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## APPENDICES

### Appendix A Surface Tension of Surfactant Solutions

**Table A1** Surface tension for solution of CPB, OP(EO)<sub>10</sub>, and their mixtures

| Total surfactant concentration<br>( $\mu\text{M}$ ) | Surface tension (mN/m) |                 |                 |                 |                |
|---|------------------------|-----------------|-----------------|-----------------|----------------|
|   | $\alpha = 0$           | $\alpha = 0.25$ | $\alpha = 0.50$ | $\alpha = 0.75$ | $\alpha = 1.0$ |
| 20  | 71.46                  | 68.47           | 66.66           | 64.00           | 60.80          |
| 40  | 69.27                  | 64.38           | 59.71           | 55.22           | 49.66          |
| 60  | 67.25                  | 56.41           | 55.16           | 49.56           | 45.92          |
| 80  | 65.58                  | 53.79           | 50.55           | 47.44           | 43.35          |
| 100   | 62.45                  | 52.12           | 46.96           | 44.39           | 41.22          |
| 200   | 57.13                  | 45.19           | 41.52           | 37.86           | 30.66          |
| 300   | 52.25                  | 39.87           | 37.47           | 33.78           | 30.73          |
| 400   | 48.15                  | 38.61           | 35.78           | 33.52           | 30.67          |
| 500   | 44.17                  | 36.16           | 35.66           | 34.02           | 30.49          |
| 600   | 39.69                  | 36.30           | 35.78           | 34.16           | 31.40          |
| 700   | 39.18                  | 36.52           | 35.76           | 33.78           | 30.48          |
| 800   | 38.59                  | 36.46           | 35.86           | 34.00           | 31.60          |
| 900   | 38.64                  | 36.57           | 35.91           | 33.75           | 30.51          |
| 1,000   | 38.66                  | 36.16           | 36.01           | 33.80           | 31.44          |
| 3,000   | 38.47                  | 36.36           | 36.53           | 33.86           | 30.81          |
| 5,000   | 38.56                  | 36.28           | 35.84           | 33.73           | 30.89          |
| 7,000   | 38.22                  | 36.12           | 36.13           | 33.76           | 30.79          |
| 10,000  | 38.00                  | 36.36           | 35.99           | 33.92           | 30.86          |

## Appendix B Adsorption Isotherm of Surfactant Solution

**Table B1** Adsorption isotherm on HDPE of 1:0 molar ratio of CPB:OP(EO)<sub>10</sub>

| Initial concentration<br>( $\mu\text{M}$ ) | Equilibrium<br>concentration ( $\mu\text{M}$ ) | Amount of surfactant adsorbed<br>( $\mu\text{mole}/\text{m}^2$ HDPE) |
|--|--|--|
| 20   | 10.81  | 0.51   |
| 40   | 26.49  | 0.74   |
| 60   | 45.14  | 0.82   |
| 80   | 62.70  | 0.96   |
| 100  | 81.89  | 1.00   |
| 200  | 179.46   | 1.13   |
| 300  | 274.32   | 1.42   |
| 400  | 372.43   | 1.53   |
| 500  | 470.54   | 1.63   |
| 600  | 567.03   | 1.83   |
| 700  | 663.24   | 2.03   |
| 800  | 762.70   | 2.06   |
| 900  | 863.78   | 2.00   |
| 1000                                       | 963.51   | 2.02   |
| 3000                                       | 2962.16  | 2.10   |
| 5000                                       | 4962.16  | 2.10   |
| 7000                                       | 6964.86  | 1.94   |
| 10000                                      | 9962.16  | 2.09   |

**Table B2** Adsorption isotherm on HDPE of 3:1 molar ratio of CPB:OP(EO)<sub>10</sub>

| Initial concentration (μM) | Equilibrium concentration (μM) | Total amount of surfactant adsorbed (μmole/m <sup>2</sup> HDPE) | Cationic surfactant adsorbed (μmole/m <sup>2</sup> HDPE) | Nonionic surfactant adsorbed (μmole/m <sup>2</sup> HDPE) |
|----------------------------|--------------------------------|---|--|--|
| 20                         | 9.80                           | 0.56  | 0.42   | 0.14   |
| 40                         | 23.13                          | 0.93  | 0.70   | 0.23   |
| 60                         | 40.00                          | 1.10  | 0.83   | 0.28   |
| 80                         | 56.33                          | 1.32  | 0.99   | 0.32   |
| 100                        | 73.20                          | 1.48  | 1.11   | 0.37   |
| 200                        | 159.73                         | 2.23  | 1.68   | 0.55   |
| 300                        | 257.14                         | 2.37  | 1.77   | 0.60   |
| 400                        | 352.97                         | 2.60  | 2.05   | 0.55   |
| 500                        | 450.07                         | 2.76  | 2.07   | 0.69   |
| 600                        | 546.40                         | 2.97  | 2.23   | 0.74   |
| 700                        | 647.34                         | 2.92  | 2.18   | 0.74   |
| 800                        | 746.67                         | 2.97  | 2.23   | 0.74   |
| 900                        | 845.70                         | 3.01  | 2.22   | 0.79   |
| 1000                       | 943.40                         | 3.13  | 2.35   | 0.78   |
| 3000                       | 2947.48                        | 2.90  | 2.16   | 0.74   |
| 5000                       | 4941.44                        | 3.22  | 2.30   | 0.92   |
| 7000                       | 6941.44                        | 3.24  | 2.32   | 0.92   |
| 10000                      | 9942.79                        | 3.16  | 2.24   | 0.92   |

**Table B3** Adsorption isotherm on HDPE of 1:1 molar ratio of CPB:OP(EO)<sub>10</sub>

| Initial concentration (μM) | Equilibrium concentration (μM) | Total amount of surfactant adsorbed (μmole/m <sup>2</sup> HDPE) | Cationic surfactant adsorbed (μmole/m <sup>2</sup> HDPE) | Nonionic surfactant adsorbed (μmole/m <sup>2</sup> HDPE) |
|----------------------------|--------------------------------|---|--|--|
| 20                         | 9.32                           | 0.59  | 0.31   | 0.28   |
| 40                         | 20.00                          | 1.10  | 0.55   | 0.55   |
| 60                         | 35.07                          | 1.38  | 0.69   | 0.69   |
| 80                         | 52.32                          | 1.53  | 0.75   | 0.79   |
| 100                        | 68.49                          | 1.75  | 0.87   | 0.88   |
| 200                        | 160.54                         | 2.19  | 1.08   | 1.11   |
| 300                        | 255.07                         | 2.50  | 1.25   | 1.25   |
| 400                        | 350.70                         | 2.72  | 1.39   | 1.34   |
| 500                        | 442.75                         | 3.16  | 1.60   | 1.57   |
| 600                        | 543.02                         | 3.17  | 1.59   | 1.57   |
| 700                        | 643.02                         | 3.17  | 1.59   | 1.58   |
| 800                        | 742.75                         | 3.17  | 1.60   | 1.57   |
| 900                        | 842.75                         | 3.18  | 1.61   | 1.57   |
| 1000                       | 943.58                         | 3.13  | 1.61   | 1.53   |
| 3000                       | 2947.97                        | 2.88  | 1.50   | 1.39   |
| 5000                       | 4947.97                        | 2.89  | 1.50   | 1.39   |
| 7000                       | 6936.94                        | 3.50  | 1.65   | 1.85   |
| 10000                      | 9939.64                        | 3.34  | 1.49   | 1.84   |

**Table B4** Adsorption isotherm on HDPE of 1:3 molar ratio of CPB:OP(EO)<sub>10</sub>

| Initial concentration (μM) | Equilibrium concentration (μM) | Total amount of surfactant adsorbed (μmole/m <sup>2</sup> HDPE) | Cationic surfactant adsorbed (μmole/m <sup>2</sup> HDPE) | Nonionic surfactant adsorbed (μmole/m <sup>2</sup> HDPE) |
|----------------------------|--------------------------------|---|--|--|
| 20                         | 6.35                           | 0.76  | 0.21   | 0.55   |
| 40                         | 11.60                          | 1.57  | 0.42   | 1.15   |
| 60                         | 24.55                          | 1.96  | 0.49   | 1.47   |
| 80                         | 42.21                          | 2.09  | 0.52   | 1.57   |
| 100                        | 54.86                          | 2.49  | 0.56   | 1.93   |
| 200                        | 140.43                         | 3.30  | 0.85   | 2.44   |
| 300                        | 233.09                         | 3.68  | 0.88   | 2.80   |
| 400                        | 321.60                         | 4.32  | 0.97   | 3.36   |
| 500                        | 425.07                         | 4.15  | 0.97   | 3.19   |
| 600                        | 521.87                         | 4.31  | 0.96   | 3.36   |
| 700                        | 622.03                         | 4.30  | 0.99   | 3.31   |
| 800                        | 721.35                         | 4.35  | 1.03   | 3.32   |
| 900                        | 822.57                         | 4.29  | 0.97   | 3.32   |
| 1000                       | 922.73                         | 4.27  | 1.00   | 3.27   |
| 3000                       | 2924.10                        | 4.20  | 0.97   | 3.23   |
| 5000                       | 4924.10                        | 4.19  | 0.97   | 3.22   |
| 7000                       | 6924.10                        | 4.21  | 0.97   | 3.23   |
| 10000                      | 9917.12                        | 4.59  | 0.90   | 3.69   |



**Table B5** Adsorption isotherm on HDPE of 0:1 molar ratio of CPB:OP(EO)<sub>10</sub>

| Initial concentration<br>( $\mu\text{M}$ ) | Equilibrium<br>concentration ( $\mu\text{M}$ ) | Amount of surfactant adsorbed<br>( $\mu\text{mole}/\text{m}^2$ HDPE) |
|--|--|--|
| 20   | 10.83  | 0.51   |
| 40   | 23.33  | 0.92   |
| 60   | 34.17  | 1.43   |
| 80   | 45.83  | 1.88   |
| 100  | 55.83  | 2.43   |
| 200  | 126.67   | 4.05   |
| 300  | 215.83   | 4.64   |
| 400  | 315.83   | 4.63   |
| 500  | 415.00   | 4.67   |
| 600  | 515.83   | 4.64   |
| 700  | 615.00   | 4.71   |
| 800  | 715.83   | 4.66   |
| 900  | 815.83   | 4.66   |
| 1000                                       | 915.83   | 4.67   |
| 3000                                       | 2916.67  | 4.60   |
| 5000                                       | 4916.67  | 4.59   |
| 7000                                       | 6916.67  | 4.61   |
| 10000                                      | 9916.67  | 4.60   |

**Table B6** Adsorption isotherm on PC of 1:0 molar ratio of CPB:OP(EO)<sub>10</sub>

| Initial concentration<br>( $\mu\text{M}$ ) | Equilibrium<br>concentration ( $\mu\text{M}$ ) | Amount of surfactant adsorbed<br>( $\mu\text{mole}/\text{m}^2$ PC) |
|--|--|--|
| 20   | 15.14  | 0.24   |
| 40   | 32.70  | 0.35   |
| 60   | 47.57  | 0.60   |
| 80   | 63.51  | 0.80   |
| 100  | 80.00  | 0.97   |
| 200  | 173.78   | 1.28   |
| 300  | 266.76   | 1.62   |
| 400  | 363.78   | 1.76   |
| 500  | 460.54   | 1.92   |
| 600  | 558.11   | 2.04   |
| 700  | 652.70   | 2.31   |
| 800  | 752.16   | 2.32   |
| 900  | 853.24   | 2.28   |
| 1000                                       | 951.89   | 2.34   |
| 3000                                       | 2954.05  | 2.24   |
| 5000                                       | 4954.05  | 2.24   |
| 7000                                       | 6951.35  | 2.37   |
| 10000                                      | 9954.05  | 2.24   |

**Table B7** Adsorption isotherm on PC of 3:1 molar ratio of CPB:OP(EO)<sub>10</sub>

| Initial concentration (μM) | Equilibrium concentration (μM) | Total amount of surfactant adsorbed (μmole/m <sup>2</sup> PC) | Cationic surfactant adsorbed (μmole/m <sup>2</sup> PC) | Nonionic surfactant adsorbed (μmole/m <sup>2</sup> PC) |
|----------------------------|--------------------------------|---|--|--|
| 20                         | 13.33                          | 0.32  | 0.24   | 0.08   |
| 40                         | 26.10                          | 0.68  | 0.47   | 0.20   |
| 60                         | 39.73                          | 0.99  | 0.74   | 0.24   |
| 80                         | 56.60                          | 1.14  | 0.85   | 0.28   |
| 100                        | 73.47                          | 1.29  | 0.97   | 0.32   |
| 200                        | 163.00                         | 1.80  | 1.36   | 0.45   |
| 300                        | 250.07                         | 2.44  | 1.83   | 0.61   |
| 400                        | 343.13                         | 2.76  | 2.07   | 0.69   |
| 500                        | 436.73                         | 3.08  | 2.31   | 0.77   |
| 600                        | 533.60                         | 3.23  | 2.42   | 0.81   |
| 700                        | 634.28                         | 3.20  | 2.39   | 0.81   |
| 800                        | 733.33                         | 3.25  | 2.44   | 0.81   |
| 900                        | 832.64                         | 3.28  | 2.43   | 0.85   |
| 1000                       | 933.60                         | 3.23  | 2.42   | 0.81   |
| 3000                       | 2933.33                        | 3.25  | 2.44   | 0.81   |
| 5000                       | 4933.33                        | 3.25  | 2.43   | 0.81   |
| 7000                       | 6933.33                        | 3.24  | 2.43   | 0.81   |
| 10000                      | 9931.98                        | 3.21  | 2.50   | 0.81   |

**Table B8** Adsorption isotherm on PC of 1:1 molar ratio of CPB:OP(EO)<sub>10</sub>

| Initial concentration (μM) | Equilibrium concentration (μM) | Total amount of surfactant adsorbed (μmole/m <sup>2</sup> PC) | Cationic surfactant adsorbed (μmole/m <sup>2</sup> PC) | Nonionic surfactant adsorbed (μmole/m <sup>2</sup> PC) |
|----------------------------|--------------------------------|---|--|--|
| 20                         | 8.49                           | 0.56  | 0.28   | 0.28   |
| 40                         | 26.58                          | 0.65  | 0.33   | 0.32   |
| 60                         | 43.56                          | 0.80  | 0.39   | 0.41   |
| 80                         | 61.64                          | 0.89  | 0.45   | 0.45   |
| 100                        | 73.15                          | 1.31  | 0.66   | 0.65   |
| 200                        | 158.09                         | 2.04  | 1.03   | 1.01   |
| 300                        | 247.95                         | 2.53  | 1.28   | 1.26   |
| 400                        | 335.34                         | 3.15  | 1.57   | 1.58   |
| 500                        | 430.14                         | 3.41  | 1.70   | 1.71   |
| 600                        | 529.86                         | 3.41  | 1.71   | 1.70   |
| 700                        | 628.47                         | 3.49  | 1.70   | 1.79   |
| 800                        | 730.14                         | 3.40  | 1.70   | 1.70   |
| 900                        | 830.14                         | 3.40  | 1.70   | 1.70   |
| 1000                       | 930.14                         | 3.40  | 1.70   | 1.70   |
| 3000                       | 2934.23                        | 3.21  | 1.58   | 1.63   |
| 5000                       | 4931.53                        | 3.33  | 1.71   | 1.62   |
| 7000                       | 6931.53                        | 3.33  | 1.71   | 1.62   |
| 10000                      | 9931.53                        | 3.33  | 1.71   | 1.62   |

**Table B9** Adsorption isotherm on PC of 1:3 molar ratio of CPB:OP(EO)<sub>10</sub>

| Initial concentration (μM) | Equilibrium concentration (μM) | Total amount of surfactant adsorbed (μmole/m <sup>2</sup> PC) | Cationic surfactant adsorbed (μmole/m <sup>2</sup> PC) | Nonionic surfactant adsorbed (μmole/m <sup>2</sup> PC) |
|----------------------------|--------------------------------|---|--|--|
| 20                         | 10.83                          | 0.73  | 0.10   | 0.73   |
| 40                         | 29.17                          | 0.86  | 0.15   | 0.86   |
| 60                         | 45.00                          | 1.20  | 0.27   | 1.20   |
| 80                         | 61.67                          | 1.46  | 0.33   | 1.46   |
| 100                        | 74.17                          | 2.06  | 0.45   | 2.06   |
| 200                        | 154.17                         | 3.66  | 0.71   | 3.66   |
| 300                        | 235.83                         | 5.11  | 1.03   | 5.11   |
| 400                        | 337.50                         | 4.99  | 1.22   | 4.99   |
| 500                        | 435.83                         | 5.13  | 1.23   | 5.13   |
| 600                        | 535.83                         | 5.11  | 1.18   | 5.11   |
| 700                        | 636.67                         | 5.07  | 1.17   | 5.07   |
| 800                        | 736.67                         | 5.06  | 1.19   | 5.06   |
| 900                        | 835.83                         | 5.13  | 1.21   | 5.13   |
| 1000                       | 934.17                         | 5.25  | 1.23   | 5.25   |
| 3000                       | 2933.33                        | 5.31  | 1.25   | 5.31   |
| 5000                       | 4933.33                        | 5.30  | 1.25   | 5.30   |
| 7000                       | 6941.67                        | 4.65  | 1.25   | 4.65   |
| 10000                      | 9933.33                        | 5.32  | 1.18   | 5.32   |

**Table B10** Adsorption isotherm on PC of 0:1 molar ratio of CPB:OP(EO)<sub>10</sub>

| Initial concentration<br>( $\mu\text{M}$ ) | Equilibrium<br>concentration ( $\mu\text{M}$ ) | Amount of surfactant adsorbed<br>( $\mu\text{mole}/\text{m}^2$ PC) |
|--|--|--|
| 20   | 10.83  | 0.73   |
| 40   | 29.17  | 0.86   |
| 60   | 45.00  | 1.20   |
| 80   | 61.67  | 1.46   |
| 100  | 74.17  | 2.06   |
| 200  | 154.17   | 3.66   |
| 300  | 235.83   | 5.11   |
| 400  | 337.50   | 4.99   |
| 500  | 435.83   | 5.13   |
| 600  | 535.83   | 5.11   |
| 700  | 636.67   | 5.07   |
| 800  | 736.67   | 5.06   |
| 900  | 835.83   | 5.13   |
| 1000                                       | 934.17   | 5.25   |
| 3000                                       | 2933.33  | 5.31   |
| 5000                                       | 4933.33  | 5.30   |
| 7000                                       | 6941.67  | 4.65   |
| 10000                                      | 9933.33  | 5.32   |

**Table B11** Adsorption isotherm on PVC of 1:0 molar ratio of CPB:OP(EO)<sub>10</sub>

| Initial concentration<br>( $\mu\text{M}$ ) | Equilibrium<br>concentration ( $\mu\text{M}$ ) | Amount of surfactant adsorbed<br>( $\mu\text{mole}/\text{m}^2$ PVC) |
|--|--|---|
| 20   | 17.57  | 0.11  |
| 40   | 34.86  | 0.23  |
| 60   | 52.70  | 0.32  |
| 80   | 70.00  | 0.44  |
| 100  | 87.30  | 0.56  |
| 200  | 172.16   | 1.22  |
| 300  | 257.57   | 1.87  |
| 400  | 348.92   | 2.25  |
| 500  | 444.86   | 2.43  |
| 600  | 540.81   | 2.61  |
| 700  | 634.59   | 2.88  |
| 800  | 734.05   | 2.91  |
| 900  | 832.70   | 2.96  |
| 1000                                       | 931.89   | 3.00  |
| 3000                                       | 2937.84  | 2.73  |
| 5000                                       | 4935.14  | 2.85  |
| 7000                                       | 6935.14  | 2.86  |
| 10000                                      | 9940.54  | 2.62  |

**Table B12** Adsorption isotherm on PVC of 3:1 molar ratio of CPB:OP(EO)<sub>10</sub>

| Initial concentration (μM) | Equilibrium concentration (μM) | Total amount of surfactant adsorbed (μmole/m <sup>2</sup> PVC) | Cationic surfactant adsorbed (μmole/m <sup>2</sup> PVC) | Nonionic surfactant adsorbed (μmole/m <sup>2</sup> PVC) |
|----------------------------|--------------------------------|--|---|---|
| 20                         | 10.07                          | 0.44   | 0.33  | 0.11  |
| 40                         | 19.86                          | 0.89   | 0.67  | 0.22  |
| 60                         | 33.47                          | 1.17   | 0.87  | 0.29  |
| 80                         | 49.53                          | 1.34   | 1.01  | 0.33  |
| 100                        | 59.32                          | 1.79   | 1.35  | 0.44  |
| 200                        | 145.59                         | 2.39   | 1.80  | 0.59  |
| 300                        | 236.46                         | 2.80   | 2.10  | 0.70  |
| 400                        | 330.34                         | 3.13   | 2.34  | 0.79  |
| 500                        | 424.21                         | 3.33   | 2.49  | 0.84  |
| 600                        | 516.73                         | 3.64   | 2.73  | 0.91  |
| 700                        | 616.60                         | 3.69   | 2.77  | 0.92  |
| 800                        | 717.03                         | 3.68   | 2.79  | 0.89  |
| 900                        | 817.45                         | 3.65   | 2.80  | 0.85  |
| 1000                       | 916.19                         | 3.68   | 2.76  | 0.91  |
| 3000                       | 2922.52                        | 3.46   | 2.71  | 0.74  |
| 5000                       | 4919.82                        | 3.53   | 2.80  | 0.73  |
| 7000                       | 6911.49                        | 3.90   | 2.80  | 1.10  |
| 10000                      | 9921.17                        | 3.47   | 2.74  | 0.73  |



**Table B13** Adsorption isotherm on PVC of 1:1 molar ratio of CPB:OP(EO)<sub>10</sub>

| Initial concentration (μM) | Equilibrium concentration (μM) | Total amount of surfactant adsorbed (μmole/m <sup>2</sup> PVC) | Cationic surfactant adsorbed (μmole/m <sup>2</sup> PVC) | Nonionic surfactant adsorbed (μmole/m <sup>2</sup> PVC) |
|----------------------------|--------------------------------|--|---|---|
| 20                         | 8.49                           | 0.51   | 0.25  | 0.26  |
| 40                         | 24.66                          | 0.67   | 0.34  | 0.33  |
| 60                         | 40.00                          | 0.88   | 0.44  | 0.44  |
| 80                         | 56.98                          | 1.01   | 0.50  | 0.51  |
| 100                        | 69.86                          | 1.33   | 0.67  | 0.66  |
| 200                        | 137.00                         | 2.77   | 1.42  | 1.36  |
| 300                        | 224.64                         | 3.32   | 1.63  | 1.69  |
| 400                        | 313.96                         | 3.78   | 1.88  | 1.91  |
| 500                        | 406.89                         | 4.10   | 2.12  | 1.98  |
| 600                        | 512.32                         | 3.87   | 1.92  | 1.95  |
| 700                        | 607.97                         | 4.06   | 2.07  | 1.98  |
| 800                        | 704.71                         | 4.19   | 2.18  | 2.02  |
| 900                        | 808.27                         | 4.05   | 2.10  | 1.95  |
| 1000                       | 908.51                         | 4.03   | 2.05  | 1.98  |
| 3000                       | 2909.58                        | 3.98   | 2.14  | 1.84  |
| 5000                       | 4901.35                        | 4.34   | 2.14  | 2.02  |
| 7000                       | 6909.68                        | 3.98   | 2.14  | 1.84  |
| 10000                      | 9915.09                        | 3.74   | 1.91  | 1.84  |

**Table B14** Adsorption isotherm on PVC of 1:3 molar ratio of CPB:OP(EO)<sub>10</sub>

| Initial concentration (μM) | Equilibrium concentration (μM) | Total amount of surfactant adsorbed (μmole/m <sup>2</sup> PVC) | Cationic surfactant adsorbed (μmole/m <sup>2</sup> PVC) | Nonionic surfactant adsorbed (μmole/m <sup>2</sup> PVC) |
|----------------------------|--------------------------------|--|---|---|
| 20                         | 6.62                           | 0.59   | 0.15  | 0.44  |
| 40                         | 9.10                           | 1.36   | 0.33  | 1.02  |
| 60                         | 19.84                          | 1.77   | 0.41  | 1.36  |
| 80                         | 26.73                          | 2.34   | 0.55  | 1.80  |
| 100                        | 45.38                          | 2.48   | 0.61  | 1.87  |
| 200                        | 138.49                         | 2.71   | 0.69  | 2.02  |
| 300                        | 217.70                         | 3.61   | 0.98  | 2.64  |
| 400                        | 293.51                         | 4.70   | 1.17  | 3.53  |
| 500                        | 383.45                         | 5.13   | 1.28  | 3.85  |
| 600                        | 483.67                         | 5.13   | 1.42  | 3.71  |
| 700                        | 580.70                         | 5.27   | 1.33  | 3.94  |
| 800                        | 682.21                         | 5.19   | 1.30  | 3.89  |
| 900                        | 781.51                         | 5.22   | 1.29  | 3.93  |
| 1000                       | 880.81                         | 5.25   | 1.29  | 3.97  |
| 3000                       | 2888.29                        | 4.92   | 1.25  | 3.67  |
| 5000                       | 4888.29                        | 4.93   | 1.25  | 3.68  |
| 7000                       | 6885.59                        | 5.05   | 1.37  | 3.68  |
| 10000                      | 9878.60                        | 5.34   | 1.31  | 4.03  |

**Table B15** Adsorption isotherm on PVC of 0:1 molar ratio of CPB:OP(EO)<sub>10</sub>

| Initial concentration<br>( $\mu\text{M}$ ) | Equilibrium<br>concentration ( $\mu\text{M}$ ) | Amount of surfactant adsorbed<br>( $\mu\text{mole}/\text{m}^2$ PVC) |
|--|--|---|
| 20   | 9.17   | 0.48  |
| 40   | 17.50  | 0.99  |
| 60   | 27.50  | 1.43  |
| 80   | 35.00  | 1.98  |
| 100  | 45.83  | 2.39  |
| 200  | 106.67   | 4.12  |
| 300  | 181.67   | 5.23  |
| 400  | 260.00   | 6.17  |
| 500  | 359.17   | 6.21  |
| 600  | 461.67   | 6.10  |
| 700  | 557.50   | 6.28  |
| 800  | 659.17   | 6.22  |
| 900  | 755.83   | 6.34  |
| 1000                                       | 867.50   | 5.83  |
| 3000                                       | 2858.33  | 6.24  |
| 5000                                       | 4858.33  | 6.26  |
| 7000                                       | 6866.68  | 5.86  |
| 10000                                      | 9858.33  | 6.25  |

**Table B16** Adsorption isotherm on ABS of 1:0 molar ratio of CPB:OP(EO)<sub>10</sub>

| Initial concentration<br>( $\mu\text{M}$ ) | Equilibrium<br>concentration ( $\mu\text{M}$ ) | Amount of surfactant adsorbed<br>( $\mu\text{mole/m}^2$ ABS) |
|--|--|--|
| 20   | 17.57  | 0.06   |
| 40   | 28.11  | 0.31   |
| 60   | 41.08  | 0.49   |
| 80   | 55.95  | 0.62   |
| 100  | 65.14  | 0.90   |
| 200  | 138.38   | 1.58   |
| 300  | 208.38   | 2.36   |
| 400  | 293.24   | 2.74   |
| 500  | 377.30   | 3.15   |
| 600  | 462.43   | 3.54   |
| 700  | 546.22   | 3.96   |
| 800  | 647.30   | 3.92   |
| 900  | 741.89   | 4.06   |
| 1000                                       | 843.78   | 4.02   |
| 3000                                       | 2843.24  | 4.04   |
| 5000                                       | 4845.95  | 3.97   |
| 7000                                       | 6843.24  | 4.03   |
| 10000                                      | 9837.84  | 4.17   |

**Table B17** Adsorption isotherm on ABS of 3:1 molar ratio of CPB:OP(EO)<sub>10</sub>

| Initial concentration (μM) | Equilibrium concentration (μM) | Total amount of surfactant adsorbed (μmole/m <sup>2</sup> ABS) | Cationic surfactant adsorbed (μmole/m <sup>2</sup> ABS) | Nonionic surfactant adsorbed (μmole/m <sup>2</sup> ABS) |
|----------------------------|--------------------------------|--|---|---|
| 20                         | 6.53                           | 0.34   | 0.26  | 0.09  |
| 40                         | 13.06                          | 0.69   | 0.52  | 0.17  |
| 60                         | 19.05                          | 1.05   | 0.80  | 0.26  |
| 80                         | 29.39                          | 1.30   | 0.98  | 0.32  |
| 100                        | 36.46                          | 1.63   | 1.23  | 0.41  |
| 200                        | 102.32                         | 2.51   | 1.89  | 0.62  |
| 300                        | 186.13                         | 2.92   | 2.19  | 0.73  |
| 400                        | 244.64                         | 4.00   | 3.01  | 0.99  |
| 500                        | 337.97                         | 4.17   | 3.14  | 1.03  |
| 600                        | 416.87                         | 4.73   | 3.54  | 1.18  |
| 700                        | 517.82                         | 4.73   | 3.54  | 1.19  |
| 800                        | 617.70                         | 4.71   | 3.55  | 1.16  |
| 900                        | 714.28                         | 4.74   | 3.55  | 1.19  |
| 1000                       | 816.33                         | 4.72   | 3.54  | 1.18  |
| 3000                       | 2819.14                        | 4.66   | 3.59  | 1.07  |
| 5000                       | 4821.85                        | 4.57   | 3.50  | 1.07  |
| 7000                       | 6821.85                        | 4.59   | 3.51  | 1.07  |
| 10000                      | 9812.16                        | 4.83   | 3.54  | 1.28  |

**Table B18** Adsorption isotherm on ABS of 1:1 molar ratio of CPB:OP(EO)<sub>10</sub>

| Initial concentration (μM) | Equilibrium concentration (μM) | Total amount of surfactant adsorbed (μmole/m <sup>2</sup> ABS) | Cationic surfactant adsorbed (μmole/m <sup>2</sup> ABS) | Nonionic surfactant adsorbed (μmole/m <sup>2</sup> ABS) |
|----------------------------|--------------------------------|--|---|---|
| 20                         | 4.93                           | 0.38   | 0.19  | 0.19  |
| 40                         | 9.86                           | 0.78   | 0.39  | 0.39  |
| 60                         | 16.71                          | 1.12   | 0.56  | 0.56  |
| 80                         | 21.64                          | 1.50   | 0.75  | 0.75  |
| 100                        | 33.42                          | 1.72   | 0.86  | 0.86  |
| 200                        | 98.09                          | 2.63   | 1.32  | 1.31  |
| 300                        | 154.23                         | 3.76   | 1.87  | 1.89  |
| 400                        | 227.70                         | 4.43   | 2.24  | 2.18  |
| 500                        | 303.58                         | 5.06   | 2.55  | 2.51  |
| 600                        | 403.58                         | 5.06   | 2.55  | 2.51  |
| 700                        | 503.58                         | 5.07   | 2.55  | 2.52  |
| 800                        | 603.58                         | 5.06   | 2.55  | 2.51  |
| 900                        | 705.20                         | 5.02   | 2.51  | 2.51  |
| 1000                       | 803.31                         | 5.07   | 2.56  | 2.51  |
| 3000                       | 2802.70                        | 5.08   | 2.51  | 2.58  |
| 5000                       | 4808.33                        | 4.92   | 2.57  | 2.35  |
| 7000                       | 6811.04                        | 4.88   | 2.51  | 2.37  |
| 10000                      | 9802.70                        | 5.08   | 2.51  | 2.58  |

**Table B19** Adsorption isotherm on ABS of 1:3 molar ratio of CPB:OP(EO)<sub>10</sub>

| Initial concentration (μM) | Equilibrium concentration (μM) | Total amount of surfactant adsorbed (μmole/m <sup>2</sup> ABS) | Cationic surfactant adsorbed (μmole/m <sup>2</sup> ABS) | Nonionic surfactant adsorbed (μmole/m <sup>2</sup> ABS) |
|----------------------------|--------------------------------|--|---|---|
| 20                         | 2.48                           | 0.45   | 0.11  | 0.34  |
| 40                         | 5.52                           | 0.89   | 0.22  | 0.66  |
| 60                         | 11.31                          | 1.26   | 0.31  | 0.95  |
| 80                         | 15.45                          | 1.67   | 0.42  | 1.25  |
| 100                        | 28.13                          | 1.85   | 0.46  | 1.39  |
| 200                        | 61.53                          | 3.55   | 0.90  | 2.65  |
| 300                        | 119.44                         | 4.66   | 1.15  | 3.50  |
| 400                        | 203.92                         | 5.06   | 1.32  | 3.74  |
| 500                        | 281.96                         | 5.60   | 1.43  | 4.18  |
| 600                        | 370.52                         | 5.90   | 1.51  | 4.39  |
| 700                        | 470.92                         | 5.89   | 1.50  | 4.39  |
| 800                        | 571.89                         | 5.87   | 1.50  | 4.38  |
| 900                        | 672.03                         | 5.88   | 1.49  | 4.38  |
| 1000                       | 771.33                         | 5.90   | 1.49  | 4.41  |
| 3000                       | 2764.19                        | 6.06   | 1.56  | 4.49  |
| 5000                       | 4766.89                        | 6.01   | 1.50  | 4.51  |
| 7000                       | 6766.89                        | 6.01   | 1.50  | 4.51  |
| 10000                      | 9762.84                        | 6.09   | 1.60  | 4.50  |

**Table B20** Adsorption isotherm on ABS of 0:1 molar ratio of CPB:OP(EO)<sub>10</sub>

| Initial concentration<br>( $\mu\text{M}$ ) | Equilibrium<br>concentration ( $\mu\text{M}$ ) | Amount of surfactant adsorbed<br>( $\mu\text{mole}/\text{m}^2$ ABS) |
|--|--|---|
| 20   | 1.64   | 0.57  |
| 40   | 2.46   | 0.97  |
| 60   | 4.10   | 1.44  |
| 80   | 5.74   | 1.91  |
| 100  | 7.38   | 2.38  |
| 200  | 34.43  | 4.26  |
| 300  | 96.72  | 5.24  |
| 400  | 169.67   | 5.93  |
| 500  | 246.72   | 6.53  |
| 600  | 342.62   | 6.61  |
| 700  | 444.26   | 6.60  |
| 800  | 539.34   | 6.71  |
| 900  | 636.89   | 6.78  |
| 1000                                       | 739.34   | 6.71  |
| 3000                                       | 2737.70  | 6.74  |
| 5000                                       | 4737.70  | 6.74  |
| 7000                                       | 6737.70  | 6.76  |
| 10000                                      | 9737.70  | 6.75  |



**Table B21** Adsorption isotherm on PMMA of 1:0 molar ratio of CPB:OP(EO)<sub>10</sub>

| Initial concentration<br>( $\mu\text{M}$ ) | Equilibrium<br>concentration ( $\mu\text{M}$ ) | Amount of surfactant adsorbed<br>( $\mu\text{mole}/\text{m}^2$ PMMA) |
|--|--|--|
| 20   | 17.30  | 0.21   |
| 40   | 30.81  | 0.72   |
| 60   | 41.89  | 1.43   |
| 80   | 55.14  | 1.96   |
| 100  | 69.73  | 2.39   |
| 200  | 157.57   | 3.35   |
| 300  | 252.70   | 3.73   |
| 400  | 344.05   | 4.42   |
| 500  | 440.27   | 4.71   |
| 600  | 535.95   | 5.06   |
| 700  | 625.41   | 5.90   |
| 800  | 724.59   | 5.94   |
| 900  | 827.30   | 5.73   |
| 1000                                       | 924.86   | 5.93   |
| 3000                                       | 2924.32  | 5.96   |
| 5000                                       | 4927.03  | 5.75   |
| 7000                                       | 6924.32  | 5.97   |
| 10000                                      | 9924.32  | 5.96   |

**Table B22** Adsorption isotherm on PMMA of 3:1 molar ratio of CPB:OP(EO)<sub>10</sub>

| Initial concentration (μM) | Equilibrium concentration (μM) | Total amount of surfactant adsorbed (μmole/m <sup>2</sup> PMMA) | Cationic surfactant adsorbed (μmole/m <sup>2</sup> PMMA) | Nonionic surfactant adsorbed (μmole/m <sup>2</sup> PMMA) |
|----------------------------|--------------------------------|---|--|--|
| 20                         | 9.80                           | 0.81  | 0.61   | 0.20   |
| 40                         | 20.14                          | 1.57  | 1.17   | 0.39   |
| 60                         | 33.20                          | 2.12  | 1.59   | 0.53   |
| 80                         | 46.80                          | 2.61  | 1.95   | 0.65   |
| 100                        | 59.05                          | 3.21  | 2.43   | 0.79   |
| 200                        | 139.86                         | 4.74  | 3.56   | 1.18   |
| 300                        | 229.39                         | 5.57  | 4.19   | 1.38   |
| 400                        | 326.26                         | 5.83  | 4.38   | 1.45   |
| 500                        | 422.32                         | 6.11  | 4.60   | 1.51   |
| 600                        | 519.73                         | 6.34  | 4.76   | 1.58   |
| 700                        | 619.32                         | 6.34  | 4.77   | 1.57   |
| 800                        | 719.73                         | 6.33  | 4.75   | 1.58   |
| 900                        | 819.05                         | 6.35  | 4.78   | 1.57   |
| 1000                       | 918.63                         | 6.39  | 4.76   | 1.64   |
| 3000                       | 2922.52                        | 6.09  | 4.78   | 1.31   |
| 5000                       | 4914.19                        | 6.68  | 4.73   | 1.95   |
| 7000                       | 6919.82                        | 6.30  | 4.99   | 1.31   |
| 10000                      | 9915.54                        | 6.67  | 4.69   | 1.97   |

**Table B23** Adsorption isotherm on PMMA of 1:1 molar ratio of CPB:OP(EO)<sub>10</sub>

| Initial concentration ( $\mu\text{M}$ ) | Equilibrium concentration ( $\mu\text{M}$ ) | Total amount of surfactant adsorbed ( $\mu\text{mole}/\text{m}^2$ PMMA) | Cationic surfactant adsorbed ( $\mu\text{mole}/\text{m}^2$ PMMA) | Nonionic surfactant adsorbed ( $\mu\text{mole}/\text{m}^2$ PMMA) |
|---|---|---|--|--|
| 20                                      | 9.86  | 0.80  | 0.41   | 0.40   |
| 40                                      | 19.46                                       | 1.62  | 0.83   | 0.79   |
| 60                                      | 34.80                                       | 1.99  | 1.00   | 0.98   |
| 80                                      | 42.21                                       | 2.99  | 1.54   | 1.45   |
| 100                                     | 54.80                                       | 3.57  | 1.79   | 1.78   |
| 200                                     | 139.73                                      | 4.76  | 2.39   | 2.37   |
| 300                                     | 229.89                                      | 5.54  | 2.84   | 2.70   |
| 400                                     | 322.18                                      | 6.12  | 3.04   | 3.08   |
| 500                                     | 413.15                                      | 6.85  | 3.43   | 3.42   |
| 600                                     | 513.15                                      | 6.86  | 3.44   | 3.42   |
| 700                                     | 612.34                                      | 6.89  | 3.48   | 3.41   |
| 800                                     | 713.99                                      | 6.76  | 3.42   | 3.34   |
| 900                                     | 813.15                                      | 6.87  | 3.44   | 3.43   |
| 1000                                    | 912.05                                      | 6.93  | 3.45   | 3.48   |
| 3000                                    | 2915.09                                     | 6.70  | 3.41   | 3.29   |
| 5000                                    | 4915.09                                     | 6.67  | 3.40   | 3.27   |
| 7000                                    | 6915.09                                     | 6.71  | 3.42   | 3.29   |
| 10000                                   | 9915.09                                     | 6.71  | 3.42   | 3.29   |

**Table B24** Adsorption isotherm on PMMA of 1:3 molar ratio of CPB:OP(EO)<sub>10</sub>

| Initial concentration (μM) | Equilibrium concentration (μM) | Total amount of surfactant adsorbed (μmole/m <sup>2</sup> PMMA) | Cationic surfactant adsorbed (μmole/m <sup>2</sup> PMMA) | Nonionic surfactant adsorbed (μmole/m <sup>2</sup> PMMA) |
|----------------------------|--------------------------------|---|--|--|
| 20                         | 9.93                           | 0.79  | 0.20   | 0.59   |
| 40                         | 20.68                          | 1.52  | 0.34   | 1.18   |
| 60                         | 31.17                          | 2.27  | 0.56   | 1.70   |
| 80                         | 41.37                          | 3.05  | 0.75   | 2.30   |
| 100                        | 53.51                          | 3.66  | 0.90   | 2.76   |
| 200                        | 131.04                         | 5.42  | 1.36   | 4.06   |
| 300                        | 217.66                         | 6.49  | 1.63   | 4.86   |
| 400                        | 311.46                         | 6.98  | 1.79   | 5.19   |
| 500                        | 411.60                         | 6.97  | 1.78   | 5.19   |
| 600                        | 511.73                         | 6.96  | 1.77   | 5.19   |
| 700                        | 611.06                         | 7.02  | 1.82   | 5.20   |
| 800                        | 712.03                         | 6.94  | 1.81   | 5.13   |
| 900                        | 812.41                         | 6.92  | 1.72   | 5.20   |
| 1000                       | 912.00                         | 6.95  | 1.75   | 5.20   |
| 3000                       | 2913.06                        | 6.85  | 1.60   | 5.25   |
| 5000                       | 4910.36                        | 7.06  | 1.81   | 5.25   |
| 7000                       | 6910.36                        | 7.06  | 1.81   | 5.25   |
| 10000                      | 9911.71                        | 6.94  | 1.70   | 5.24   |

**Table B25** Adsorption isotherm on PMMA of 0:1 molar ratio of CPB:OP(EO)<sub>10</sub>

| Initial concentration<br>( $\mu\text{M}$ ) | Equilibrium<br>concentration ( $\mu\text{M}$ ) | Amount of surfactant adsorbed<br>( $\mu\text{mole}/\text{m}^2$ PMMA) |
|--|--|--|
| 20   | 6.56   | 1.06   |
| 40   | 10.66  | 2.32   |
| 60   | 18.03  | 3.30   |
| 80   | 23.77  | 4.45   |
| 100  | 31.15  | 5.44   |
| 200  | 104.10   | 7.54   |
| 300  | 200.00   | 7.88   |
| 400  | 298.36   | 8.04   |
| 500  | 400.00   | 7.89   |
| 600  | 497.54   | 8.09   |
| 700  | 596.72   | 8.12   |
| 800  | 698.36   | 8.03   |
| 900  | 797.54   | 8.09   |
| 1000                                       | 898.36   | 8.00   |
| 3000                                       | 2901.64  | 7.77   |
| 5000                                       | 4901.64  | 7.74   |
| 7000                                       | 6901.64  | 7.74   |
| 10000                                      | 9901.64  | 7.76   |

**Table B26** Adsorption isotherm on Nylon66 of 1:0 molar ratio of CPB:OP(EO)<sub>10</sub>

| Initial concentration<br>( $\mu\text{M}$ ) | Equilibrium<br>concentration ( $\mu\text{M}$ ) | Amount of surfactant adsorbed<br>( $\mu\text{mole}/\text{m}^2$ Nylon66) |
|--|--|---|
| 20   | 10.27  | 0.29  |
| 40   | 13.24  | 0.81  |
| 60   | 16.49  | 1.38  |
| 80   | 20.00  | 1.85  |
| 100  | 23.24  | 2.42  |
| 200  | 44.05  | 4.91  |
| 300  | 122.16   | 5.63  |
| 400  | 200.54   | 6.27  |
| 500  | 295.68   | 6.37  |
| 600  | 397.57   | 6.35  |
| 700  | 495.95   | 6.39  |
| 800  | 595.14   | 6.37  |
| 900  | 696.76   | 6.39  |
| 1000                                       | 811.35   | 6.40  |
| 3000                                       | 2797.30  | 6.37  |
| 5000                                       | 4800.00  | 6.29  |
| 7000                                       | 6794.59  | 6.35  |
| 10000                                      | 9797.30  | 6.37  |

**Table B27** Adsorption isotherm on Nylon66 of 3:1 molar ratio of CPB:OP(EO)<sub>10</sub>

| Initial concentration (μM) | Equilibrium concentration (μM) | Total amount of surfactant adsorbed (μmole/m <sup>2</sup> Nylon66) | Cationic surfactant adsorbed (μmole/m <sup>2</sup> Nylon66) | Nonionic surfactant adsorbed (μmole/m <sup>2</sup> Nylon66) |
|----------------------------|--------------------------------|--|---|---|
| 20                         | 9.80                           | 0.32   | 0.24  | 0.08  |
| 40                         | 13.33                          | 0.99   | 0.75  | 0.25  |
| 60                         | 16.60                          | 1.41   | 1.06  | 0.35  |
| 80                         | 18.78                          | 2.17   | 1.64  | 0.53  |
| 100                        | 21.78                          | 2.49   | 1.88  | 0.61  |
| 200                        | 62.59                          | 4.02   | 3.02  | 1.00  |
| 300                        | 148.85                         | 5.05   | 3.80  | 1.25  |
| 400                        | 222.59                         | 5.50   | 4.13  | 1.37  |
| 500                        | 308.31                         | 6.21   | 4.67  | 1.54  |
| 600                        | 388.02                         | 6.46   | 4.83  | 1.63  |
| 700                        | 477.03                         | 7.06   | 5.32  | 1.74  |
| 800                        | 573.11                         | 7.02   | 5.32  | 1.70  |
| 900                        | 672.68                         | 7.06   | 5.33  | 1.74  |
| 1000                       | 771.44                         | 7.07   | 5.32  | 1.75  |
| 3000                       | 2810.81                        | 7.17   | 5.27  | 1.89  |
| 5000                       | 4791.89                        | 7.02   | 5.33  | 1.69  |
| 7000                       | 6740.09                        | 7.08   | 5.26  | 1.82  |
| 10000                      | 9771.40                        | 7.03   | 5.24  | 1.80  |

**Table B28** Adsorption isotherm on Nylon66 of 1:1 molar ratio of CPB:OP(EO)<sub>10</sub>

| Initial concentration (μM) | Equilibrium concentration (μM) | Total amount of surfactant adsorbed (μmole/m <sup>2</sup> Nylon66) | Cationic surfactant adsorbed (μmole/m <sup>2</sup> Nylon66) | Nonionic surfactant adsorbed (μmole/m <sup>2</sup> Nylon66) |
|----------------------------|--------------------------------|--|---|---|
| 20                         | 4.66                           | 0.46   | 0.23  | 0.22  |
| 40                         | 8.22                           | 0.93   | 0.47  | 0.47  |
| 60                         | 16.71                          | 1.31   | 0.65  | 0.66  |
| 80                         | 20.00                          | 1.88   | 0.94  | 0.94  |
| 100                        | 31.53                          | 2.13   | 1.09  | 1.04  |
| 200                        | 82.45                          | 3.67   | 1.82  | 1.85  |
| 300                        | 132.91                         | 5.15   | 2.61  | 2.54  |
| 400                        | 210.16                         | 5.92   | 2.99  | 2.94  |
| 500                        | 292.68                         | 6.51   | 3.35  | 3.17  |
| 600                        | 367.43                         | 7.24   | 3.66  | 3.58  |
| 700                        | 443.85                         | 7.92   | 3.98  | 3.94  |
| 800                        | 532.91                         | 7.96   | 4.01  | 3.95  |
| 900                        | 637.79                         | 7.83   | 3.90  | 3.93  |
| 1000                       | 743.33                         | 8.01   | 4.06  | 3.95  |
| 3000                       | 2736.94                        | 8.09   | 3.99  | 4.10  |
| 5000                       | 4742.57                        | 8.01   | 4.12  | 3.89  |
| 7000                       | 6742.57                        | 8.10   | 4.16  | 3.93  |
| 10000                      | 9736.94                        | 8.10   | 3.99  | 4.10  |



**Table B29** Adsorption isotherm on Nylon66 of 1:3 molar ratio of CPB:OP(EO)<sub>10</sub>

| Initial concentration (μM) | Equilibrium concentration (μM) | Total amount of surfactant adsorbed (μmole/m <sup>2</sup> Nylon66) | Cationic surfactant adsorbed (μmole/m <sup>2</sup> Nylon66) | Nonionic surfactant adsorbed (μmole/m <sup>2</sup> Nylon66) |
|----------------------------|--------------------------------|--|---|---|
| 20                         | 6.89                           | 0.17   | 0.04  | 0.13  |
| 40                         | 9.10                           | 0.39   | 0.09  | 0.29  |
| 60                         | 15.74                          | 0.56   | 0.15  | 0.41  |
| 80                         | 17.95                          | 0.78   | 0.20  | 0.58  |
| 100                        | 22.36                          | 0.98   | 0.25  | 0.72  |
| 200                        | 40.56                          | 2.01   | 0.51  | 1.50  |
| 300                        | 58.36                          | 3.04   | 0.70  | 2.34  |
| 400                        | 73.58                          | 4.09   | 0.99  | 3.10  |
| 500                        | 105.38                         | 4.96   | 1.24  | 3.72  |
| 600                        | 128.81                         | 5.90   | 1.46  | 4.43  |
| 700                        | 159.41                         | 6.81   | 1.69  | 5.13  |
| 800                        | 207.12                         | 7.45   | 1.84  | 5.61  |
| 900                        | 257.25                         | 8.08   | 1.96  | 6.12  |
| 1000                       | 300.70                         | 8.76   | 2.19  | 6.57  |
| 1200                       | 504.84                         | 8.75   | 2.19  | 6.55  |
| 1500                       | 810.27                         | 8.68   | 2.20  | 6.48  |
| 2000                       | 1302.12                        | 8.78   | 2.22  | 6.56  |
| 2500                       | 1798.96                        | 8.80   | 2.23  | 6.57  |
| 3000                       | 2309.01                        | 8.73   | 2.20  | 6.53  |
| 5000                       | 4300.68                        | 8.80   | 2.19  | 6.61  |
| 7000                       | 6309.01                        | 8.70   | 2.20  | 6.51  |
| 10000                      | 9304.73                        | 8.74   | 2.14  | 6.60  |

**Table B30** Adsorption isotherm on Nylon66 of 0:1 molar ratio of CPB:OP(EO)<sub>10</sub>

| Initial concentration<br>( $\mu\text{M}$ ) | Equilibrium<br>concentration ( $\mu\text{M}$ ) | Amount of surfactant adsorbed<br>( $\mu\text{mole}/\text{m}^2$ Nylon66) |
|--|--|---|
| 20   | 5.00   | 0.19  |
| 40   | 6.67   | 0.42  |
| 60   | 10.83  | 0.62  |
| 80   | 12.50  | 0.85  |
| 100  | 17.50  | 1.04  |
| 200  | 26.67  | 2.17  |
| 300  | 45.00  | 3.20  |
| 400  | 54.17  | 4.46  |
| 500  | 78.33  | 5.53  |
| 600  | 84.17  | 6.73  |
| 700  | 132.50   | 7.68  |
| 800  | 210.83   | 10.27   |
| 900  | 301.67   | 10.18   |
| 1000                                       | 511.67   | 10.30   |
| 3000                                       | 2675.00  | 10.19   |
| 5000                                       | 4525.00  | 10.36   |
| 7000                                       | 6658.33  | 10.64   |
| 10000                                      | 9675.00  | 10.13   |

### Appendix C Contact Angle of Surfactant Solutions

**Table C1** Contact angle for solutions of CPB, OP(EO)<sub>10</sub>, and their mixtures on HDPE

| Total surfactant concentration<br>( $\mu\text{M}$ ) | Contact angle (degree) |                 |                 |                 |                |
|---|------------------------|-----------------|-----------------|-----------------|----------------|
|   | $\alpha = 0$           | $\alpha = 0.25$ | $\alpha = 0.50$ | $\alpha = 0.75$ | $\alpha = 1.0$ |
| 20  | 88.33                  | 82.77           | 82.41           | 81.37           | 78.90          |
| 40  | 86.70                  | 80.50           | 79.83           | 75.63           | 71.20          |
| 60  | 84.14                  | 79.21           | 78.62           | 74.77           | 68.30          |
| 80  | 81.10                  | 76.24           | 78.79           | 70.20           | 65.76          |
| 100   | 78.73                  | 73.77           | 71.52           | 66.40           | 61.14          |
| 200   | 76.45                  | 68.50           | 67.77           | 56.07           | 44.16          |
| 300   | 74.24                  | 65.57           | 60.37           | 50.73           | 44.27          |
| 400   | 72.11                  | 60.42           | 53.82           | 50.77           | 44.13          |
| 500   | 70.81                  | 56.60           | 53.81           | 50.73           | 43.91          |
| 600   | 62.66                  | 56.76           | 53.91           | 50.53           | 44.26          |
| 700   | 62.87                  | 56.54           | 53.72           | 50.75           | 44.05          |
| 800   | 62.26                  | 56.62           | 53.82           | 50.73           | 44.18          |
| 900   | 62.85                  | 56.68           | 53.87           | 50.73           | 44.14          |
| 1,000   | 62.65                  | 56.62           | 53.88           | 50.75           | 44.09          |
| 3,000   | 62.52                  | 56.43           | 53.81           | 50.74           | 44.16          |
| 5,000   | 62.73                  | 56.46           | 53.82           | 50.81           | 44.12          |
| 7,000   | 62.70                  | 56.60           | 53.82           | 50.73           | 44.22          |
| 10,000  | 62.63                  | 56.65           | 53.81           | 50.71           | 44.11          |

**Table C2** Contact angle for solutions of CPB, OP(EO)<sub>10</sub>, and their mixtures on PC

| Total surfactant concentration<br>( $\mu\text{M}$ ) | Contact angle (degree) |                 |                 |                 |                |
|---|------------------------|-----------------|-----------------|-----------------|----------------|
|   | $\alpha = 0$           | $\alpha = 0.25$ | $\alpha = 0.50$ | $\alpha = 0.75$ | $\alpha = 1.0$ |
| 20  | 82.53                  | 81.72           | 78.61           | 78.61           | 76.87          |
| 40  | 80.48                  | 78.05           | 71.92           | 71.92           | 70.29          |
| 60  | 78.65                  | 76.45           | 67.88           | 67.88           | 65.22          |
| 80  | 75.60                  | 74.16           | 64.09           | 64.09           | 59.31          |
| 100   | 70.11                  | 66.13           | 59.84           | 59.84           | 53.68          |
| 200   | 67.21                  | 62.37           | 52.72           | 52.72           | 41.96          |
| 300   | 65.60                  | 55.78           | 49.77           | 49.77           | 41.87          |
| 400   | 63.46                  | 54.88           | 79.52           | 49.52           | 42.02          |
| 500   | 61.40                  | 54.70           | 48.87           | 48.87           | 41.92          |
| 600   | 58.16                  | 54.60           | 49.89           | 49.89           | 41.96          |
| 700   | 58.35                  | 54.49           | 49.82           | 49.82           | 41.83          |
| 800   | 58.28                  | 54.81           | 49.62           | 49.62           | 41.94          |
| 900   | 58.12                  | 54.79           | 49.60           | 49.60           | 41.96          |
| 1,000   | 57.97                  | 54.61           | 49.74           | 49.74           | 42.07          |
| 3,000   | 58.17                  | 54.67           | 49.62           | 49.62           | 41.87          |
| 5,000   | 58.21                  | 54.77           | 49.78           | 49.78           | 42.04          |
| 7,000   | 58.15                  | 54.74           | 49.80           | 49.80           | 41.96          |
| 10,000  | 58.09                  | 54.70           | 49.68           | 49.68           | 41.92          |

**Table C3** Contact angle for solutions of CPB, OP(EO)<sub>10</sub>, and their mixtures on PVC

| Total surfactant concentration<br>( $\mu\text{M}$ ) | Contact angle (degree) |                 |                 |                 |                |
|---|------------------------|-----------------|-----------------|-----------------|----------------|
|   | $\alpha = 0$           | $\alpha = 0.25$ | $\alpha = 0.50$ | $\alpha = 0.75$ | $\alpha = 1.0$ |
| 20  | 81.65                  | 80.35           | 79.04           | 77.85           | 76.36          |
| 40  | 79.23                  | 78.27           | 77.41           | 75.59           | 69.52          |
| 60  | 76.32                  | 74.64           | 73.02           | 72.93           | 60.59          |
| 80  | 75.31                  | 72.27           | 70.07           | 68.99           | 53.37          |
| 100   | 73.64                  | 70.15           | 69.88           | 63.11           | 44.46          |
| 200   | 70.33                  | 65.20           | 62.45           | 60.03           | 37.40          |
| 300   | 67.60                  | 60.71           | 55.33           | 49.04           | 37.39          |
| 400   | 65.49                  | 56.43           | 50.65           | 48.92           | 37.48          |
| 500   | 61.41                  | 53.80           | 50.71           | 49.89           | 37.37          |
| 600   | 55.84                  | 53.06           | 50.60           | 49.03           | 37.42          |
| 700   | 55.13                  | 53.83           | 50.68           | 49.16           | 37.44          |
| 800   | 54.88                  | 53.76           | 50.69           | 49.05           | 37.39          |
| 900   | 55.22                  | 53.77           | 50.67           | 49.12           | 37.44          |
| 1,000   | 55.47                  | 53.01           | 50.65           | 49.02           | 37.39          |
| 3,000   | 55.48                  | 53.73           | 50.67           | 48.93           | 37.43          |
| 5,000   | 55.75                  | 53.86           | 50.64           | 49.00           | 37.42          |
| 7,000   | 55.53                  | 53.55           | 50.61           | 49.02           | 37.41          |
| 10,000  | 55.63                  | 53.85           | 50.61           | 49.09           | 37.40          |

**Table C4** Contact angle for solutions of CPB, OP(EO)<sub>10</sub>, and their mixtures on ABS

| Total surfactant concentration<br>( $\mu\text{M}$ ) | Contact angle (degree) |                 |                 |                 |                |
|---|------------------------|-----------------|-----------------|-----------------|----------------|
|   | $\alpha = 0$           | $\alpha = 0.25$ | $\alpha = 0.50$ | $\alpha = 0.75$ | $\alpha = 1.0$ |
| 20  | 81.42                  | 79.57           | 77.57           | 76.89           | 75.42          |
| 40  | 80.11                  | 78.59           | 77.10           | 75.05           | 67.59          |
| 60  | 78.05                  | 76.24           | 74.96           | 74.83           | 58.40          |
| 80  | 76.42                  | 74.63           | 72.61           | 69.57           | 51.43          |
| 100   | 75.40                  | 74.90           | 70.26           | 68.40           | 43.23          |
| 200   | 72.52                  | 66.10           | 64.78           | 55.40           | 36.50          |
| 300   | 72.41                  | 60.37           | 52.05           | 47.77           | 36.38          |
| 400   | 68.62                  | 54.36           | 49.15           | 47.66           | 36.56          |
| 500   | 61.37                  | 52.24           | 49.16           | 47.60           | 36.29          |
| 600   | 55.60                  | 52.22           | 49.14           | 47.77           | 36.77          |
| 700   | 55.54                  | 51.69           | 49.18           | 47.41           | 36.64          |
| 800   | 55.53                  | 52.02           | 49.15           | 47.85           | 36.42          |
| 900   | 55.67                  | 52.78           | 49.22           | 47.66           | 36.51          |
| 1,000   | 55.53                  | 52.33           | 48.91           | 47.74           | 36.19          |
| 3,000   | 55.66                  | 52.26           | 49.21           | 47.77           | 36.49          |
| 5,000   | 55.55                  | 52.06           | 49.17           | 47.71           | 36.49          |
| 7,000   | 55.64                  | 52.32           | 49.16           | 47.74           | 36.65          |
| 10,000  | 55.59                  | 52.08           | 49.14           | 47.75           | 36.48          |

**Table C5** Contact angle for solutions of CPB, OP(EO)<sub>10</sub>, and their mixtures on PMMA

| Total surfactant concentration<br>( $\mu\text{M}$ ) | Contact angle (degree) |                 |                 |                 |                |
|---|------------------------|-----------------|-----------------|-----------------|----------------|
|   | $\alpha = 0$           | $\alpha = 0.25$ | $\alpha = 0.50$ | $\alpha = 0.75$ | $\alpha = 1.0$ |
| 20  | 74.32                  | 73.56           | 71.43           | 70.11           | 64.66          |
| 40  | 69.26                  | 68.33           | 68.46           | 69.41           | 60.04          |
| 60  | 68.90                  | 65.51           | 67.51           | 65.36           | 57.14          |
| 80  | 66.52                  | 59.85           | 61.84           | 60.47           | 50.84          |
| 100   | 65.23                  | 58.32           | 58.28           | 55.97           | 42.89          |
| 200   | 64.12                  | 55.72           | 52.11           | 45.47           | 35.19          |
| 300   | 61.16                  | 53.42           | 50.60           | 42.74           | 35.01          |
| 400   | 56.66                  | 51.68           | 44.04           | 42.34           | 35.10          |
| 500   | 53.43                  | 46.40           | 44.00           | 42.66           | 35.07          |
| 600   | 50.60                  | 46.27           | 44.17           | 42.13           | 35.14          |
| 700   | 50.98                  | 46.33           | 44.12           | 42.61           | 35.22          |
| 800   | 50.30                  | 46.23           | 44.08           | 42.59           | 35.34          |
| 900   | 50.29                  | 46.20           | 43.96           | 42.60           | 35.01          |
| 1,000   | 50.89                  | 46.63           | 44.03           | 42.76           | 35.34          |
| 3,000   | 50.43                  | 46.43           | 44.00           | 42.71           | 35.22          |
| 5,000   | 50.67                  | 46.41           | 43.98           | 42.84           | 35.13          |
| 7,000   | 50.63                  | 46.40           | 44.27           | 42.73           | 35.11          |
| 10,000  | 50.61                  | 46.28           | 44.11           | 42.81           | 35.26          |

**Table C6** Contact angle for solutions of CPB, OP(EO)<sub>10</sub>, and their mixtures on Nylon66

| Total surfactant concentration<br>( $\mu\text{M}$ ) | Contact angle (degree) |                 |                 |                 |                |
|---|------------------------|-----------------|-----------------|-----------------|----------------|
|   | $\alpha = 0$           | $\alpha = 0.25$ | $\alpha = 0.50$ | $\alpha = 0.75$ | $\alpha = 1.0$ |
| 20  | 61.42                  | 67.52           | 65.51           | 63.58           | 62.29          |
| 40  | 58.59                  | 59.81           | 59.37           | 56.44           | 54.64          |
| 60  | 56.56                  | 57.34           | 56.72           | 53.78           | 52.14          |
| 80  | 54.77                  | 55.55           | 54.45           | 49.60           | 48.09          |
| 100   | 53.91                  | 53.48           | 52.01           | 46.00           | 41.69          |
| 200   | 51.57                  | 47.22           | 45.78           | 43.35           | 33.91          |
| 300   | 48.14                  | 46.15           | 43.69           | 39.56           | 33.69          |
| 400   | 46.76                  | 44.26           | 41.31           | 39.30           | 33.83          |
| 500   | 43.81                  | 41.70           | 40.86           | 39.72           | 34.09          |
| 600   | 43.53                  | 41.63           | 41.19           | 39.42           | 34.24          |
| 700   | 43.92                  | 41.65           | 41.48           | 39.17           | 33.59          |
| 800   | 43.80                  | 41.62           | 41.26           | 39.45           | 33.70          |
| 900   | 44.04                  | 41.68           | 41.30           | 39.64           | 33.52          |
| 1,000   | 43.19                  | 41.60           | 41.22           | 39.26           | 33.65          |
| 3,000   | 43.99                  | 41.66           | 41.26           | 39.68           | 34.13          |
| 5,000   | 43.95                  | 41.64           | 41.27           | 39.47           | 33.89          |
| 7,000   | 43.70                  | 41.67           | 41.64           | 39.54           | 33.92          |
| 10,000  | 43.97                  | 41.68           | 41.65           | 39.52           | 33.88          |



## Appendix D Example of Calculation for Surfactant Adsorption Isotherms

### Adsorption for solution of CPB on HDPE

$$\text{Surfactant}_{\text{adsorb}} = \frac{[\text{Surfactant}]_I - [\text{Surfactant}]_E \times V_{\text{sol}}}{1,000 \times W_{\text{plastic}} \times a_s}$$

where

|                                     |   |  |
|-------------------------------------|---|--|
| $\text{Surfactant}_{\text{adsorb}}$ | = | Adsorption of surfactant, ( $\mu\text{mole}/\text{m}^2$ plastic) |
| $[\text{Surfactant}]_I$             | = | Initial surfactant solution concentration, ( $\mu\text{M}$ )     |
| $[\text{Surfactant}]_E$             | = | Equilibrium surfactant solution concentration, ( $\mu\text{M}$ ) |
| $V_{\text{sol}}$                    | = | Volume of solution, (mL)   |
| $W_{\text{plastic}}$                | = | Weight of plastic, (g)   |
| $a_s$                               | = | Specific surface area of plastic, ( $\text{m}^2/\text{g}$ )      |

The adsorption isotherm was a plot between adsorption of surfactant on HDPE ( $\mu\text{mole}/\text{m}^2$  HDPE) and concentration of surfactant solution ( $\mu\text{M}$ ).

$$[\text{Surfactant}]_I = 1,000 \mu\text{M}$$

Equilibrium concentration of surfactant was converted from

$$\text{UV-Vis spectrophotometer (wavelength)} \longrightarrow \mu\text{M}.$$

Calibration equation for CPB solution from UV-Vis spectrophotometer,

$$Y = 0.0037X.$$

where

$$\begin{aligned} X &= [\text{Surfactant}]_E, (\mu\text{M}) \\ Y &= \text{Wavelength} = 3.565 \end{aligned}$$

Substituting into calibration equation,

$$X = 3.565/0.0037 = 963.51 \mu\text{M}$$

Thus, surfactant adsorption for solution of CPB on HDPE at 1,000  $\mu\text{M}$ , initial concentration is

$$\text{Surfactant}_{\text{adsorb}} = \frac{(1,000 - 963.15) \times 20}{1,000 \times 0.2506 \times 1.443} = 2.02 \mu\text{mole}/\text{m}^2 \text{ HDPE}$$

Note: Calibration equation for OP(EO)<sub>10</sub> solution from UV-Vis spectrophotometer,

$$Y = 0.0012X$$

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