IMMOBILIZATION OF CAFFEIC ACID ON CROSS-LINKED CATIONIC STARCHES WITH DIFFERENT DEGREE OF SUBSTITUTION

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Caffeic acid (CA) is hydroxycinnamic acid derivative, with antioxidant, anti-inflammatory, and anticancer activities. However, the application of CA is restricted because of its readily oxidation, low bioavailability, sensitivity to heat, light and moisture. In order to overcome these disadvantages this anionic phenolic compound could be immobilized on cationic polymers such as cross-linked cationic starch.

In the present study, the equilibrium adsorption of CA on cross-linked cationic starch (CCS) derivatives with different degree of substitution (DS) of quaternary ammonium groups was investigated. The Langmuir, Freundlich and Dubinin–Radushkevich adsorption models were applied to describe the adsorption isotherms of CA (Fig. 1, Table 1).

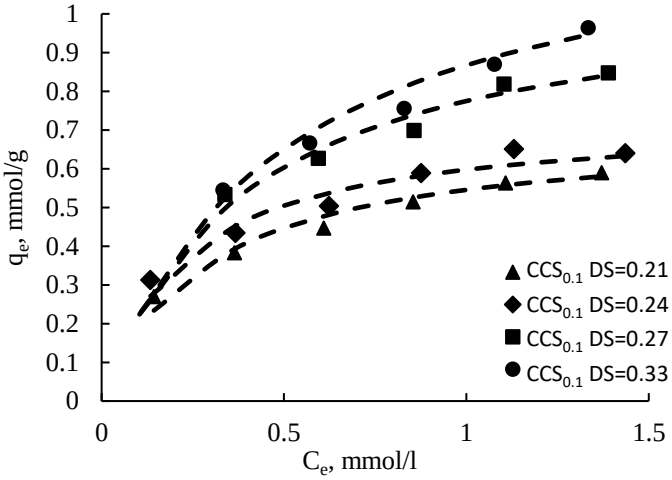

Fig. 1. Adsorption isotherms of CA on CCS with different DS at temperature of 30 °C. Symbols represent experimental data and lines represent fitted curves of the Langmuir adsorption model.

Table 1. Adsorption model parameters for adsorption of CA on CCS with different DS at temperature of 30 °C

Adsorbent	Langmuir model				Freundlich model		Dubinin-Radushkevich model	
	Q_L (mmol/g)	K_L (1/mol)	EF	R^2	n_F	R^2	E_{DR} (kJ/mol)	R^2
$CCS_{0.1}$ DS=0.21	0.70	3488	0.65	0.9918	2.85	0.9978	11.8	0.9980
$CCS_{0.1}$ DS=0.24	0.73	4368	0.61	0.9936	2.95	0.9948	12.2	0.9893
$CCS_{0.1}$ DS=0.27	1.08	2510	0.81	0.9845	3.08	0.9924	12.0	0.9863
$CCS_{0.1}$ DS=0.33	1.30	1993	0.84	0.9911	2.44	0.9984	10.7	0.9959

According to the Langmuir adsorption model, CA was adsorbed on the active centres of CCS, i.e. on the quaternary ammonium groups. The driving forces of adsorption were interactions between these groups and carboxylic groups of phenolic acid. As could be seen, with the increase of DS of CCS the values of the Langmuir sorption capacity Q_L and adsorption efficiency EF increased. Meanwhile, the calculated values of Dubinin-Radushkevich adsorption energy E_{DR} confirmed that CA was adsorbed by ion exchange mechanism and values of Freundlich constant n_F showed that conditions for CA adsorption on all CCS derivatives were favourable.

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