SUPPORTING INFORMATION FOR

Development of Composite Materials Based on the Interaction between Nanoparticles and Surfactants for Application on Chemical Enhanced Oil Recovery

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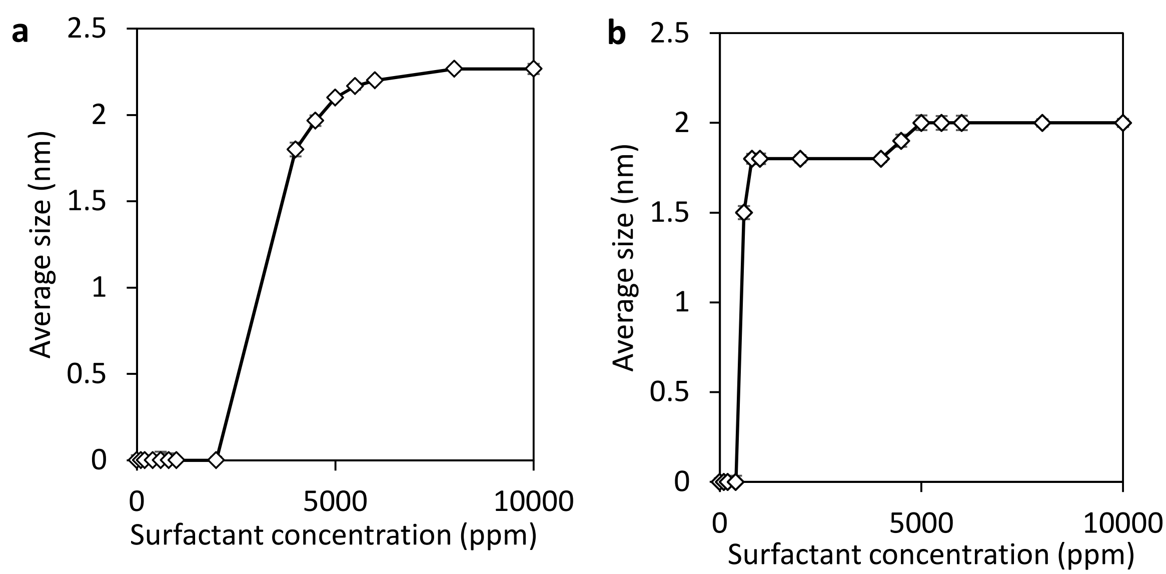
Figure S1 shows the average size of micelle as a function of surfactant concentration obtained by DLS measurements at 25 °C.



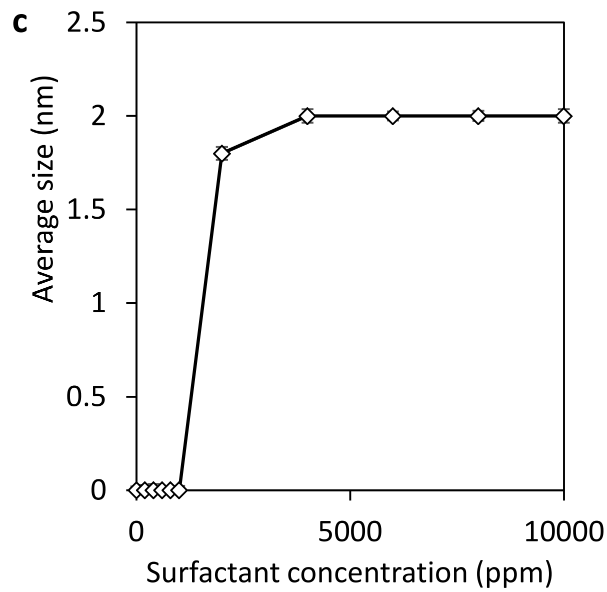


Figure S1. The average size of micelle of a) CTAB, b) Tween 20, and c) SDS for different surfactant concentrations at 25 °C.

The Table S1 shows the model parameters obtained from SLE model[1] for CTAB surfactant onto SiO_2 nanoparticles from route I and route II at 25, 50 and 70 °C. Similarly, the Table S2 and Table S3 present the parameters estimated from the SLE model for Tween 20 and SDS, respectively.

Table S1. Parameters estimated from the SLE model for CTAB surfactant onto SiO_2 nanoparticles from route I and II at 25, 50 and 70 °C.

Route	**Parameter**	**Temperature (°C)**		
		25	**50**	**70**
I	K_H **(mg·g^{-1})**	1.99	3.65	6.1

	K (g·g^{-1})	67.6	55.8	51.6
	q_m (mg·g^{-1})	1800.02	1700.08	1650.11
	R^2	0.99	0.99	0.99
	RSM%	5.42	3.26	5.09
II	K_H (mg·g^{-1})	1.53	3.05	4.20
	K (g·g^{-1})	67.81	57.60	44.56
	q_m (mg·g^{-1})	1935.50	1780.05	1700.10
	R^2	0.99	0.99	0.99
	RSM%	4.96	2.18	1.76

Table S2. Parameters estimated from SLE model for Tween 20 surfactant onto SiO_2 nanoparticles from route I and II at 25, 50 and 70 °C.

Route	**Parameter**	**Temperature (°C)**		
		25	**50**	**70**
I	K_H (mg·g^{-1})	10.15	14.60	22.27
	K (g·g^{-1})	57.13	42.18	39.74
	q_m (mg·g^{-1})	1569.28	1505.33	1448.52
	R^2	0.99	0.99	0.99
	RSM%	3.42	4.96	3.72
II	K_H (mg·g^{-1})	10.86	16.96	25.96

K **(g·g^{-1})**	80.16	66.16	62.16
q_m **(mg·g^{-1})**	1050.62	970.06	961.01
R^2	0.98	0.99	0.99
RSM%	5.76	3.62	3.66

Table S3. Parameters estimated from SLE model for SDS surfactant onto SiO_2 nanoparticles from route I and II at 25, 50 and 70 °C.

Route	**Parameter**	**Temperature (°C)**		
		25	**50**	**70**
I	K_H **(mg·g^{-1})**	1.92	5.72	9.33
	K **(g·g^{-1})**	2.21	3.04	4.33
	q_m **(mg·g^{-1})**	306.14	292.29	268.21
	R^2	0.99	0.99	0.99
	RSM%	1.50	9.01	2.45
II	K_H **(mg·g^{-1})**	1.54	5.22	9.85
	K **(g·g^{-1})**	1.56	2.69	5.15
	q_m **(mg·g^{-1})**	346.48	321.57	278.23
	R^2	0.99	0.99	0.99
	RSM%	2.67	5.92	1.09

Also, the estimated thermodynamic parameters for CTAB, Tween 20 and SDS surfactants adsorption onto SiO_2 nanoparticles from route I and route II are presented in Table S4.

Table S4. Estimated thermodynamic parameters for CTAB, Tween 20 and SDS surfactants adsorption onto SiO_2 nanoparticles from route I and II.

Route	Surfactant	Temperature (°C)	Property		
			$-\Delta G^{\circ}_{ads}$ (kJ·mol^{-1})	$-\Delta H^{\circ}_{ads}$ (kJ·mol^{-1})	ΔS°_{ads} (J· (mol·K)$^{-1}$)
I	CTAB	25	36.42	6.61	44.52
		50	38.69		
		70	43.46		
	Tween 20	25	159.25	4.12	48.44
		50	166.42		
		70	181.13		
	SDS	25	26.06	25.37	2.07
		50	25.84		
		70	26.20		
II	CTAB	25	153.26	6.05	54.58

	50	162.23		
	70	180.94		
	25	67.21		
Tween 20	50	70.42	4.51	42.57
	70	77.02		
	25	26.17		
SDS	50	25.76	26.54	1.58
	70	26.16		

References

(1) Montoya, T.; Coral, D.; Franco, C. A.; Nassar, N. N.; Cortés, F. B. A Novel Solid–Liquid Equilibrium Model for Describing the Adsorption of Associating Asphaltene Molecules onto Solid Surfaces Based on the "Chemical Theory". *Energy & Fuels* **2014**, *28*, (8), 4963-4975.