Removal of caffeine by oxidized biochar

Ioannis Anastopoulos¹, Ioannis Pashalidis¹, and Artis Robalds²

¹Department of Chemistry, University of Cyprus, P.O. Box 20537, CY-1678 Nicosia, Cyprus, (anastopoulos_ioannis@windowslive.com, pspasch@ucy.ac.cy)
²Institute of Food Safety, Animal Health and Environment "BIOR", Lejupes street 3, Riga LV-1076, Latvia, (artis.robalds@lu.lv)

Oxidized biochar from plant biomass (OBPM) was used to remove caffeine (CF) from aqueous solutions. Among examined parameters that affect adsorption, pH was found to play the most important role. By increasing the initial pH from 2 to 4, the adsorption capacity of CF was increased, whereas for pH above 4, a decline of the adsorption efficiency was noticed. The effect of contact time was also investigated in the range of 1 – 150 minutes and results indicated that the adsorption process consists of two steps. The initial step was relatively fast most probably, because a large number of adsorption surface sites was available, and with proceeding contact time the adsorption rate declined. The latter could be attributed to the decreasing number of vacant sites and to the development of repulsive forces between the free CF molecules and the occupied OBPM surface. The experimental data were best fitted by the pseudo-second order kinetic, compared to pseudo-first order kinetic model and the Freundlich isotherm model better fitted the data. The raise of temperature from 25 to 50 °C affected negatively the CF removal, indicating the exothermicity of the adsorption. Finally, FTIR spectroscopic data and investigations on the effect of ionic strength indicated that the adsorption mechanism is mainly based on electrostatic interactions and the formation of outer sphere surface complexes.