



## Sorption of 4-chlorophenol and lead(II) on granular activated carbon: equilibrium, kinetics and thermodynamics

Lidia Reczek<sup>a,\*</sup>, Magdalena M. Michel<sup>a</sup>, Krzysztof Kuśmierk<sup>b</sup>,  
Andrzej Świątkowski<sup>b</sup>, Tadeusz Siwiec<sup>a</sup>

<sup>a</sup>*Warsaw University of Life Sciences – SGGW, Faculty of Civil and Environmental Engineering, Nowoursynowska 166, 02-787 Warszawa, Poland, Tel. +48 22 5935162; email: lidia\_reczek@sggw.pl (L. Reczek), Tel. +48 22 5935160; email: magdalena\_michel@sggw.pl (M.M. Michel), Tel. +48 22 5935161; email: tadeusz\_siwiec@sggw.pl (T. Siwiec)*

<sup>b</sup>*Military University of Technology, Faculty of Advanced Technologies and Chemistry, Kaliskiego 2, 00-908 Warszawa, Poland, Tel. +48 261839561; emails: krzysztof.kusmierk@wat.edu.pl (K. Kuśmierk), a.swiatkowski@wp.pl (A. Świątkowski)*

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### ABSTRACT

In the presented study, the kinetics, equilibrium and thermodynamics of simultaneous sorption of 4-chlorophenol (4-CP) and lead(II) (Pb(II)) from aqueous solutions are investigated and described. The granular activated carbon Norit ROW 0.8 Supra was used as sorbent. The sorption process was carried out at various temperatures (283, 293 K). The kinetic models, such as pseudo-first-order and pseudo-second-order, and the Weber-Morris intraparticle diffusion model, were used to describe the sorption rate and mechanism. Both the sorption of the Pb(II) and the 4-CP at 283 and 293 K temperatures followed the pseudo-second-order kinetic model. The equilibrium data were analyzed by the Langmuir, Freundlich, Redlich–Peterson and Langmuir–Freundlich models by using the non-linear regression technique. The sorption equilibrium of both of the sorbates at 283 K on the Norit carbon was best described by the Langmuir–Freundlich isotherm equation. At a temperature of 293 K the sorption of the Pb(II) was best described by the Redlich–Peterson isotherm equation ( $R^2 = 0.9951$ ), but in the case of the 4-CP, the sorption was best described by both the Redlich–Peterson and the Freundlich models. The equilibrium of the 4-CP sorption on the granular activated carbon was established faster than the Pb(II) sorption. The presence of the 4-CP slowed down the Pb(II) sorption. The sorption of the 4-CP and the Pb(II) on the granulated activated carbon has a positive character and is favourable. Gibb's free energy showed that the Pb(II) and 4-CP sorption are spontaneous processes. Proposed in this paper is the manner of carrying out the research and the processing of the research results which can be applied to other multicomponent water pollution systems.

*Keywords:* GAC; Lead; Phenols; Sorption

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\* Corresponding author.