APPLICATION OF ADSORPTION THEORIES TO DESCRIBE CEFOPERAZONE PRECONCENTRATION USING AMINATED SILICA

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The use of theoretical sorption models makes it possible to describe the equality in the system and calculate the physico-chemical characteristics to optimize the conditions and understand the mechanisms of interaction. In this work, the application of sorption theories to the preconcentration of cefoperazone (Cefoper) with silica modified with polydimethyldialammonium (PDDA), polyhexamethylene guanidine (PGMG) and polyethylenimine (PEI) was studied.

Cefoper is quantitatively (98%) extracted from aqueous solutions with sorbents SiO_2-PDDA, SiO_2-PGMG at pH 3-6. The experimentally determined sorption capacity of SiO_2-PDDA, SiO_2-PGMG, and SiO_2-PEI according to Cefoper is 0.118, 0.087, and 0.104 mmol/g, respectively. The experimental sorption isotherms are satisfactorily described by the Langmuir model (see the table). The adsorption equilibrium constant KL decreases with the transition from SiO_2-PDDA and SiO_2-PGMG to SiO_2-PEI, which is associated with the greater strength of the interaction of Cefoper with PGMG and PDDA, and this is confirmed by experimental data. The values of the coefficients RL of the Langmuir model and n of the Freundlich model indicate active sorption. The energy of interaction between Cefoper and sorbent polyamines decreases as the surface is filled. The free energy according to the Dubinin-Radostkevich model E < 8 kJ/mol indicates the physical mechanism of sorption, the energy according to the Temkin (B) model indicates the exothermic nature of the process.

Parameters of theoretical models of Cefoperazone sorption

The sorption model	Parameter	SiO_2- PDDA	SiO_2- PGMG	SiO_2- PEI
Langmuir	a_{max}, mmol/g	0.134	0.104	0.192
	K_L, l/mmol	11.0	9.28	1.91
	R_L	0.1-0.9	0.1-0.9	0.3-1.0
	R^2	0.993	0.994	0.757
Freundlich	K_F, mmol/g	0.258	0.162	0.211
	1/n	0.662	0.617	0.888
	R^2	0.933	0.963	0.943
Dubinin-Radostkevich	a_{max}, mmol/g	0.129	0.098	0.121
	K, mol^2/kJ^2	0.017	0.017	0.032
	E, kJ/mol	5.36	5.44	3.92
	R^2	0.984	0.987	0.995
Temkina	A_T, l/mg	209	165	54
	B, kJ/mol	23.5	18.4	27.7
	R^2	0.922	0.937	0.934