | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE |
| 0.1 | 0.075 | 0.000 | 0.925 | 0.178 | 0.000 | 0.822 | 0.181 | 0.000 | 0.819 |
| 0.2 | 0.000 | 1.000 | 0.000 | 0.125 | 0.000 | 0.875 | 0.129 | 0.000 | 0.871 |
| 0.4 | 0.000 | 1.000 | 0.000 | 0.002 | 0.978 | 0.020 | 0.002 | 0.969 | 0.029 |
| 0.5 | 0.980 | 0.000 | 0.020 | 0.902 | 0.000 | 0.098 | 0.912 | 0.000 | 0.088 |

Table A-2i Dowfax 8390 = 580 mM, Ratio of Dowfax8390 to octanoic acid = 0.75

| | Relative volume | | | | | | | | |
|--------------------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|
| | 24°C | | | 35°C | | | 45°C | | |
| CaCl ₂ (g) | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE |
| 0.025 | 0.018 | 0.000 | 0.982 | 0.060 | 0.000 | 0.940 | 0.059 | 0.000 | 0.941 |
| 0.05 | 0.000 | 1.000 | 0.000 | 0.050 | 0.000 | 0.950 | 0.050 | 0.000 | 0.950 |
| 0.1 | 0.000 | 1.000 | 0.000 | 0.050 | 0.000 | 0.950 | 0.050 | 0.000 | 0.950 |
| 0.4 | 0.000 | 1.000 | 0.000 | 0.980 | 0.000 | 0.020 | 0.971 | 0.000 | 0.029 |
| 0.5 | 0.961 | 0.000 | 0.039 | 0.912 | 0.000 | 0.088 | 0.903 | 0.000 | 0.088 |

Table A-2j Dowfax 8390 = 625 mM, Ratio of Dowfax8390 to octanoic acid = 0.75

| | Relative volume | | | | | | | | |
|--------------------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|
| | 24°C | | | 35°C | | | 45°C | | |
| CaCl ₂ (g) | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE |
| 0 | 0.000 | 1.000 | 0.000 | 0.020 | 0.000 | 0.980 | 0.020 | 0.000 | 0.980 |
| 0.025 | 0.000 | 1.000 | 0.000 | 0.000 | 1.000 | 0.000 | 0.000 | 1.000 | 0.000 |
| 0.4 | 0.000 | 1.000 | 0.000 | 0.971 | 0.000 | 0.029 | 0.971 | 0.000 | 0.029 |
| 0.5 | 0.950 | 0.000 | 0.050 | 0.931 | 0.000 | 0.069 | 0.912 | 0.000 | 0.088 |

Table A-3 Data of sample preparation, R = 1.0, CaCl₂ scan, 24 °C, 35 °C, 45 °C

| Dowfax8390, mM | Dowfax8390, g | octanoic acid, g | octanoic acid, mL | PCE, g | %(Dowfax + octanoic acid) | CaCl ₂ added in each tube, g |
|-------------------|------------------|---------------------|----------------------|--------|------------------------------|---|
| 80 | 0.22 | 0.22 | 0.25 | 7.72 | 3.52 | 1.1,1.2,1.3,1.4,1.5,1.6 |
| 120 | 0.34 | 0.34 | 0.37 | 7.52 | 5.37 | 1.0,1.1,1.2,1.3,1.4,1.5,1.6 |
| 220 | 0.62 | 0.62 | 0.68 | 7.02 | 10.25 | 0.9,1.0,1.5,1.6,1.7 |
| 280 | 0.78 | 0.78 | 0.86 | 6.72 | 13.38 | 0.9,1.0,1.3,1.4,1.5 |
| 340 | 0.95 | 0.95 | 1.05 | 6.42 | 16.68 | 0.7,0.8,1.1,1.3,1.5,1.6 |
| 440 | 1.23 | 1.23 | 1.35 | 5.92 | 22.57 | 0.7,0.8,0.9,1.0 |
| 500 | 1.40 | 1.40 | 1.54 | 5.62 | 26.37 | 0.7,0.788,0.802,0.9 |
| 520 | 1.46 | 1.46 | 1.60 | 5.52 | 27.69 | 0.3,0.4,0.7,0.8 |
| 580 | 1.62 | 1.62 | 1.78 | 5.22 | 31.79 | 0.1,0.2,0.6,0.7 |
| 625 | 1.75 | 1.75 | 1.92 | 4.99 | 35.02 | 0.038,0.05,0.6,0.7 |

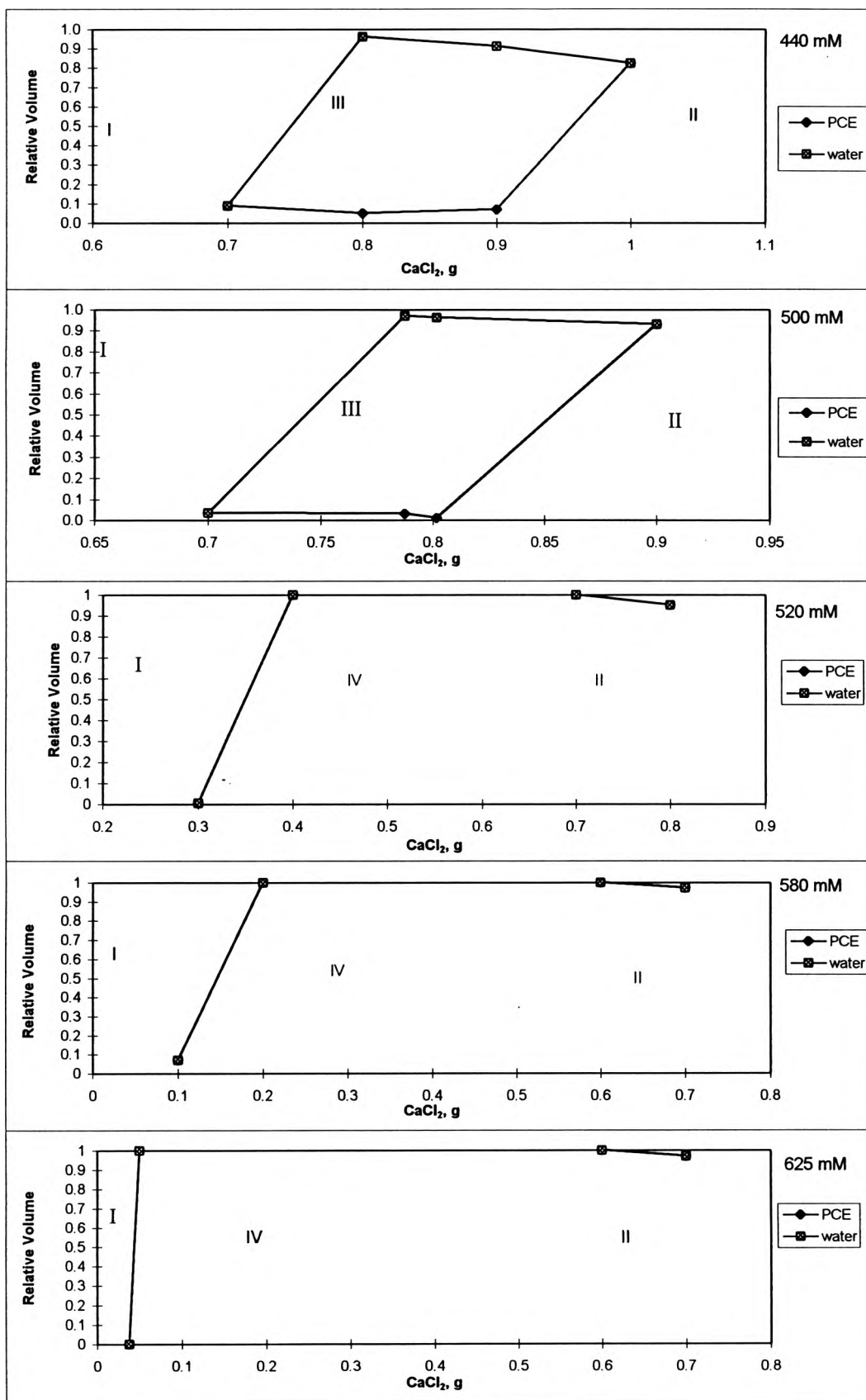


Figure A.5 Relative volume of the microemulsion, 440-625 mM Dowfax8390, $R = 1.0$, $24\text{ }^{\circ}\text{C}$.

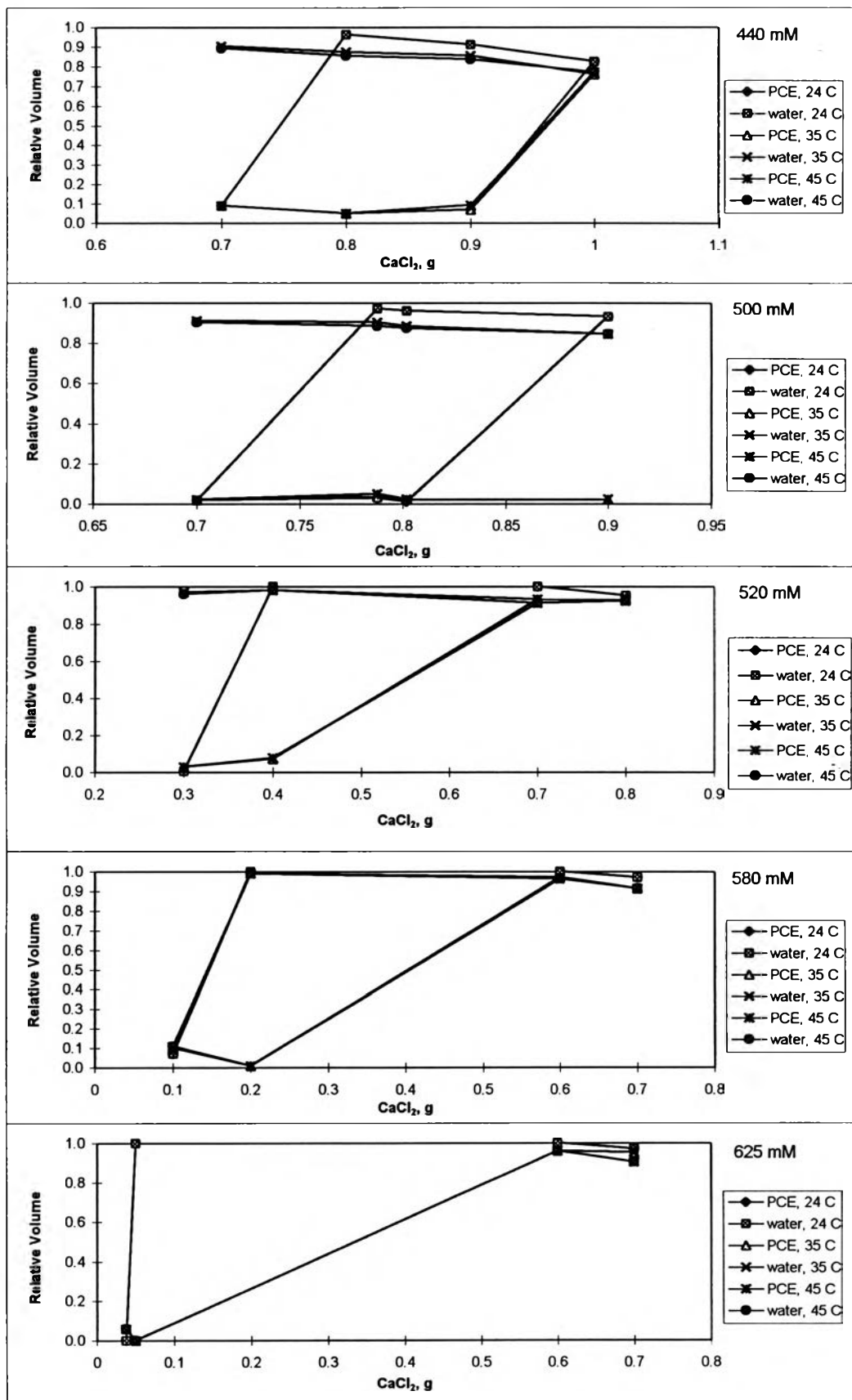


Figure A.6 Relative volume of the microemulsion, 440-625 mM Dowfax8390, R = 1.0, 24 °C - 45 °C.

Table A-4 Ranges of CaCl₂ produce Type III or Type IV microemulsion, R = 1.0, CaCl₂ scan, 24 °C, 35 °C, 45 °C

| Dowfax 8390 (wt%) | CaCl ₂ (24 °C) ^a | | | | CaCl ₂ (35 °C) ^b | | | | CaCl ₂ (45 °C) ^b | | | |
|-------------------------|--|------|------------------|-------|--|-------------------|------------------|-------|--|-------------------|------------------|-------|
| | ending type I | | starting type II | | present of type III | | starting type II | | present of type III | | starting type II | |
| | g | % | g | % | g | % | g | % | g | % | g | % |
| 3.52 | 1.2 | 9.44 | 1.6 | 12.58 | 1.1 | 8.65 | 1.5 | 11.80 | 1.1 | 8.65 | 1.5 | 11.80 |
| 5.37 | 1.1 | 8.79 | 1.6 | 12.78 | 1.0 | 8.79 | 1.6 | 12.78 | 1.0 | 8.79 | 1.6 | 12.78 |
| 10.25 | 0.9 | 7.49 | 1.7 | 14.15 | 0.9 | 7.49 | 1.6 | 13.32 | 0.9 | 7.49 | 1.6 | 13.32 |
| 13.38 | 0.9 | 7.68 | 1.5 | 12.80 | 0.9 | 7.68 | 1.5 | 12.80 | 0.9 | 7.68 | 1.5 | 12.80 |
| 16.68 | 0.7 | 6.13 | 1.6 | 14.01 | 0.7 | 6.13 | 1.6 | 14.01 | 0.7 | 6.13 | 1.6 | 14.01 |
| 22.57 | 0.7 | 3.41 | 1.0 | 9.16 | 0.7 | 3.41 | 1.0 | 9.16 | 0.7 | 3.41 | 1.0 | 9.16 |
| 26.37 | 0.7 | 6.59 | 0.9 | 8.48 | 0.7 | 6.59 | 0.9 | 8.48 | 0.7 | 6.59 | 0.9 | 8.48 |
| 27.69 | 0.3 | 2.85 | 0.8 | 7.61 | 0.3 | 2.85 | 0.7 | 6.66 | 0.3 | 2.85 | 0.7 | 6.66 |
| 31.79 | 0.1 | 0.98 | 0.7 | 6.85 | 0.1 ^c | 0.98 ^c | 0.6 | 5.87 | 0.1 ^c | 0.98 ^c | 0.6 | 5.87 |
| 35.02 | 0.038 | 0.38 | 0.7 | 7.00 | 0.05 ^c | 0.50 ^c | 0.6 | 6.00 | 0.05 ^c | 0.50 ^c | 0.6 | 6.00 |

a : Type III occur below 27.69% (Dowfax8390 + octanoic acid) and type IV occur at 27.69% and above.

b : Type IV occur at 31.79% and above.

c : Last point of type I.

Table A-4a Dowfax 8390 = 440 mM, Ratio of Dowfax8390 to octanoic acid = 1.0

| | Relative volume | | | | | | | | |
|--------------------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|
| | 24°C | | | 35°C | | | 45°C | | |
| CaCl ₂ (g) | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE |
| 0.7 | 0.089 | 0.000 | 0.911 | 0.088 | 0.814 | 0.098 | 0.088 | 0.804 | 0.108 |
| 0.8 | 0.049 | 0.912 | 0.039 | 0.049 | 0.824 | 0.127 | 0.049 | 0.806 | 0.146 |
| 0.9 | 0.069 | 0.843 | 0.088 | 0.069 | 0.784 | 0.147 | 0.092 | 0.743 | 0.165 |
| 1.0 | 0.824 | 0.000 | 0.176 | 0.760 | 0.000 | 0.240 | 0.769 | 0.000 | 0.231 |

Table A-4b Dowfax 8390 = 500 mM, Ratio of Dowfax8390 to octanoic acid = 1.0

| | Relative volume | | | | | | | | |
|--------------------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|
| | 24°C | | | 35°C | | | 45°C | | |
| CaCl ₂ (g) | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE |
| 0.7 | 0.020 | 0.000 | 0.980 | 0.020 | 0.891 | 0.089 | 0.022 | 0.879 | 0.099 |
| 0.788 | 0.029 | 0.941 | 0.029 | 0.034 | 0.868 | 0.098 | 0.050 | 0.834 | 0.117 |
| 0.802 | 0.010 | 0.951 | 0.039 | 0.022 | 0.861 | 0.118 | 0.023 | 0.850 | 0.126 |
| 0.9 | 0.931 | 0.000 | 0.069 | 0.021 | 0.823 | 0.155 | 0.023 | 0.821 | 0.155 |

Table A-4c Dowfax 8390 = 520 mM, Ratio of Dowfax8390 to octanoic acid = 1.0

| | Relative volume | | | | | | | | |
|--------------------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|
| | 24°C | | | 35°C | | | 45°C | | |
| CaCl ₂ (g) | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE |
| 0.3 | 0.006 | 0.000 | 0.994 | 0.030 | 0.940 | 0.030 | 0.030 | 0.930 | 0.040 |
| 0.4 | 0.000 | 1.000 | 0.000 | 0.07 | 0.909 | 0.019 | 0.077 | 0.904 | 0.019 |
| 0.7 | 0.000 | 1.000 | 0.000 | 0.9307 | 0.000 | 0.0693 | 0.912 | 0.000 | 0.088 |
| 0.8 | 0.951 | 0.000 | 0.049 | 0.9314 | 0.000 | 0.0686 | 0.922 | 0.000 | 0.078 |

Table A-4d Dowfax 8390 = 580 mM, Ratio of Dowfax8390 to octanoic acid = 1.0

| | Relative volume | | | | | | | | |
|--------------------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|
| | 24°C | | | 35°C | | | 45°C | | |
| CaCl ₂ (g) | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE |
| 0.1 | 0.070 | 0.000 | 0.930 | 0.099 | 0.000 | 0.901 | 0.109 | 0.000 | 0.891 |
| 0.2 | 0.000 | 1.000 | 0.000 | 0.008 | 0.982 | 0.010 | 0.008 | 0.982 | 0.010 |
| 0.6 | 0.000 | 1.000 | 0.000 | 0.970 | 0.000 | 0.030 | 0.961 | 0.000 | 0.039 |
| 0.7 | 0.971 | 0.000 | 0.029 | 0.913 | 0.000 | 0.087 | 0.913 | 0.000 | 0.087 |

Table A-4e Dowfax 8390 = 625 mM, Ratio of Dowfax8390 to octanoic acid = 1.0

| | Relative volume | | | | | | | | |
|--------------------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|
| | 24°C | | | 35°C | | | 45°C | | |
| CaCl ₂ (g) | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE |
| 0.038 | 0.0001 | 0.000 | 0.9999 | 0.059 | 0.000 | 0.941 | 0.059 | 0.000 | 0.941 |
| 0.05 | 0.000 | 1.000 | 0.000 | 0.001 | 0.000 | 0.999 | 0.001 | 0.000 | 0.999 |
| 0.6 | 0.000 | 1.000 | 0.000 | 0.961 | 0.000 | 0.039 | 0.961 | 0.000 | 0.039 |
| 0.7 | 0.971 | 0.000 | 0.029 | 0.951 | 0.000 | 0.049 | 0.903 | 0.000 | 0.097 |

Table A-5 Data of sample preparation, R = 0.75, MgCl₂.6H₂O + CaCl₂ scan (include hexa-hydrate), 24 °C, 35 °C, 45 °C

| Dowfax8390, mM | Dowfax8390, g | octanoic acid, g | octanoic acid, mL | PCE, g | %(Dowfax + octanoic acid) | MgCl ₂ .6H ₂ O + CaCl ₂ added in each tube, g |
|-------------------|------------------|---------------------|----------------------|--------|------------------------------|---|
| 80 | 0.22 | 0.30 | 0.33 | 7.58 | 4.15 | 2.0,2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8 |
| 120 | 0.34 | 0.45 | 0.49 | 7.32 | 6.37 | 2.0,2.1,2.3,2.5,2.7,2.8 |
| 220 | 0.62 | 0.82 | 0.90 | 6.65 | 12.34 | 1.3,1.4,1.5,1.7,1.9,2.5,2.7,2.8 |
| 280 | 0.78 | 1.05 | 1.15 | 6.25 | 16.26 | 1.2,1.4,1.5,1.8,2.4,2.5,2.6,2.8,3.0 |
| 340 | 0.95 | 1.27 | 1.39 | 5.85 | 20.47 | 1.1,1.2,1.3,1.7,2.5,2.6 |
| 440 | 1.23 | 1.64 | 1.81 | 5.19 | 28.22 | 1.1,1.2,2.3,2.4 |
| 500 | 1.40 | 1.87 | 2.05 | 4.79 | 33.38 | 1.0,1.1,1.7,1.8 |
| 520 | 1.46 | 1.94 | 2.13 | 4.65 | 35.20 | 1.0,1.1,1.4,1.5 |
| 580 | 1.62 | 2.17 | 2.38 | 4.25 | 40.95 | 0.075,0.1,0.9,1.0 |
| 625 | 1.75 | 2.33 | 2.56 | 3.95 | 45.61 | 0,0.05,0.1,0.8,0.9 |

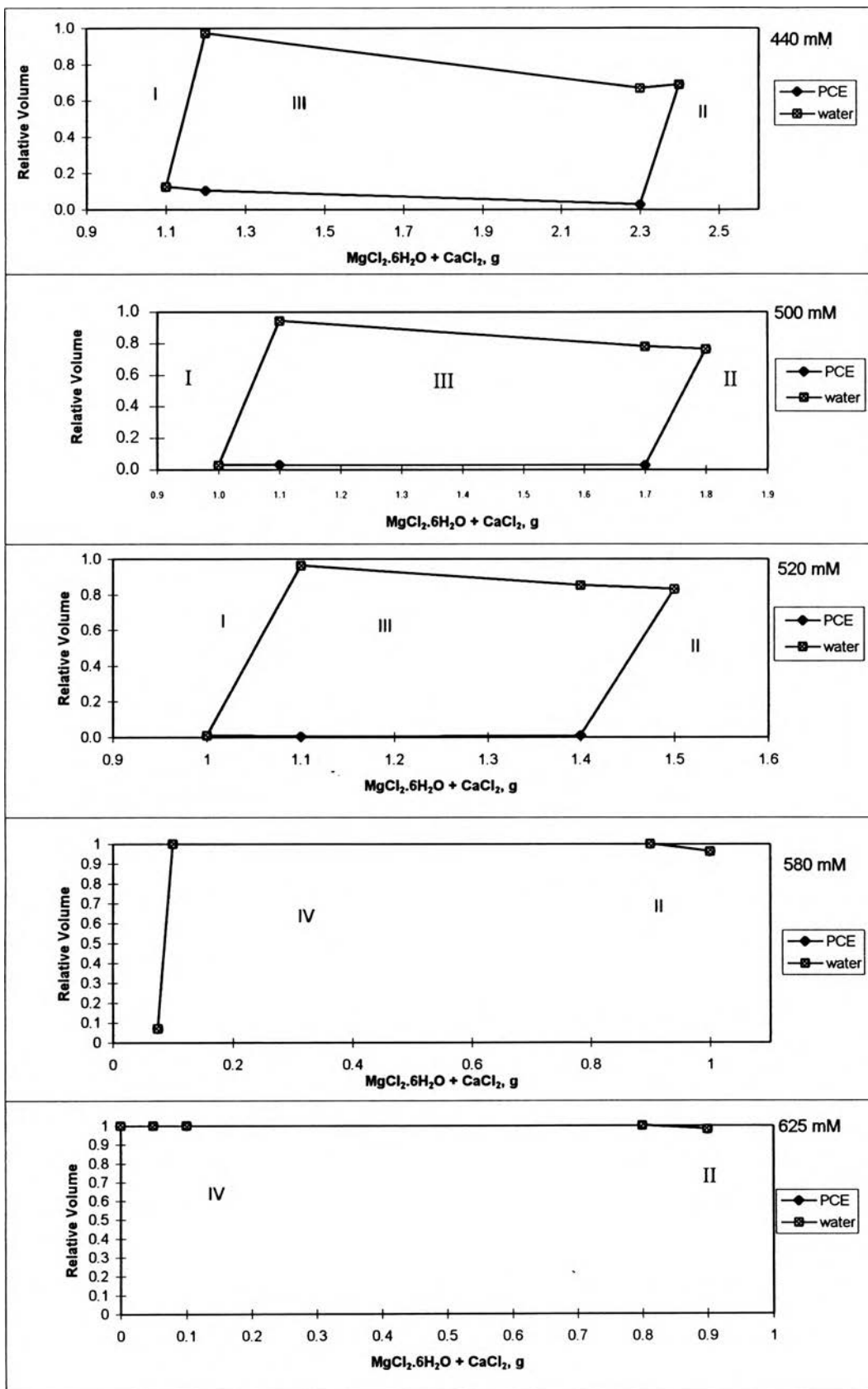


Figure A.7 Relative volume of the microemulsion, 440-625 mM Dowfax8390, $R = 0.75$, 24°C .

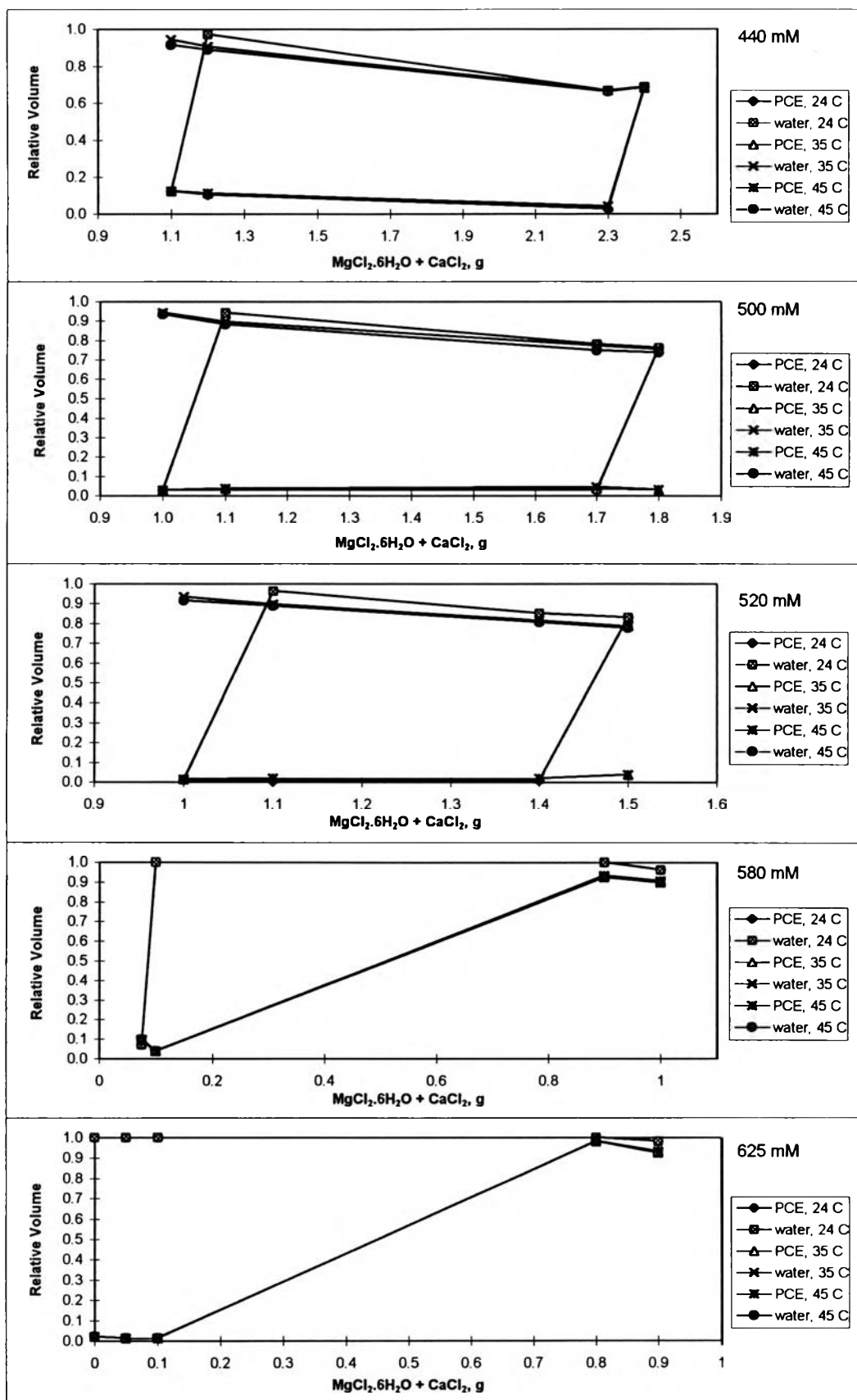


Figure A.8 Relative volume of the microemulsion, 440-625 mM Dowfax8390, $R = 0.75$, 24 °C - 45 °C.

Table A-6 Ranges of MgCl₂ + CaCl₂ produce Type III or Type IV microemulsion, R = 0.75, MgCl₂ + CaCl₂ scan (exclude heax-hydrate), 24 °C, 35 °C, 45 °C

| Dowfax 8390 (wt%) | MgCl ₂ + CaCl ₂ (24 °C) | | | | MgCl ₂ + CaCl ₂ (35 °C) ^b | | | | MgCl ₂ + CaCl ₂ (45 °C) ^b | | | |
|-------------------------|---|-------|------------------|-------|--|-------------------|------------------|-------|--|-------------------|------------------|-------|
| | ending type I | | starting type II | | present of type III | | starting type II | | present of type III | | starting type II | |
| | g | % | g | % | g | % | g | % | g | % | g | % |
| 4.15 | 1.38 | 10.97 | 1.84 | 14.62 | 1.31 | 10.41 | 1.84 | 14.62 | 1.31 | 10.41 | 1.84 | 14.62 |
| 6.37 | 1.31 | 10.64 | 1.90 | 15.43 | 1.31 | 10.64 | 1.90 | 15.43 | 1.31 | 10.64 | 1.90 | 15.43 |
| 12.34 | 0.92 | 7.90 | 1.84 | 15.79 | 0.85 | 7.30 | 1.84 | 15.79 | 0.85 | 7.30 | 1.84 | 15.79 |
| 16.26 | 0.92 | 8.18 | 1.97 | 17.51 | 0.79 | 7.02 | 1.77 | 15.73 | 0.79 | 7.02 | 1.77 | 15.73 |
| 20.47 | 0.72 | 6.64 | 1.71 | 15.76 | 0.72 | 6.64 | 1.71 | 15.76 | 0.72 | 6.64 | 1.71 | 15.76 |
| 28.22 | 0.72 | 7.07 | 1.58 | 15.51 | 0.72 | 7.07 | 1.58 | 15.51 | 0.72 | 7.07 | 1.58 | 15.51 |
| 33.38 | 0.66 | 6.74 | 1.18 | 12.06 | 0.66 | 6.74 | 1.18 | 12.06 | 0.66 | 6.74 | 1.18 | 12.06 |
| 35.20 | 0.66 | 6.84 | 0.98 | 10.15 | 0.66 | 6.84 | 0.98 | 10.15 | 0.66 | 6.84 | 0.98 | 10.15 |
| 40.95 | 0.049 | 0.53 | 0.66 | 7.13 | 0.066 ^c | 0.71 ^c | 0.59 | 6.38 | 0.066 ^c | 0.71 ^c | 0.59 | 6.38 |
| 45.61 | 0 | 0 | 0.59 | 6.59 | 0.066 ^c | 0.74 ^c | 0.52 | 5.81 | 0.066 ^c | 0.74 ^c | 0.52 | 5.81 |

%mixed (MgCl₂ + CaCl₂) was calculated excluding hydrate.

a : Type III occur below 40.95% (Dowfax8390 + octanoic acid) and type IV occur at 40.95% and above.

b : Type IV occur at 40.95% and above.

c : Last point of type I.

Table A-6a Dowfax 8390 = 440 mM, Ratio of Dowfax8390 to octanoic acid = 0.75

| | Relative volume | | | | | | | | |
|--|-----------------|-----------------|---------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|
| | 24°C | | | 35°C | | | 45°C | | |
| MgCl ₂ 6H ₂ O + CaCl ₂ (g) | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE |
| 1.1 | 0.124 | 0.000 | 0.876 | 0.124 | 0.819 | 0.057 | 0.123 | 0.819 | 0.792 |
| 1.2 | 0.104 | 0.868 | 0.028 | 0.113 | 0.792 | 0.094 | 0.112 | 0.792 | 0.776 |
| 2.3 | 0.027 | 0.640 | 0.333 | 0.036 | 0.631 | 0.333 | 0.040 | 0.631 | 0.621 |
| 2.4 | 0.688 | 0.000 | 0.313 | 0.681 | 0.000 | 0.319 | 0.684 | 0.000 | 0.000 |

Table A-6b Dowfax 8390 = 500 mM, Ratio of Dowfax8390 to octanoic acid = 0.75

| | Relative volume | | | | | | | | |
|--|-----------------|-----------------|---------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|
| | 24°C | | | 35°C | | | 45°C | | |
| MgCl ₂ 6H ₂ O + CaCl ₂ (g) | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE |
| 1.0 | 0.029 | 0.000 | 0.971 | 0.029 | 0.914 | 0.057 | 0.029 | 0.905 | 0.067 |
| 1.1 | 0.031 | 0.911 | 0.057 | 0.035 | 0.860 | 0.105 | 0.036 | 0.846 | 0.118 |
| 1.7 | 0.028 | 0.752 | 0.220 | 0.037 | 0.734 | 0.229 | 0.043 | 0.703 | 0.255 |
| 1.8 | 0.761 | 0.000 | 0.239 | 0.029 | 0.723 | 0.248 | 0.029 | 0.707 | 0.264 |

Table A-6c Dowfax 8390 = 520 mM, Ratio of Dowfax8390 to octanoic acid = 0.75

| | Relative volume | | | | | | | | |
|--|-----------------|-----------------|---------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|
| | 24°C | | | 35°C | | | 45°C | | |
| MgCl ₂ 6H ₂ O + CaCl ₂ (g) | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE |
| 1.0 | 0.010 | 0.000 | 0.990 | 0.014 | 0.919 | 0.067 | 0.014 | 0.901 | 0.085 |
| 1.1 | 0.004 | 0.958 | 0.038 | 0.019 | 0.877 | 0.104 | 0.019 | 0.868 | 0.113 |
| 1.4 | 0.008 | 0.841 | 0.151 | 0.019 | 0.794 | 0.187 | 0.019 | 0.787 | 0.194 |
| 1.5 | 0.830 | 0.000 | 0.170 | 0.038 | 0.745 | 0.217 | 0.037 | 0.738 | 0.224 |

Table A-6d Dowfax 8390 = 580 mM, Ratio of Dowfax8390 to octanoic acid = 0.75

| | Relative volume | | | | | | | | |
|--|-----------------|-----------------|---------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|
| | 24°C | | | 35°C | | | 45°C | | |
| MgCl ₂ 6H ₂ O + CaCl ₂ (g) | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE |
| 0.075 | 0.069 | 0.000 | 0.931 | 0.094 | 0.000 | 0.906 | 0.099 | 0.000 | 0.901 |
| 0.1 | 0.000 | 1.000 | 0.000 | 0.039 | 0.000 | 0.961 | 0.039 | 0.000 | 0.961 |
| 0.9 | 0.000 | 1.000 | 0.000 | 0.933 | 0.000 | 0.067 | 0.925 | 0.000 | 0.075 |
| 1.0 | 0.962 | 0.000 | 0.038 | 0.905 | 0.000 | 0.095 | 0.896 | 0.000 | 0.104 |

Table A-6e Dowfax 8390 = 625 mM, Ratio of Dowfax8390 to octanoic acid = 0.75

| | Relative volume | | | | | | | | |
|--|-----------------|-----------------|---------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|
| | 24°C | | | 35°C | | | 45°C | | |
| MgCl ₂ 6H ₂ O + CaCl ₂ (g) | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE |
| 0 | 0.000 | 1.000 | 0.000 | 0.020 | 0.000 | 0.980 | 0.020 | 0.000 | 0.980 |
| 0.05 | 0.000 | 1.000 | 0.000 | 0.014 | 0.000 | 0.986 | 0.014 | 0.000 | 0.986 |
| 0.1 | 0.000 | 1.000 | 0.000 | 0.012 | 0.000 | 0.988 | 0.013 | 0.000 | 0.987 |
| 0.8 | 0.000 | 1.000 | 0.000 | 0.981 | 0.000 | 0.019 | 0.981 | 0.000 | 0.019 |
| 0.9 | 0.981 | 0.000 | 0.019 | 0.933 | 0.000 | 0.067 | 0.925 | 0.000 | 0.075 |

Table A-7 Data of sample preparation, R = 1.0, MgCl₂.6H₂O + CaCl₂ scan (include hexa-hydrate), 24 °C, 35 °C, 45 °C

| Dowfax8390, mM | Dowfax8390, g | octanoic acid,g | octanoic acid, mL | PCE, g | %(Dowfax + octanoic acid) | MgCl ₂ .6H ₂ O + CaCl ₂ added in each tube, g |
|-------------------|------------------|--------------------|----------------------|--------|------------------------------|---|
| 80 | 0.22 | 0.22 | 0.25 | 7.72 | 3.52 | 2.1,2.3,2.4,2.5,2.6,2.8,2.9 |
| 120 | 0.34 | 0.34 | 0.37 | 7.52 | 5.37 | 1.9,2.0,2.1,2.3,2.5,2.6,2.7 |
| 220 | 0.62 | 0.62 | 0.68 | 7.02 | 10.25 | 1.5,1.6,1.7,1.9,2.0,2.1,2.7,2.8,2.9,3.0 |
| 280 | 0.78 | 0.78 | 0.86 | 6.72 | 13.38 | 1.5,1.6,1.7,1.8,2.1,2.6,2.7 |
| 340 | 0.95 | 0.95 | 1.05 | 6.42 | 16.68 | 1.4,1.5,1.7,2.6,2.8,2.9 |
| 440 | 1.23 | 1.23 | 1.35 | 5.92 | 22.57 | 1.4,1.5,2.3,2.4 |
| 500 | 1.40 | 1.40 | 1.54 | 5.62 | 26.37 | 1.3,1.4,1.7,1.8 |
| 520 | 1.46 | 1.46 | 1.60 | 5.52 | 27.69 | 1.3,1.325,1.35 |
| 580 | 1.62 | 1.62 | 1.78 | 5.22 | 31.79 | 0.3,0.4,1.2,1.3 |
| 625 | 1.75 | 1.75 | 1.92 | 4.99 | 35.02 | 0.05,0.1,1.1,1.2 |

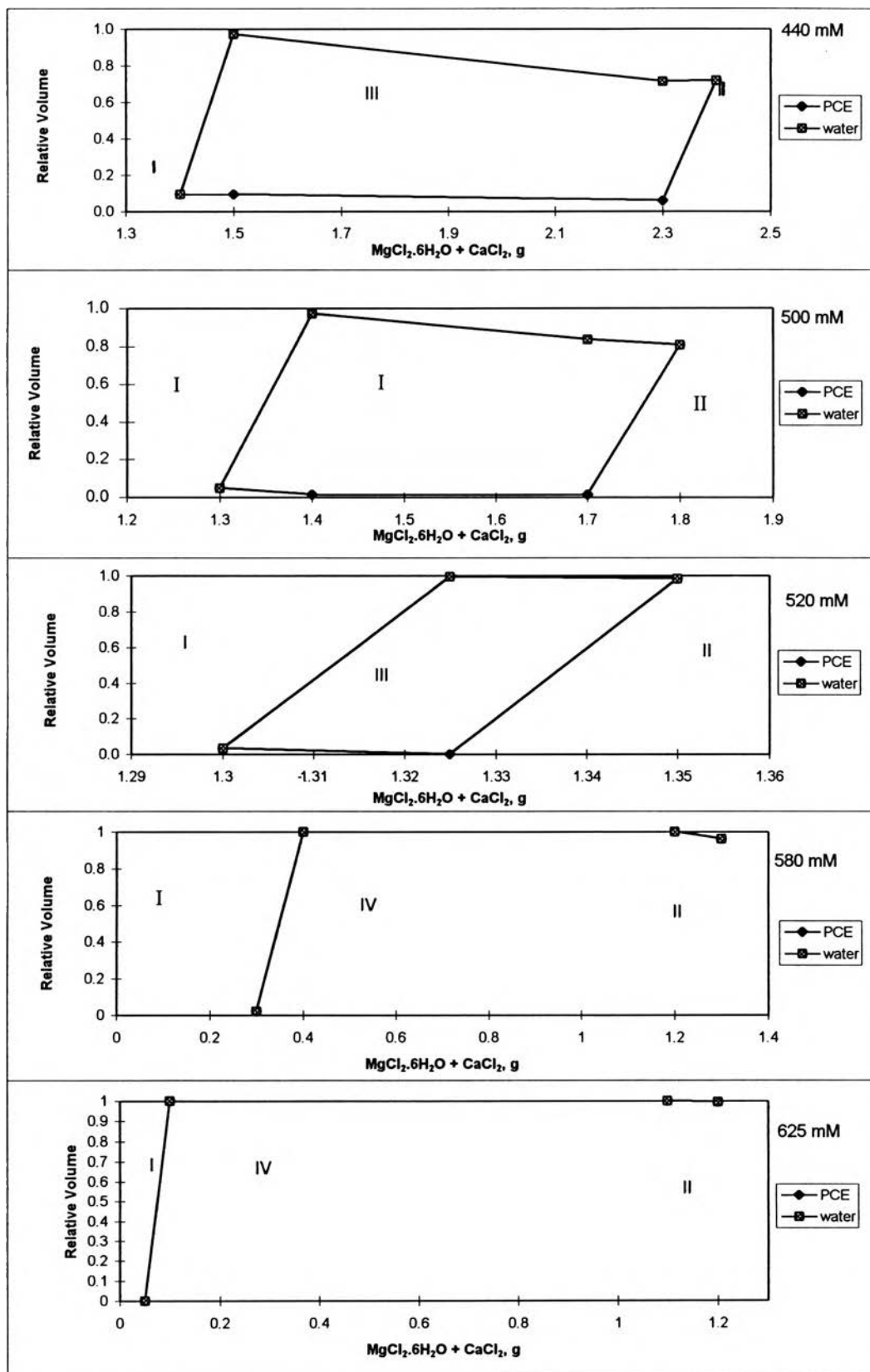


Figure A.9 Relative volume of the microemulsion, 440-625 mM Dowfax8390, $R = 1.0$, 24°C .

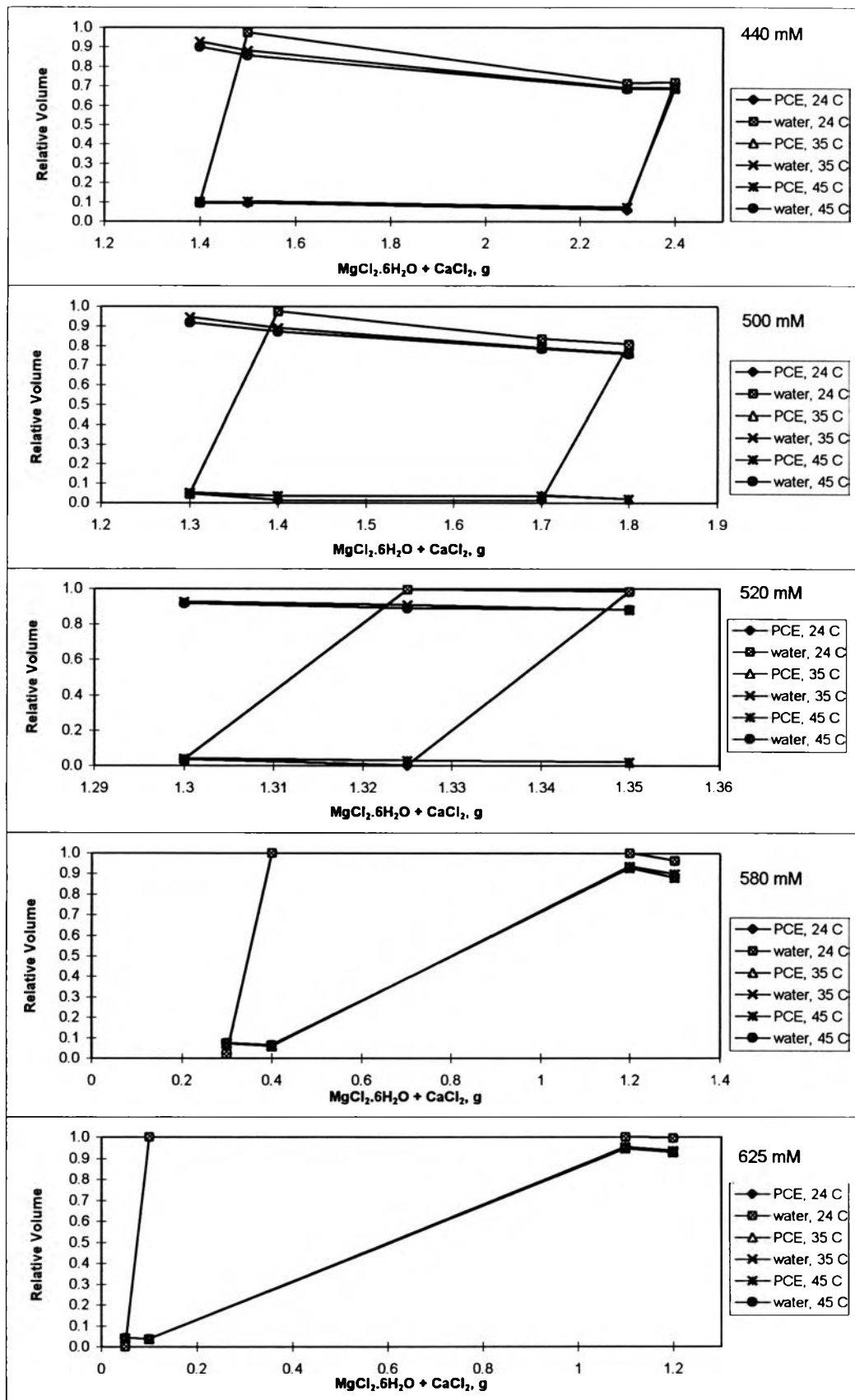


Figure A.10 Relative volume of the microemulsion, 440-625 mM Dowfax8390, $R = 1.0$, 24 °C - 45 °C.

Table A-8 Ranges of MgCl₂ + CaCl₂ produce Type III or Type IV microemulsion, R = 1.0, MgCl₂ + CaCl₂ scan (exclude heax-hydrate), 24 °C, 35 °C, 45 °C

| Dowfax 8390 (wt%) | MgCl ₂ + CaCl ₂ (24 °C) | | | | MgCl ₂ + CaCl ₂ (35 °C) ^b | | | | MgCl ₂ + CaCl ₂ (45 °C) ^b | | | |
|-------------------------|---|-------|------------------|-------|--|-------------------|------------------|-------|--|-------------------|------------------|-------|
| | ending type I | | starting type II | | present of type III | | starting type II | | present of type III | | starting type II | |
| | g | % | g | % | g | % | g | % | g | % | g | % |
| 3.52 | 1.51 | 11.88 | 1.90 | 14.94 | 1.38 | 10.85 | 1.90 | 14.94 | 1.38 | 10.85 | 1.90 | 14.94 |
| 5.37 | 1.31 | 10.47 | 1.77 | 14.14 | 1.25 | 9.99 | 1.77 | 14.14 | 1.25 | 9.99 | 1.77 | 14.14 |
| 10.25 | 1.05 | 8.74 | 1.97 | 16.39 | 0.98 | 8.16 | 1.90 | 15.81 | 0.98 | 8.16 | 1.90 | 15.81 |
| 13.38 | 0.98 | 8.36 | 1.77 | 15.11 | 0.98 | 8.36 | 1.77 | 15.11 | 0.98 | 8.36 | 1.77 | 15.11 |
| 16.68 | 0.92 | 8.06 | 1.90 | 16.64 | 0.92 | 8.06 | 1.90 | 16.64 | 0.92 | 8.06 | 1.90 | 16.64 |
| 22.57 | 0.92 | 8.43 | 1.58 | 14.47 | 0.92 | 8.43 | 1.58 | 14.47 | 0.92 | 8.43 | 1.58 | 14.47 |
| 26.37 | 0.85 | 8.01 | 1.18 | 11.11 | 0.85 | 8.01 | 1.18 | 11.11 | 0.85 | 8.01 | 1.18 | 11.11 |
| 27.69 | 0.85 | 8.08 | 0.89 | 8.46 | 0.85 | 8.08 | 0.89 | 8.46 | 0.85 | 8.08 | 0.89 | 8.46 |
| 31.79 | 0.20 | 1.96 | 0.85 | 8.32 | 0.26 ^c | 2.54 ^c | 0.79 | 7.73 | 0.26 ^c | 2.54 ^c | 0.79 | 7.73 |
| 35.02 | 0.033 | 0.33 | 0.79 | 7.90 | 0.066 ^c | 0.66 ^c | 0.72 | 7.20 | 0.066 ^c | 0.66 ^c | 0.72 | 7.20 |

%mixed (MgCl₂ + CaCl₂) was calculated excluding hydrate.

a : Type III occur below 31.79% (Dowfax8390 + octanoic acid) and type IV occur at 31.79% and above.

b : Type IV occur at 31.79% and above.

c : Last point of type I.

Table A-8a Dowfax 8390 = 440 mM, Ratio of Dowfax8390 to octanoic acid = 1.0

| | Relative volume | | | | | | | | |
|--|-----------------|-----------------|---------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|
| | 24°C | | | 35°C | | | 45°C | | |
| MgCl ₂ 6H ₂ O + CaCl ₂ (g) | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE |
| 1.4 | 0.093 | 0.000 | 0.907 | 0.103 | 0.822 | 0.075 | 0.102 | 0.796 | 0.102 |
| 1.5 | 0.093 | 0.879 | 0.028 | 0.102 | 0.778 | 0.120 | 0.101 | 0.752 | 0.147 |
| 2.3 | 0.058 | 0.654 | 0.288 | 0.071 | 0.616 | 0.313 | 0.071 | 0.611 | 0.319 |
| 2.4 | 0.717 | 0.000 | 0.283 | 0.690 | 0.000 | 0.310 | 0.684 | 0.000 | 0.316 |

Table A-8b Dowfax 8390 = 500 mM, Ratio of Dowfax8390 to octanoic acid = 1.0

| | Relative volume | | | | | | | | |
|--|-----------------|-----------------|---------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|
| | 24°C | | | 35°C | | | 45°C | | |
| MgCl ₂ 6H ₂ O + CaCl ₂ (g) | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE |
| 1.3 | 0.047 | 0.000 | 0.953 | 0.047 | 0.896 | 0.057 | 0.051 | 0.864 | 0.084 |
| 1.4 | 0.014 | 0.958 | 0.028 | 0.035 | 0.853 | 0.112 | 0.034 | 0.836 | 0.130 |
| 1.7 | 0.013 | 0.822 | 0.165 | 0.037 | 0.752 | 0.211 | 0.036 | 0.745 | 0.218 |
| 1.8 | 0.807 | 0.000 | 0.193 | 0.018 | 0.743 | 0.239 | 0.018 | 0.736 | 0.245 |

Table A-8c Dowfax 8390 = 520 mM, Ratio of Dowfax8390 to octanoic acid = 1.0

| | Relative volume | | | | | | | | |
|--|-----------------|-----------------|---------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|
| | 24°C | | | 35°C | | | 45°C | | |
| MgCl ₂ 6H ₂ O + CaCl ₂ (g) | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE |
| 1.3 | 0.033 | 0.000 | 0.967 | 0.037 | 0.888 | 0.075 | 0.039 | 0.877 | 0.084 |
| 1.325 | 0.0001 | 0.9953 | 0.0046 | 0.028 | 0.879 | 0.093 | 0.028 | 0.860 | 0.112 |
| 1.35 | 0.981 | 0.000 | 0.019 | 0.017 | 0.863 | 0.120 | 0.017 | 0.863 | 0.120 |

Table A-8d Dowfax 8390 = 580 mM, Ratio of Dowfax8390 to octanoic acid = 1.0

| | Relative volume | | | | | | | | |
|--|-----------------|-----------------|---------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|
| | 24°C | | | 35°C | | | 45°C | | |
| MgCl ₂ 6H ₂ O + CaCl ₂ (g) | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE |
| 0.3 | 0.022 | 0.000 | 0.978 | 0.071 | 0.000 | 0.929 | 0.073 | 0.000 | 0.927 |
| 0.4 | 0.000 | 1.000 | 0.000 | 0.058 | 0.000 | 0.942 | 0.062 | 0.000 | 0.938 |
| 1.2 | 0.000 | 1.000 | 0.000 | 0.935 | 0.000 | 0.065 | .926 | 0.000 | 0.074 |
| 1.3 | 0.963 | 0.000 | 0.037 | 0.897 | 0.000 | 0.103 | 0.880 | 0.000 | 0.120 |

Table A-8e Dowfax 8390 = 625 mM, Ratio of Dowfax8390 to octanoic acid = 1.0

| | Relative volume | | | | | | | | |
|--|-----------------|-----------------|---------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|
| | 24°C | | | 35°C | | | 45°C | | |
| MgCl ₂ 6H ₂ O + CaCl ₂ (g) | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE | excess water | middle phase | excess PCE |
| 0.05 | 0.0001 | 0.000 | 0.9999 | 0.040 | 0.000 | 0.960 | 0.040 | 0.000 | 0.960 |
| 0.1 | 0.000 | 1.000 | 0.000 | 0.035 | 0.000 | 0.965 | 0.035 | 0.000 | 0.965 |
| 1.1 | 0.000 | 1.000 | 0.000 | 0.953 | 0.000 | 0.047 | 0.944 | 0.000 | 0.056 |
| 1.2 | 0.9954 | 0.000 | 0.0046 | 0.935 | 0.000 | 0.065 | 0.926 | 0.000 | 0.074 |

Note : Calculation of % (Dowfax8390 + octanoic acid)

Example ; 80 mM Dowfax8390 = 5 mL

Dowfax8390 concentration as received 35% (w/w) (625mM)

Density of Dowfax8390 solution = 1.03 - 1.15 g/cc

$$\begin{aligned}\text{wt of Dowfax8390} &= (80 \text{ mM})(35\%/625 \text{ mM})(5 \text{ mL}/100) \\ &= 0.22\end{aligned}$$

$$\text{g of Dowfax8390/ g of octanoic acid} = 0.75$$

$$\text{g of octanoic acid} = 0.22/ 0.75 = 0.30$$

$$\text{Density of octanoic acid} = 0.91 \text{ g/cc}$$

$$\text{mL of octanoic acid} = 0.30/ 0.91 = 0.33$$

$$\text{Density of PCE} = 1.623 \text{ g/cc}$$

$$\text{g of PCE} = (5 \text{ mL} - 0.33 \text{ mL}) * (1.623 \text{ g/mL}) = 7.58$$

$$\begin{aligned}\% (\text{Dowfax8390} + \text{octanoic acid}) &= \{ \text{wt} (\text{Dowfax8390} + \text{octanoic acid}) / \text{wt} (\text{PCE} + \text{water}) \} * 100 \\ &= \{ (0.22 + 0.30) / (7.58 + 5) \} * 100 = 4.15\%\end{aligned}$$

APPENDIX B
EXPERIMENTAL DATA OF SOLUBILIZATION STUDY

| | |
|---------------------------------------|--|
| Initial oil/water volume ratio | = 1/1 |
| Ratio of Dowfax8390/octanoic acid (R) | = 0.75, 1.0 |
| Dowfax8390 concentration | = 80 - 625 mM |
| Temperature | = 24 °C, 35 °C , 45 °C |
| Electrolyte | = CaCl ₂ , CaCl ₂ + MgCl ₂ .6H ₂ O |

Determination of solubilization parameters.

- I at 24 °C and Ratio of Dowfax8390/octanoic acid = 0.75
(section 4.1.1 and Figure B.1 - B.2)
at 24 °C and Ratio of Dowfax8390/octanoic acid = 1.0
(section 4.1.2 and Figure B.5)
at 24 °C and Ratio of Dowfax8390/octanoic acid = 0.75, 1.0
(section 4.1.3 and Figure B.7, and B.9)
- II at 24 °C, 35 °C , 45 °C and Ratio of Dowfax8390/octanoic acid = 0.75, 1.0
single electrolyte (section 4.1.4 and Figure B.3 - B.4, and B.6)
at 24 °C, 35 °C , 45 °C and Ratio of Dowfax8390/octanoic acid = 0.75, 1.0
mixed electrolyte (section 4.1.4 and Figure B.8, and B.10)

Table B-1 Dowfax8390 = 80 mM, Ratio of Dowfax8390 to octanoic acid = 0.75

| | Solubilization Parameter | | | | | |
|--------------------------|--------------------------|-----------------|---------------|-----------------|---------------|-----------------|
| | 24°C | | 35°C | | 45°C | |
| | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) |
| CaCl ₂ (g) | | | | | | |
| 1.1 | 2.27 | 22.73 | 2.27 | 5.45 | 2.27 | 10.00 |
| 1.2 | 2.73 | 1.36 | 2.73 | 3.18 | 2.73 | 3.18 |
| 1.25 | 2.73 | 6.36 | 2.27 | 3.18 | 2.27 | 3.64 |
| 1.3 | 2.73 | 5.00 | 2.73 | 2.27 | 2.73 | 3.18 |
| 1.4 | 2.73 | 2.73 | 2.73 | 1.82 | 2.73 | 2.27 |
| 1.45 | 3.64 | 2.27 | 3.18 | 1.36 | 3.18 | 1.82 |
| 1.5 | 1.36 | 2.73 | 1.36 | 1.82 | 1.36 | 2.73 |
| 1.57 | 22.73 | 2.27 | 22.73 | 2.73 | 22.73 | 2.73 |
| 1.6 | 22.73 | 9.55 | 22.73 | 10.00 | 22.73 | 9.55 |

Table B-2 Dowfax 8390 = 120 mM, Ratio of Dowfax8390 to octanoic acid = 0.75

| | Solubilization Parameter | | | | | |
|--------------------------|--------------------------|-----------------|---------------|-----------------|---------------|-----------------|
| | 24°C | | 35°C | | 45°C | |
| CaCl ₂ (g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) |
| 1 | 2.65 | 14.71 | 2.65 | 8.24 | 2.65 | 5.59 |
| 1.1 | 3.53 | 8.82 | 2.94 | 5.00 | 2.94 | 4.41 |
| 1.2 | 3.24 | 5.00 | 3.24 | 3.53 | 2.94 | 2.94 |
| 1.25 | 3.24 | 4.12 | 3.94 | 1.47 | 1.47 | 2.65 |
| 1.3 | 2.94 | 3.82 | 2.94 | 2.94 | 2.94 | 2.65 |
| 1.4 | 3.53 | 2.94 | 3.24 | 2.35 | 2.94 | 2.06 |
| 1.5 | 3.53 | 2.06 | 3.53 | 1.47 | 3.53 | 1.18 |
| 1.55 | 14.71 | 2.35 | 14.71 | 2.35 | 14.71 | 2.06 |
| 1.6 | 14.71 | 0.00 | 14.71 | 0.00 | 14.71 | 0.00 |

Table B-3 Dowfax8390 = 220 mM, Ratio of Dowfax8390 to octanoic acid = 0.75

| | Solubilization Parameter | | | | | |
|--------------------------|--------------------------|-----------------|---------------|-----------------|---------------|-----------------|
| | 24°C | | 35°C | | 45°C | |
| | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) |
| CaCl ₂ (g) | | | | | | |
| 0.8 | 2.90 | 8.06 | 2.90 | 6.29 | 2.74 | 4.68 |
| 0.9 | 3.06 | 7.10 | 3.06 | 5.32 | 2.90 | 4.03 |
| 1.0 | 3.06 | 5.00 | 3.06 | 4.03 | 3.06 | 3.06 |
| 1.1 | 3.23 | 3.71 | 3.23 | 3.06 | 3.06 | 2.58 |
| 1.25 | 2.58 | 1.94 | 3.39 | 2.42 | 3.23 | 1.29 |
| 1.4 | 3.71 | 1.29 | 4.52 | 1.77 | 3.55 | 1.61 |
| 1.5 | 3.55 | 1.77 | 3.39 | 1.61 | 3.23 | 0.97 |
| 1.6 | 8.06 | 0.00 | 8.06 | 0.00 | 8.06 | 0.00 |

Table B-4 Dowfax8390 = 280 mM, Ratio of Dowfax8390 to octanoic acid = 0.75

| | Solubilization Parameter | | | | | |
|------|--------------------------|---------------|-----------------|---------------|-----------------|---------------|
| | 24°C | | 35°C | | 45°C | |
| | CaCl ₂ (g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) |
| 0.75 | 2.95 | 6.41 | 2.95 | 5.26 | 2.82 | 4.10 |
| 0.8 | 3.08 | 5.77 | 3.08 | 4.62 | 3.08 | 3.72 |
| 0.9 | 3.08 | 4.49 | 3.08 | 3.72 | 3.08 | 3.08 |
| 1.1 | 3.33 | 2.95 | 3.33 | 2.56 | 3.33 | 2.31 |
| 1.3 | 3.72 | 2.05 | 3.72 | 1.92 | 3.72 | 1.79 |
| 1.4 | 3.97 | 1.15 | 3.97 | 1.03 | 3.97 | 1.54 |
| 1.5 | 0.38 | 0.00 | 0.13 | 0.00 | 0.00 | 0.13 |

Table B-5 Dowfax8390 = 340 mM, Ratio of Dowfax8390 to octanoic acid = 0.75

| | Solubilization Parameter | | | | | |
|------|--------------------------|-----------------|---------------|-----------------|---------------|-----------------|
| | 24°C | | 35°C | | 45°C | |
| | PCE (g) | water (ml/g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) |
| 0.65 | 3.16 | 5.26 | 2.00 | 4.74 | 3.05 | 3.79 |
| 0.7 | 3.16 | 5.05 | 3.05 | 4.32 | 3.05 | 3.47 |
| 0.8 | 3.26 | 4.11 | 3.26 | 3.58 | 3.26 | 2.95 |
| 0.9 | 3.37 | 3.37 | 3.37 | 2.95 | 3.37 | 2.53 |
| 1.1 | 3.68 | 2.32 | 3.68 | 2.21 | 3.68 | 2.00 |
| 1.2 | 3.79 | 2.11 | 3.79 | 2.00 | 3.79 | 1.89 |
| 1.3 | 3.89 | 1.79 | 3.89 | 1.68 | 3.89 | 1.05 |
| 1.4 | 5.26 | 3.47 | 5.26 | 2.42 | 5.26 | 1.68 |

Table B-6 Dowfax8390 = 440 mM, Ratio of Dowfax8390 to octanoic acid = 0.75

| | Solubilization Parameter | | | | | |
|------|--------------------------|---------------|-----------------|---------------|-----------------|---------------|
| | 24°C | | 35°C | | 45°C | |
| | CaCl ₂ (g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) |
| 0.55 | 3.54 | 4.07 | 3.58 | 3.33 | 3.58 | 3.17 |
| 0.6 | 3.41 | 3.82 | 3.33 | 3.09 | 3.33 | 3.01 |
| 0.9 | 3.86 | 2.36 | 3.50 | 2.03 | 3.50 | 2.03 |
| 1.1 | 4.07 | 1.95 | 3.74 | 1.63 | 3.74 | 1.63 |

Table B-7 Dowfax8390 = 500 mM, Ratio of Dowfax8390 to octanoic acid = 0.75

| | Solubilization Parameter | | | | | |
|------|--------------------------|---------------|-----------------|---------------|-----------------|---------------|
| | 24°C | | 35°C | | 45°C | |
| | CaCl ₂ (g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) |
| 0.5 | 3.54 | 3.57 | 3.44 | 3.07 | 3.44 | 3.00 |
| 0.55 | 3.57 | 3.57 | 3.50 | 2.86 | 3.50 | 2.86 |
| 0.6 | 3.57 | 3.14 | 3.36 | 2.57 | 3.34 | 2.50 |
| 0.7 | 3.57 | 2.71 | 3.40 | 2.29 | 3.40 | 2.21 |

Table B-8 Dowfax8390 = 520 mM, Ratio of Dowfax8390 to octanoic acid = 0.75

| | Solubilization Parameter | | | | | |
|--------------------------|--------------------------|-----------------|---------------|-----------------|---------------|-----------------|
| | 24°C | | 35°C | | 45°C | |
| CaCl ₂ (g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) |
| 0.1 | 2.91 | 3.42 | 2.19 | 3.42 | 2.16 | 3.42 |
| 0.2 | 3.42 | 3.42 | 2.57 | 3.42 | 2.53 | 3.42 |
| 0.4 | 3.42 | 3.42 | 3.41 | 3.29 | 3.41 | 3.22 |
| 0.5 | 3.42 | 3.29 | 3.42 | 2.74 | 3.42 | 2.81 |

Table B-9 Dowfax8390 = 580 mM, Ratio of Dowfax8390 to octanoic acid = 0.75

| | Solubilization Parameter | | | | | |
|--------------------------|--------------------------|-----------------|---------------|-----------------|---------------|-----------------|
| | 24°C | | 35°C | | 45°C | |
| CaCl ₂ (g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) |
| 0.025 | 2.98 | 3.09 | 2.72 | 3.09 | 2.72 | 3.09 |
| 0.05 | 3.09 | 3.09 | 2.78 | 3.09 | 2.78 | 3.09 |
| 0.1 | 3.09 | 3.09 | 2.78 | 3.09 | 2.78 | 3.09 |
| 0.4 | 3.09 | 3.09 | 3.09 | 2.96 | 3.09 | 2.90 |
| 0.5 | 3.09 | 2.84 | 3.09 | 2.53 | 3.09 | 2.47 |

Table B-10 Dowfax8390 = 625 mM, Ratio of Dowfax8390 to octanoic acid = 0.75

| | Solubilization Parameter | | | | | |
|-------|--------------------------|---------------|-----------------|---------------|-----------------|---------------|
| | 24°C | | 35°C | | 45°C | |
| | CaCl ₂ (g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) |
| 0 | 2.86 | 2.86 | 2.74 | 2.86 | 2.74 | 2.86 |
| 0.025 | 2.86 | 2.86 | 2.86 | 2.86 | 2.86 | 2.86 |
| 0.4 | 2.86 | 2.86 | 2.86 | 2.69 | 2.86 | 2.69 |
| 0.5 | 2.86 | 2.57 | 2.86 | 2.46 | 2.86 | 2.34 |

Table B-11 Dowfax8390 = 440 mM, Ratio of Dowfax8390 to octanoic acid = 1.0

| | Solubilization Parameter | | | | | |
|-----|--------------------------|---------------|-----------------|---------------|-----------------|---------------|
| | 24°C | | 35°C | | 45°C | |
| | CaCl ₂ (g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) |
| 0.7 | 3.33 | 4.07 | 3.33 | 3.25 | 3.33 | 3.17 |
| 0.8 | 3.66 | 3.74 | 3.66 | 3.01 | 3.66 | 2.85 |
| 0.9 | 3.50 | 3.33 | 3.50 | 2.85 | 3.29 | 2.68 |
| 1.0 | 4.07 | 2.60 | 4.07 | 2.03 | 4.07 | 2.11 |

Table B-12 Dowfax8390 = 500 mM, Ratio of Dowfax8390 to octanoic acid = 1.0

| | Solubilization Parameter | | | | | |
|-------|--------------------------|---------------|-----------------|---------------|-----------------|---------------|
| | 24°C | | 35°C | | 45°C | |
| | CaCl ₂ (g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) |
| 0.7 | 3.43 | 3.57 | 3.43 | 2.93 | 3.41 | 2.86 |
| 0.788 | 3.36 | 3.36 | 3.32 | 2.86 | 3.21 | 2.71 |
| 0.802 | 3.50 | 3.29 | 3.41 | 2.71 | 3.40 | 2.64 |
| 0.9 | 3.57 | 3.07 | 3.41 | 2.43 | 3.40 | 2.43 |

Table B-13 Dowfax8390 = 520 mM, Ratio of Dowfax8390 to octanoic acid = 1.0

| | Solubilization Parameter | | | | | |
|-----|--------------------------|---------------|-----------------|---------------|-----------------|---------------|
| | 24°C | | 35°C | | 45°C | |
| | CaCl ₂ (g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) |
| 0.3 | 3.38 | 3.42 | 3.22 | 3.22 | 3.22 | 3.15 |
| 0.4 | 3.42 | 3.42 | 2.91 | 3.29 | 2.88 | 3.29 |
| 0.7 | 3.42 | 3.42 | 3.42 | 2.95 | 3.42 | 2.81 |
| 0.8 | 3.42 | 3.08 | 3.42 | 2.95 | 3.42 | 2.88 |

Table B-14 Dowfax8390 = 580 mM, Ratio of Dowfax8390 to octanoic acid = 1.0

| | Solubilization Parameter | | | | | |
|--------------------------|--------------------------|-----------------|---------------|-----------------|---------------|-----------------|
| | 24°C | | 35°C | | 45°C | |
| | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) |
| CaCl ₂ (g) | | | | | | |
| 0.1 | 2.65 | 3.09 | 2.47 | 3.09 | 2.41 | 3.09 |
| 0.2 | 3.09 | 3.09 | 3.04 | 3.02 | 3.04 | 3.02 |
| 0.6 | 3.09 | 3.09 | 3.09 | 2.90 | 3.09 | 2.84 |
| 0.7 | 3.09 | 2.90 | 3.09 | 2.53 | 3.09 | 2.53 |

Table B-15 Dowfax8390 = 625 mM, Ratio of Dowfax8390 to octanoic acid = 1.0

| | Solubilization Parameter | | | | | |
|--------------------------|--------------------------|-----------------|---------------|-----------------|---------------|-----------------|
| | 24°C | | 35°C | | 45°C | |
| | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) |
| CaCl ₂ (g) | | | | | | |
| 0.038 | 2.86 | 2.86 | 2.51 | 2.86 | 2.51 | 2.86 |
| 0.05 | 2.86 | 2.86 | 2.85 | 2.86 | 2.85 | 2.86 |
| 0.6 | 2.86 | 2.86 | 2.86 | 2.63 | 2.86 | 2.63 |
| 0.7 | 2.86 | 2.69 | 2.86 | 2.57 | 2.86 | 2.29 |

Table B-16 Dowfax8390 = 440 mM, Ratio of Dowfax8390 to octanoic acid = 0.75

| | Solubilization Parameter | | | | | |
|--|--------------------------|-----------------|---------------|-----------------|---------------|-----------------|
| | 24°C | | 35°C | | 45°C | |
| | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) |
| MgCl ₂ ·6H ₂ O +CaCl ₂ (g) | | | | | | |
| 1.1 | 3.01 | 4.07 | 3.01 | 3.58 | 3.01 | 3.33 |
| 1.2 | 3.17 | 3.82 | 3.09 | 3.25 | 3.09 | 3.09 |
| 2.3 | 3.82 | 1.06 | 3.74 | 1.06 | 3.70 | 0.98 |
| 2.4 | 4.07 | 1.22 | 4.07 | 1.14 | 4.07 | 1.14 |

Table B-17 Dowfax8390 = 500 mM, Ratio of Dowfax8390 to octanoic acid = 0.75

| | Solubilization Parameter | | | | | |
|--|--------------------------|-----------------|---------------|-----------------|---------------|-----------------|
| | 24°C | | 35°C | | 45°C | |
| | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) |
| MgCl ₂ ·6H ₂ O +CaCl ₂ (g) | | | | | | |
| 1.0 | 3.36 | 3.57 | 3.36 | 3.14 | 3.36 | 3.07 |
| 1.1 | 3.34 | 3.14 | 3.31 | 2.79 | 3.30 | 2.68 |
| 1.7 | 3.36 | 1.86 | 3.29 | 1.79 | 3.24 | 1.57 |
| 1.8 | 3.57 | 1.71 | 3.34 | 1.64 | 3.34 | 1.50 |

Table B-18 Dowfax8390 = 520 mM, Ratio of Dowfax8390 to octanoic acid = 0.75

| | Solubilization Parameter | | | | | |
|--|--------------------------|-----------------|---------------|-----------------|---------------|-----------------|
| | 24°C | | 35°C | | 45°C | |
| | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) |
| MgCl ₂ ·6H ₂ O +CaCl ₂ (g) | | | | | | |
| 1.0 | 3.36 | 3.42 | 3.32 | 2.95 | 3.32 | 2.81 |
| 1.1 | 3.40 | 3.15 | 3.29 | 2.67 | 3.29 | 2.60 |
| 1.4 | 3.37 | 2.33 | 3.29 | 2.05 | 3.29 | 1.99 |
| 1.5 | 3.42 | 2.19 | 3.15 | 1.85 | 3.15 | 1.78 |

Table B-19 Dowfax8390 = 580 mM, Ratio of Dowfax8390 to octanoic acid = 0.75

| | Solubilization Parameter | | | | | |
|--|--------------------------|-----------------|---------------|-----------------|---------------|-----------------|
| | 24°C | | 35°C | | 45°C | |
| | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) |
| MgCl ₂ ·6H ₂ O +CaCl ₂ (g) | | | | | | |
| 0.075 | 2.65 | 3.09 | 2.50 | 3.09 | 2.47 | 3.09 |
| 0.1 | 3.09 | 3.09 | 2.84 | 3.09 | 2.84 | 3.09 |
| 0.9 | 3.09 | 3.09 | 3.09 | 2.65 | 3.09 | 2.59 |
| 1.0 | 3.09 | 2.84 | 3.09 | 2.47 | 3.09 | 2.41 |

Table B-20 Dowfax8390 = 625 mM, Ratio of Dowfax8390 to octanoic acid = 0.75

| | Solubilization Parameter | | | | | |
|--|--------------------------|-----------------|---------------|-----------------|---------------|-----------------|
| | 24°C | | 35°C | | 45°C | |
| | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) |
| MgCl ₂ ·6H ₂ O +CaCl ₂ (g) | | | | | | |
| 0 | 2.86 | 2.86 | 2.74 | 2.86 | 2.74 | 2.86 |
| 0.05 | 2.86 | 2.86 | 2.78 | 2.86 | 2.78 | 2.86 |
| 0.1 | 2.86 | 2.86 | 2.79 | 2.86 | 2.78 | 2.86 |
| 0.8 | 2.86 | 2.86 | 2.86 | 2.74 | 2.86 | 2.74 |
| 0.9 | 2.86 | 2.74 | 2.86 | 2.46 | 2.86 | 2.40 |

Table B-21 Dowfax8390 = 440 mM, Ratio of Dowfax8390 to octanoic acid = 1.0

| | Solubilization Parameter | | | | | |
|--|--------------------------|-----------------|---------------|-----------------|---------------|-----------------|
| | 24°C | | 35°C | | 45°C | |
| | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) |
| MgCl ₂ ·6H ₂ O +CaCl ₂ (g) | | | | | | |
| 1.4 | 3.25 | 4.07 | 3.17 | 3.41 | 3.17 | 3.17 |
| 1.5 | 3.25 | 3.82 | 3.17 | 3.01 | 3.17 | 2.76 |
| 2.3 | 3.54 | 1.46 | 3.41 | 1.22 | 3.41 | 1.14 |
| 2.4 | 4.07 | 1.46 | 4.07 | 1.22 | 4.07 | 1.14 |

Table B-22 Dowfax8390 = 500 mM, Ratio of Dowfax8390 to octanoic acid = 1.0

| | Solubilization Parameter | | | | | |
|--|--------------------------|-----------------|---------------|-----------------|---------------|-----------------|
| | 24°C | | 35°C | | 45°C | |
| | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) |
| MgCl ₂ ·6H ₂ O +CaCl ₂ (g) | | | | | | |
| 1.3 | 3.21 | 3.57 | 3.21 | 3.14 | 3.18 | 2.93 |
| 1.4 | 3.46 | 3.36 | 3.31 | 2.71 | 3.31 | 2.57 |
| 1.7 | 3.47 | 2.29 | 3.29 | 1.93 | 3.29 | 1.86 |
| 1.8 | 3.57 | 2.07 | 3.43 | 1.71 | 3.43 | 1.64 |

Table B-23 Dowfax8390 = 520 mM, Ratio of Dowfax8390 to octanoic acid = 1.0

| | Solubilization Parameter | | | | | |
|--|--------------------------|-----------------|---------------|-----------------|---------------|-----------------|
| | 24°C | | 35°C | | 45°C | |
| | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) |
| MgCl ₂ ·6H ₂ O +CaCl ₂ (g) | | | | | | |
| 1.3 | 3.18 | 3.42 | 3.15 | 2.88 | 3.14 | 2.81 |
| 1.325 | 3.42 | 3.39 | 3.22 | 2.74 | 3.22 | 2.60 |
| 1.35 | 3.42 | 3.29 | 3.30 | 2.53 | 3.30 | 2.53 |

Table B-24 Dowfax8390 = 580 mM, Ratio of Dowfax8390 to octanoic acid = 1.0

| | Solubilization Parameter | | | | | |
|--|--------------------------|-----------------|---------------|-----------------|---------------|-----------------|
| | 24°C | | 35°C | | 45°C | |
| | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) |
| MgCl ₂ ·6H ₂ O +CaCl ₂ (g) | | | | | | |
| 0.3 | 2.95 | 3.09 | 2.64 | 3.09 | 2.62 | 3.09 |
| 0.4 | 3.09 | 3.09 | 2.72 | 3.09 | 2.69 | 3.09 |
| 1.2 | 3.09 | 3.09 | 3.09 | 2.65 | 3.09 | 2.59 |
| 1.3 | 3.09 | 2.84 | 3.09 | 2.41 | 3.09 | 2.28 |

Table B-25 Dowfax8390 = 625 mM, Ratio of Dowfax8390 to octanoic acid = 1.0

| | Solubilization Parameter | | | | | |
|--|--------------------------|-----------------|---------------|-----------------|---------------|-----------------|
| | 24°C | | 35°C | | 45°C | |
| | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) | PCE (ml/g) | water (ml/g) |
| MgCl ₂ ·6H ₂ O +CaCl ₂ (g) | | | | | | |
| 0.05 | 2.86 | 2.86 | 2.63 | 2.86 | 2.63 | 2.86 |
| 0.1 | 2.86 | 2.86 | 2.66 | 2.86 | 2.66 | 2.86 |
| 1.1 | 2.86 | 2.86 | 2.86 | 2.57 | 2.86 | 2.51 |
| 1.2 | 2.86 | 2.83 | 2.86 | 2.46 | 2.86 | 2.40 |

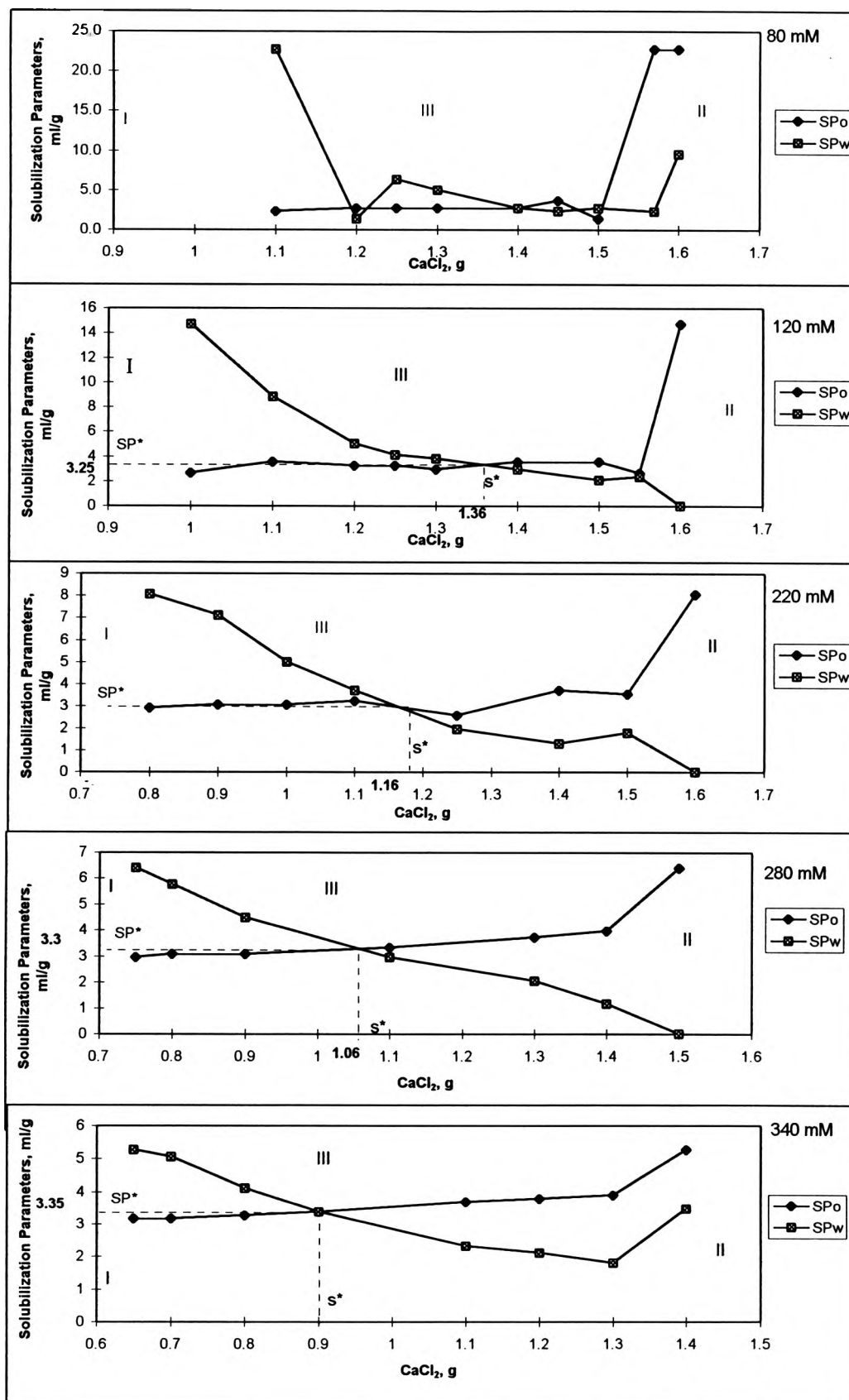


Figure B.1 Solubilization parameters, SP_o, SP_w, and SP*, 80-340 mM Dowfax8390, R = 0.75, 24 °C.

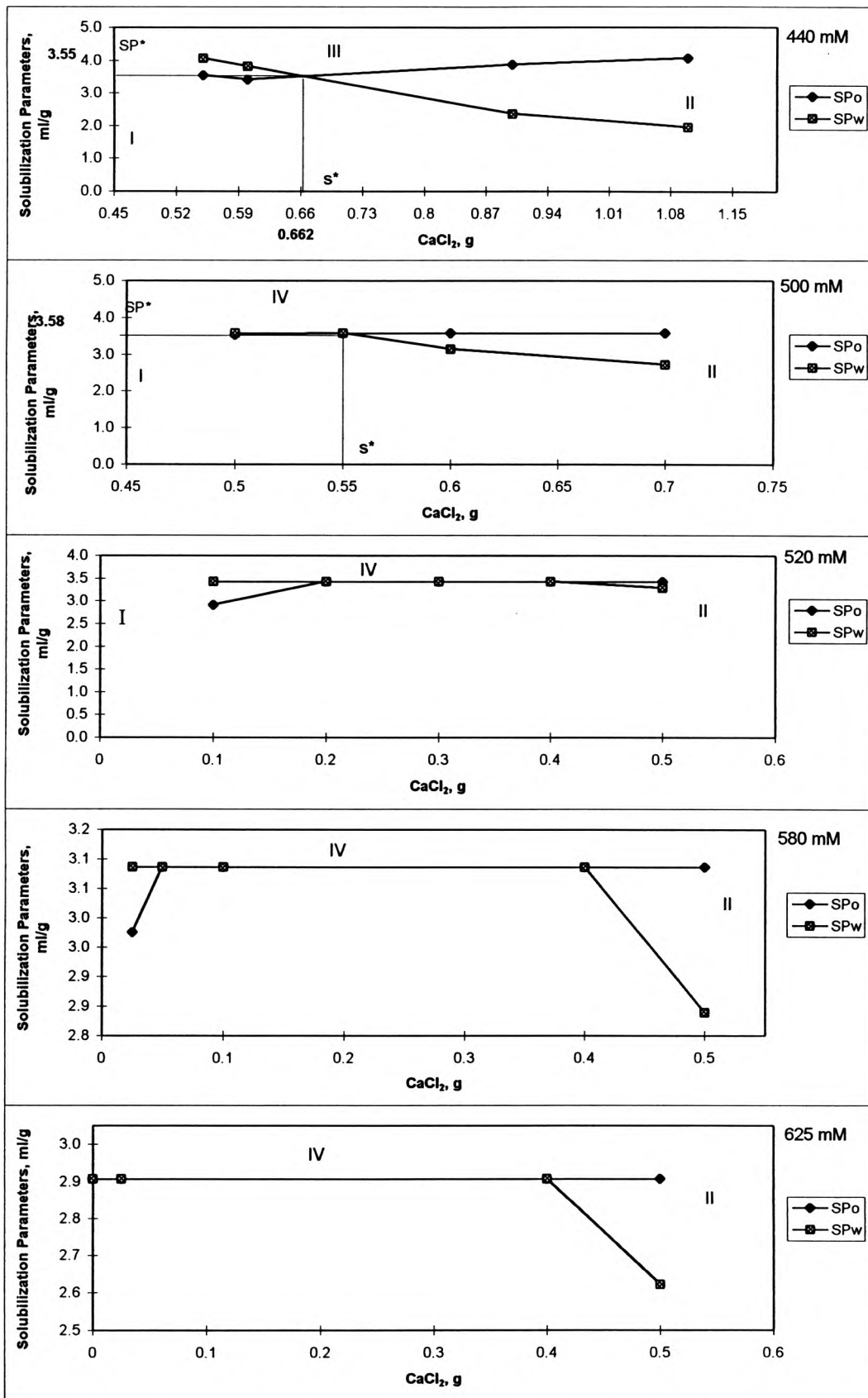


Figure B.2 Solubilization parameters, SP_o, SP_w, and SP*, 440-625 mM Dowfax8390, R = 0.75, 24 °C.

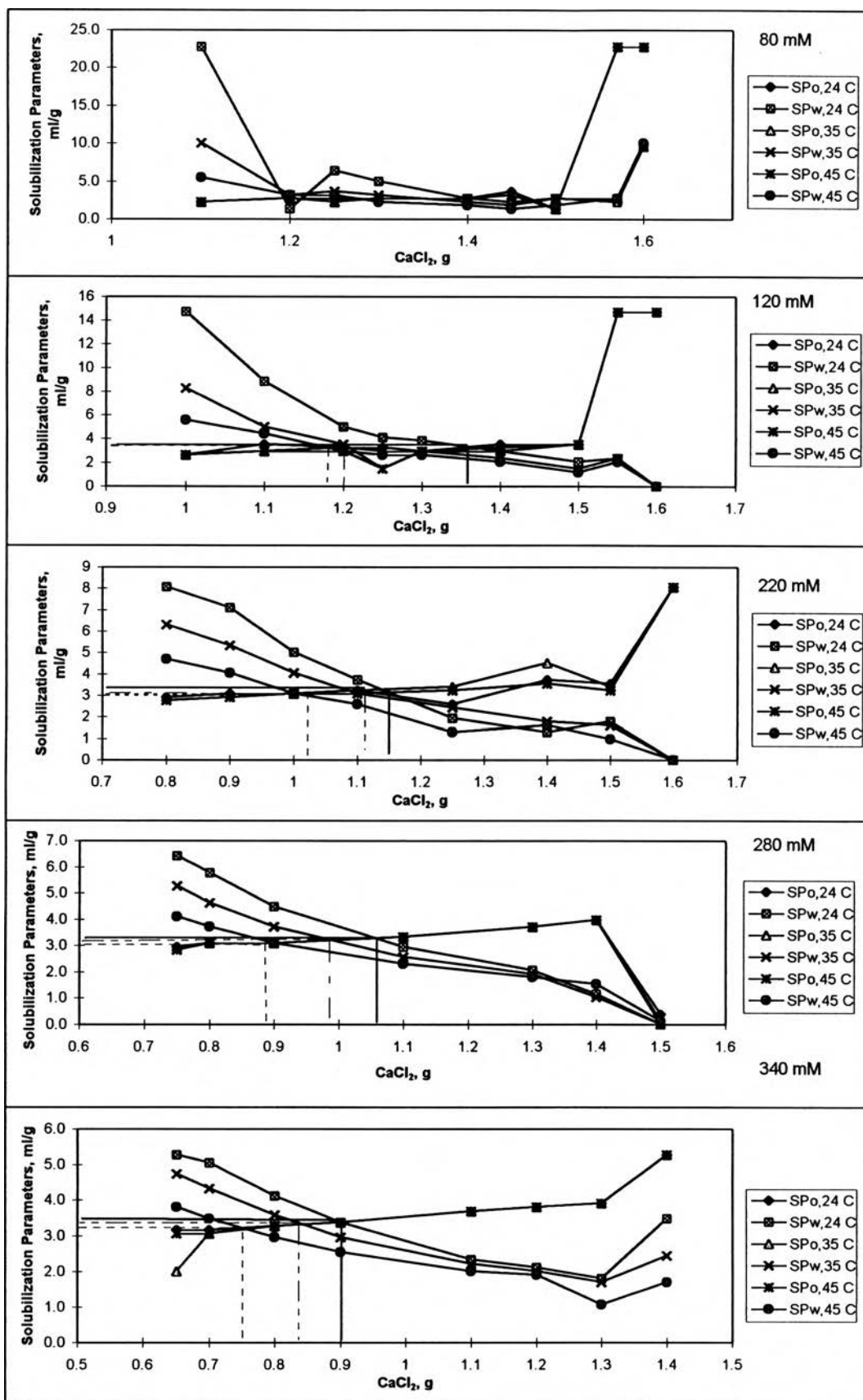


Figure B.3 Solubilization parameters, SP_o , SP_w , and SP^* , 80-340 mM Dowfax8390, $R = 0.75$, 24 °C - 45 °C.

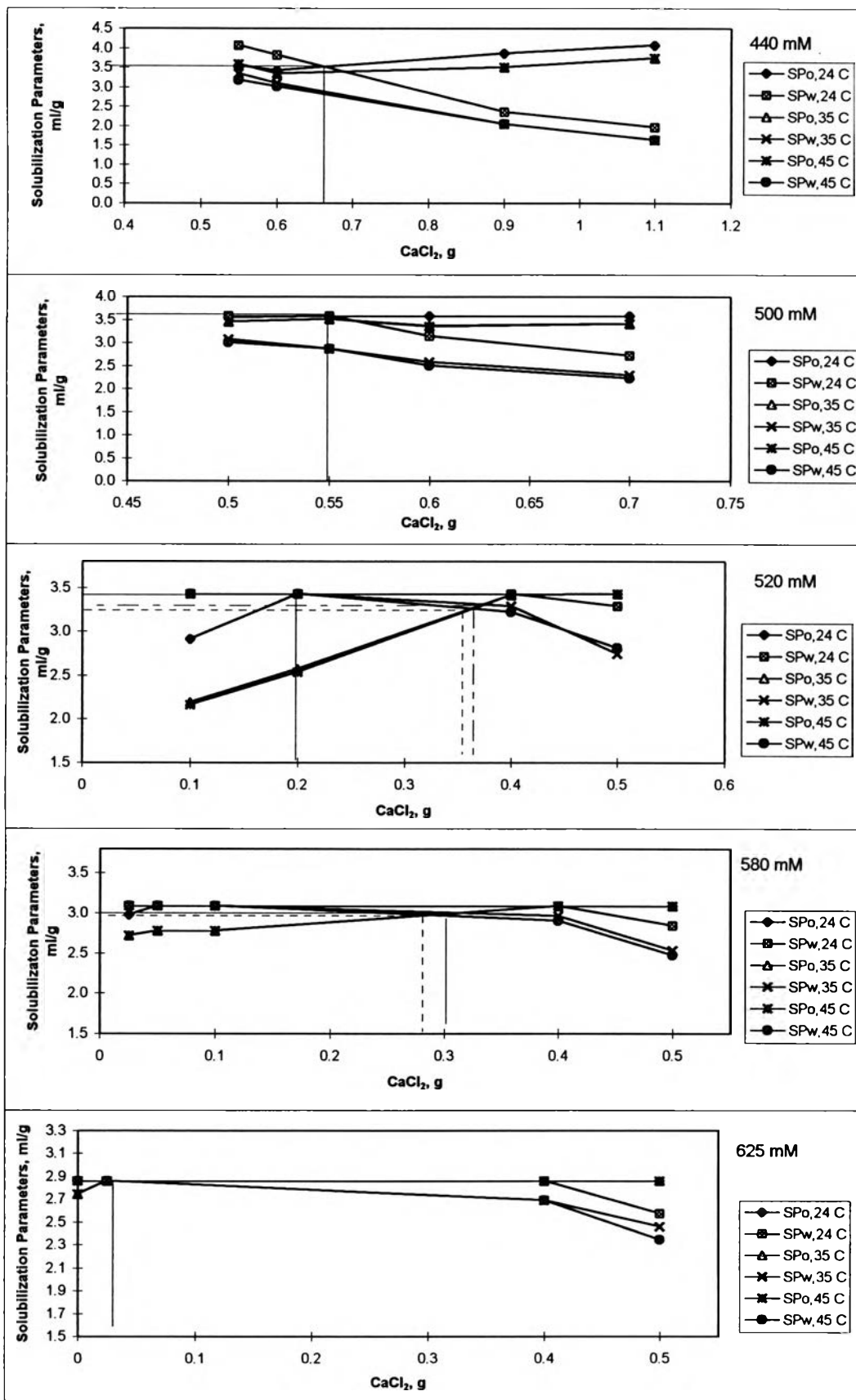


Figure B.4 Solubilization parameters, SP_o, SP_w, and SP*, 440-625 mM Dowfax8390, R = 0.75, 24 °C - 45 °C.

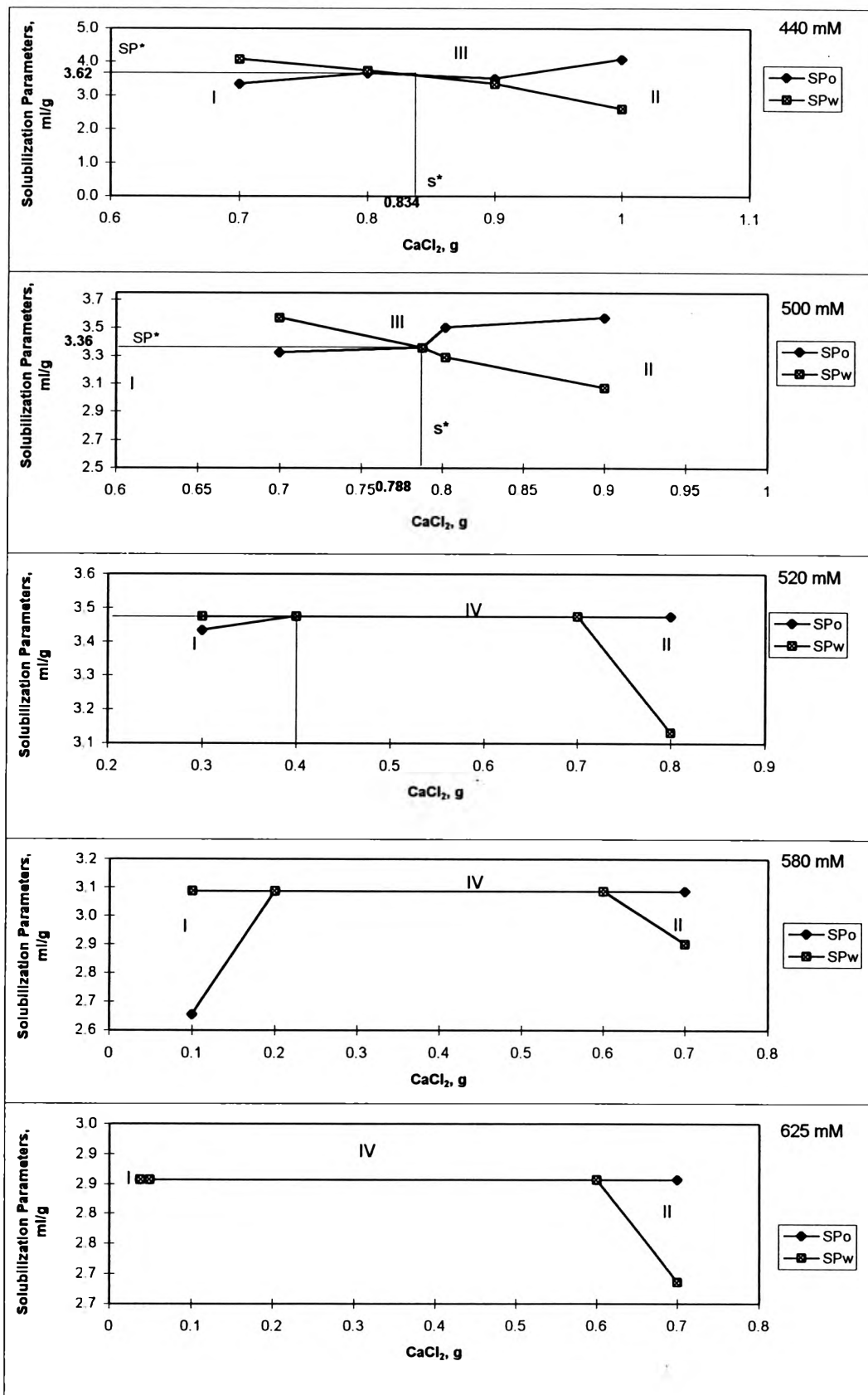


Figure B.5 Solubilization parameters, SP_o, SP_w, and SP*, 440-625 mM Dowfax8390, R = 1.0, 24 °C.

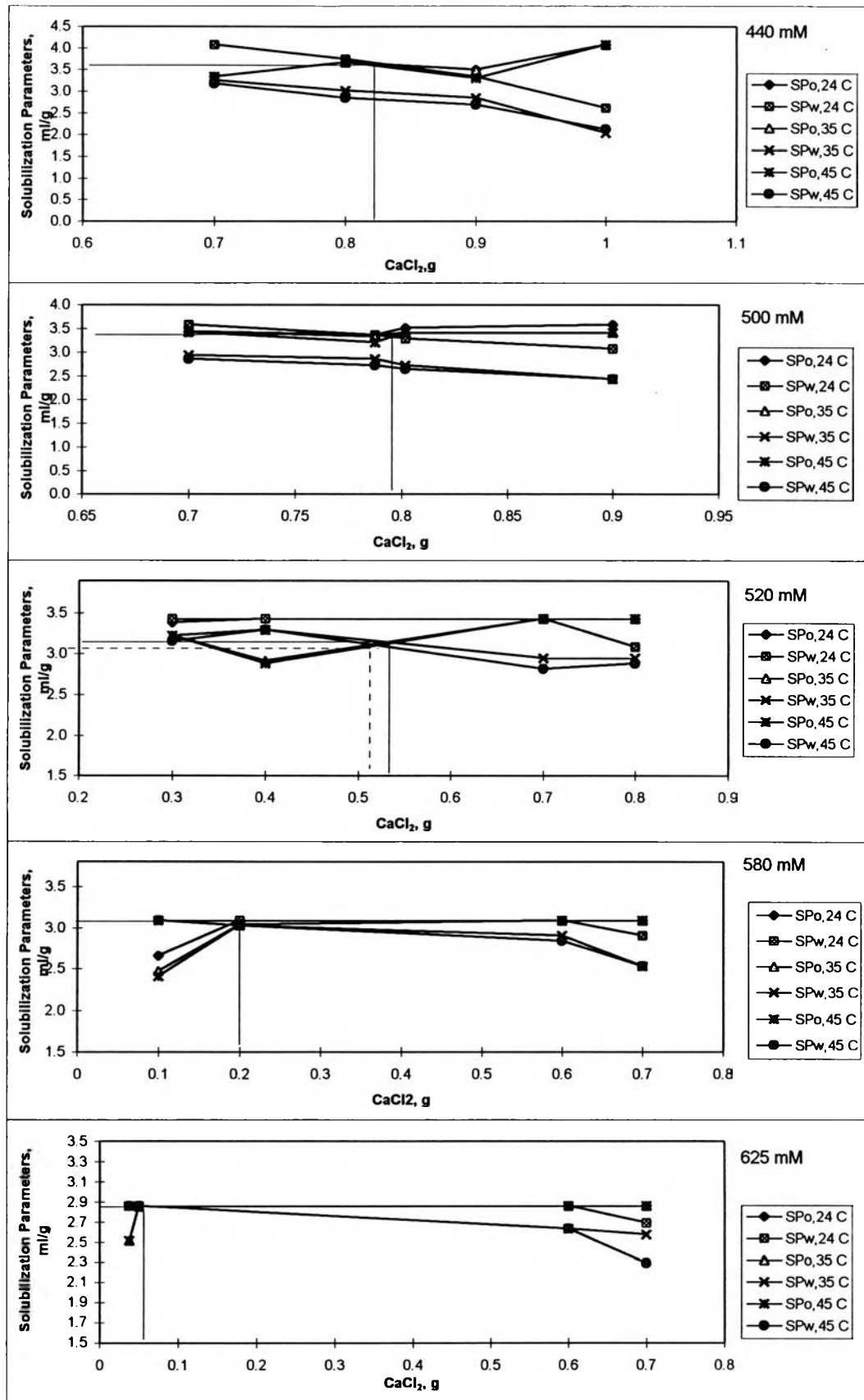


Figure B.6 Solubilization parameters, SP_o, SP_w, and SP*, 440-625 mM Dowfax8390, R = 1.0, 24 °C - 45 °C.

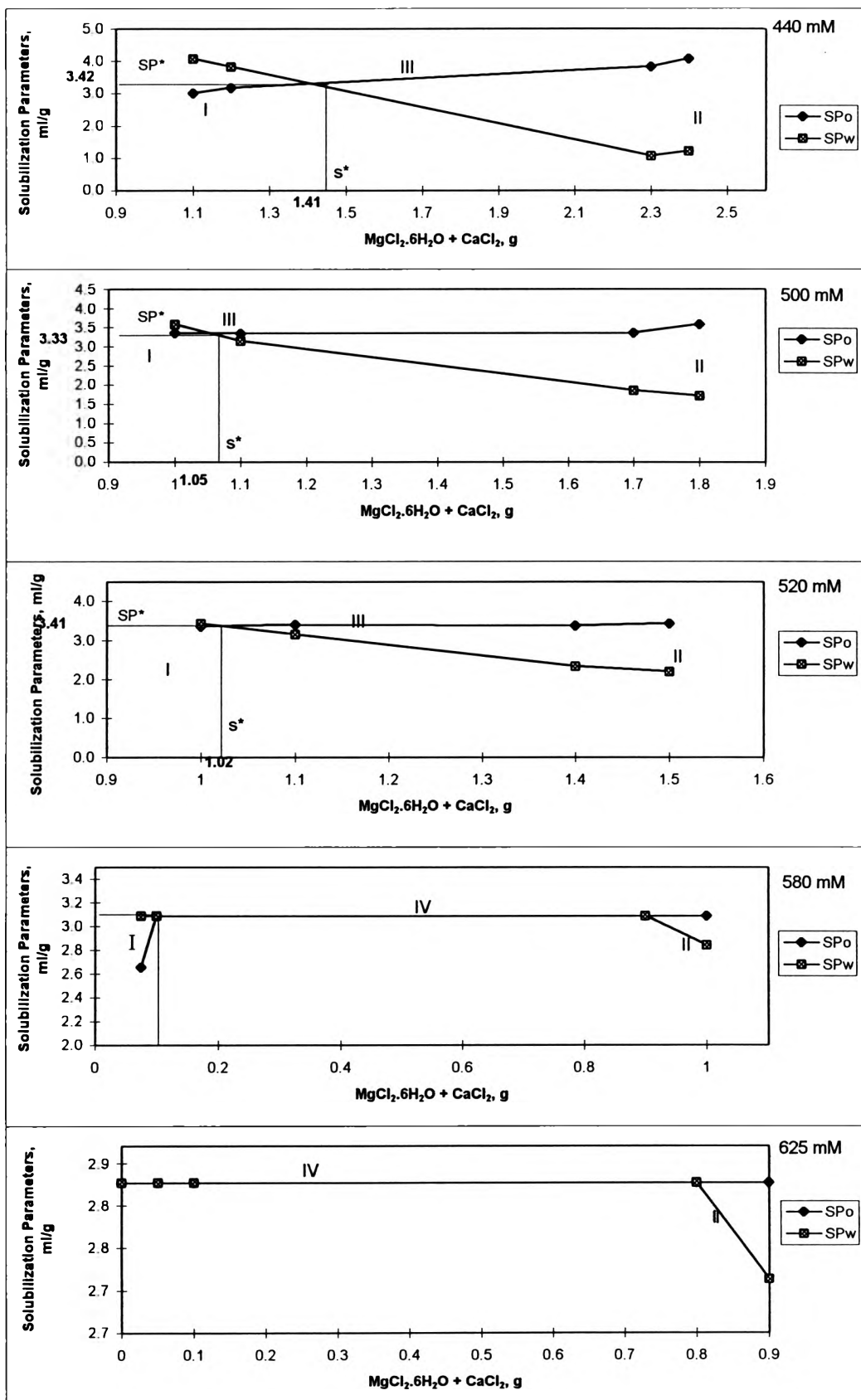


Figure B.7 Solubilization parameters, SP_o, SP_w, and SP*, 440-625 mM Dowfax8390, R = 0.75, 24 °C.

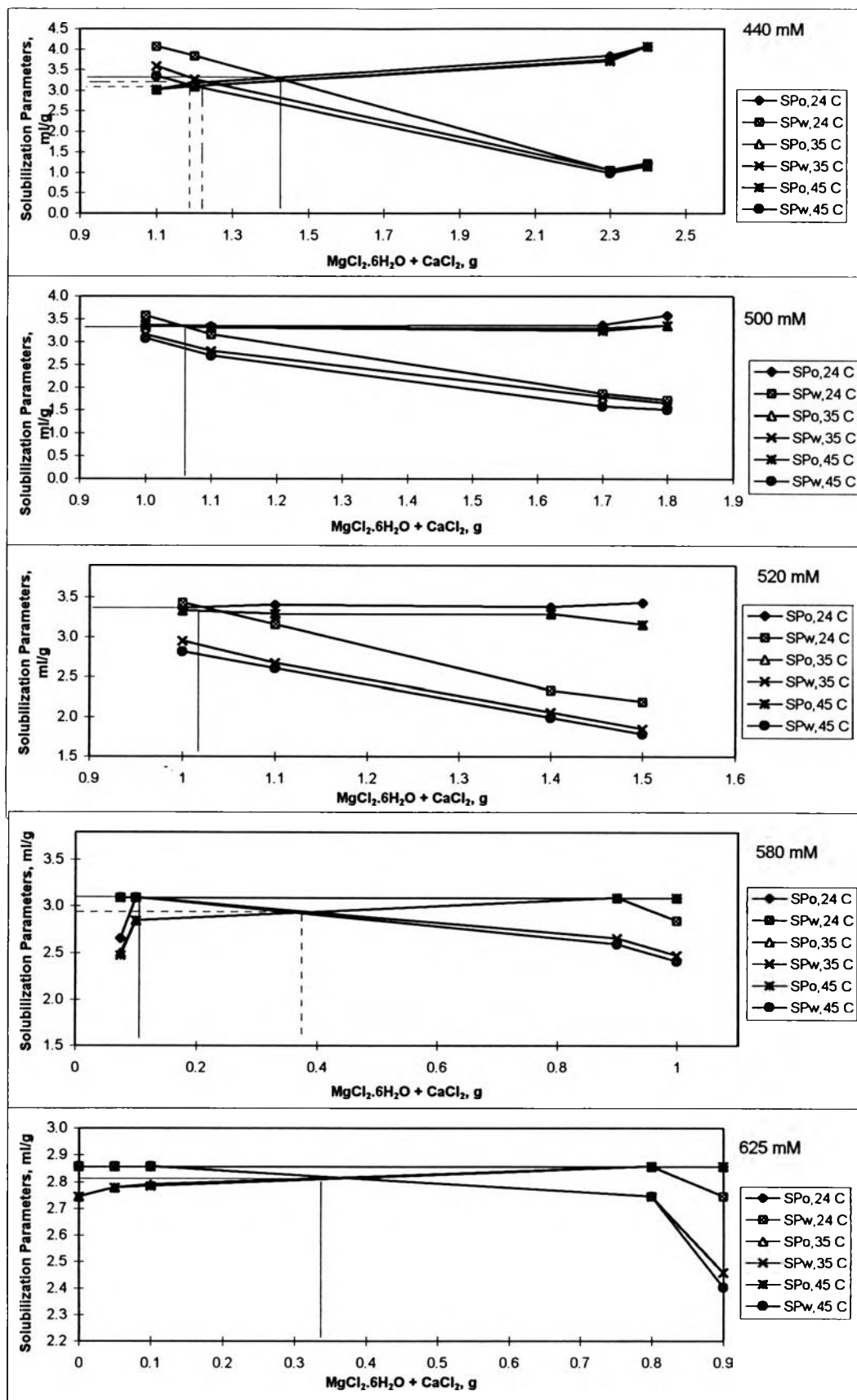


Figure B.8 Solubilization parameters, SP_o, SP_w, and SP*, 440-625 mM Dowfax8390, R = 0.75, 24 °C - 45 °C.

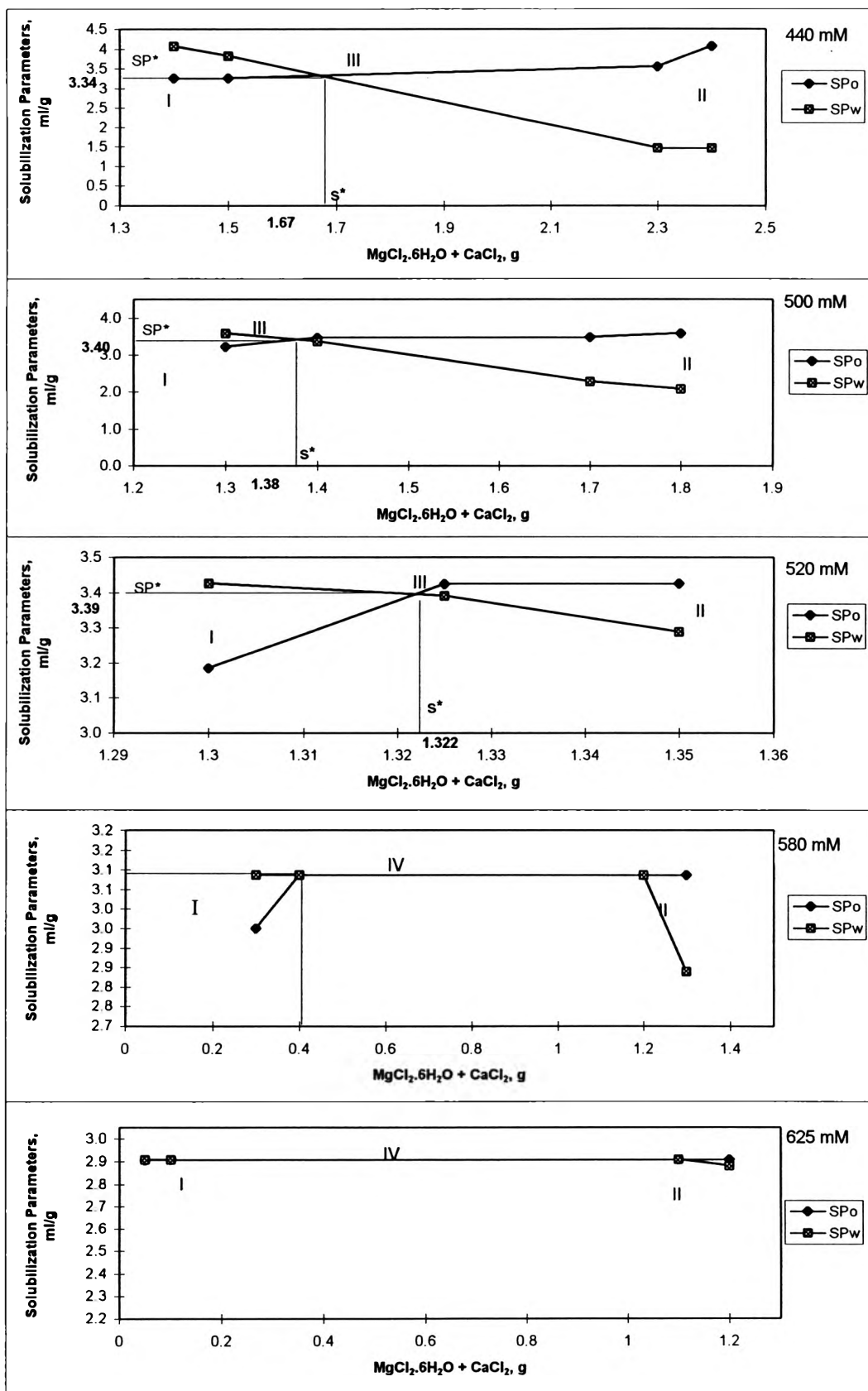


Figure B.9 Solubilization parameters, SP_o , SP_w , and SP^* , 440-625 mM Dowfax8390, $R = 1.0$, $24^\circ C$.

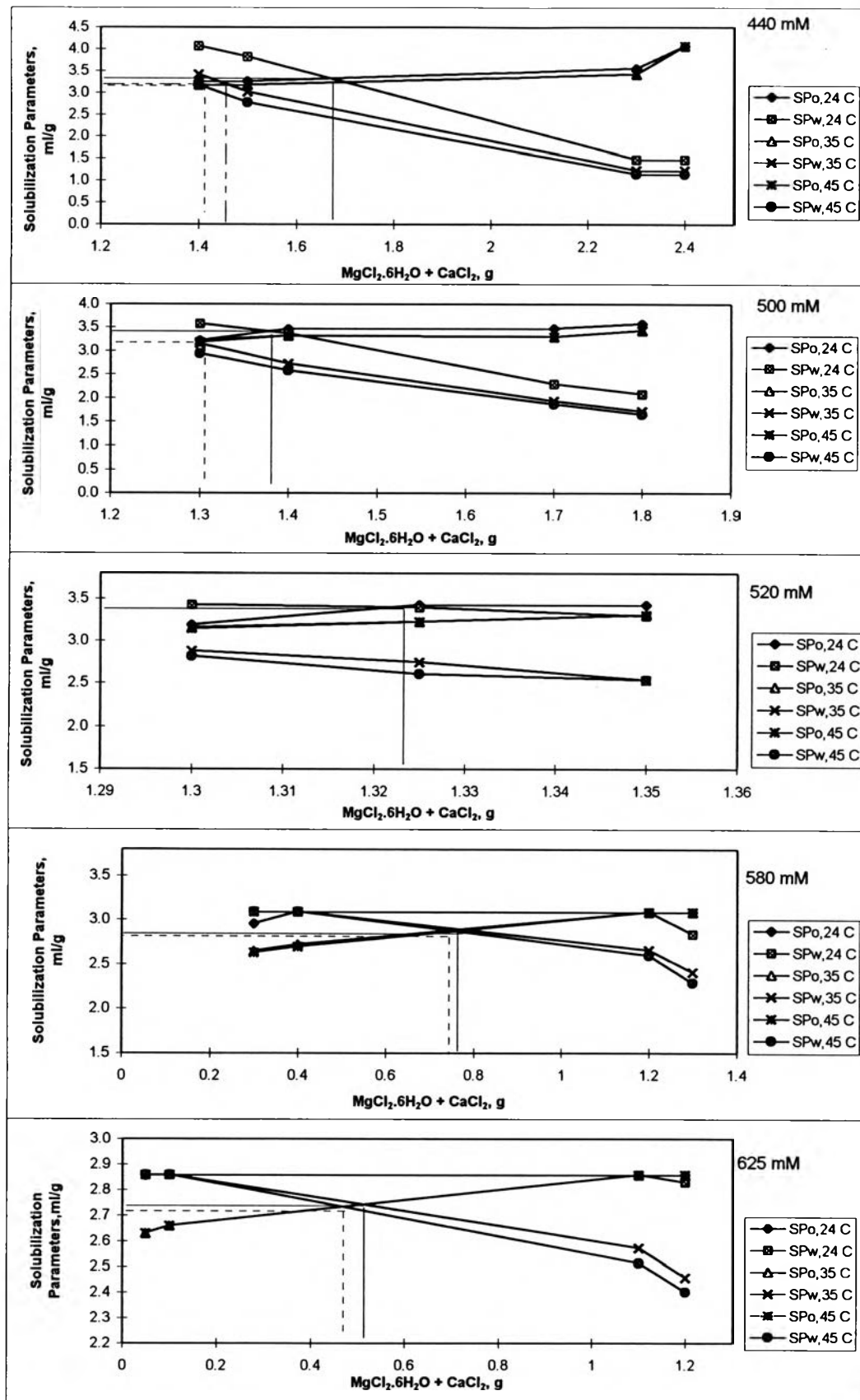


Figure B.10 Solubilization parameters, SP_o , SP_w , and SP^* , 440-625 mM Dowfax8390, $R = 1.0$, 24 °C - 45 °C.

Table B-26 Summary of the optimum solubilization parameter and optimum hardness at 24 °C

(obtained from Figure B.1 - B.50)

| Dowfax8390 (wt%) | R = 0.75, CaCl ₂ | | R = 1.0, CaCl ₂ | | R = 0.75, MgCl ₂ +CaCl ₂ | | R = 1.0, MgCl ₂ +CaCl ₂ | |
|---------------------|-----------------------------|-------|----------------------------|-------|--|--------|---|--------|
| | SP*(ml/g) | s*(g) | SP*(ml/g) | s*(g) | SP*(ml/g) | s*(g) | SP*(ml/g) | s*(g) |
| 4.15 | NA | NA | | | | | | |
| 6.37 | 3.25 | 1.36 | | | | | | |
| 12.34 | 3.0 | 1.16 | | | | | | |
| 16.26 | 3.3 | 1.06 | | | | | | |
| 20.47 | 3.35 | 0.9 | | | | | | |
| 22.57 | | | 3.62 | 0.834 | | | 3.34 | 1.096 |
| 26.37 | | | 3.36 | 0.788 | | | 3.40 | 0.906 |
| 27.69 | | | 3.42 | 0.4 | | | 3.39 | 0.868 |
| 28.22 | 3.55 | 0.662 | | | 3.42 | 0.926 | | |
| 31.79 | | | 3.09 | 0.2 | | | 3.09 | 0.263 |
| 33.38 | 3.58 | 0.55 | | | 3.33 | 0.689 | | |
| 35.02 | | | 2.86 | 0.05 | | | 2.86 | 0.0656 |
| 35.20 | 3.42 | 0.2 | | | 3.41 | 0.670 | | |
| 40.95 | 3.09 | 0.05 | | | 3.09 | 0.0656 | | |
| 45.61 | 2.86 | 0.025 | | | 2.86 | 0.0328 | | |

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