# ADSORPTION OF ZINC AND CADMIUM IONS ON ACTIVATED CARBON CLOTH

*B. Babić, S. Milonjić, S. Čupić, M. Polovina, B. Kaluđerović*
*The Vinča Institute of Nuclear Sciences, P.O.Box 522, 11001 Belgrade, Yugoslavia*

## Introduction

Activated carbon cloth (ACC), obtained by carbonization and activation of impregnated viscose rayon cloth, upon activation preserves textile form and characteristics. Due to high specific surface area and microporosity, ACC shows good adsorptive properties both in the gaseous and the liquid phase.

In the present paper, adsorption of zinc and cadmium ions from aqueous solutions on ACC as a function of solution pH and ion concentration was investigated.

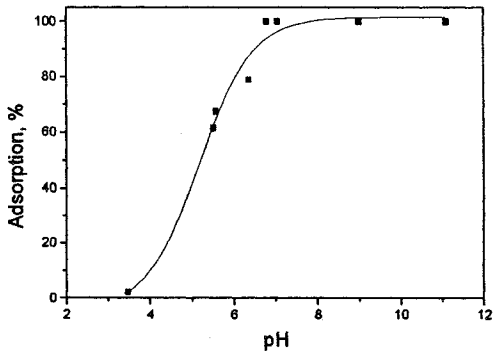
## Experimental

ACC was obtained by a usual procedure [1]. The specific surface area measured by BET method was found to be 1125 $m^2/g$. Samples were washed in distilled water until negative reaction with chloride ions, while the samples for zinc adsorption were washed in a $HNO_3$ solution to remove traces of zinc from impregnants.

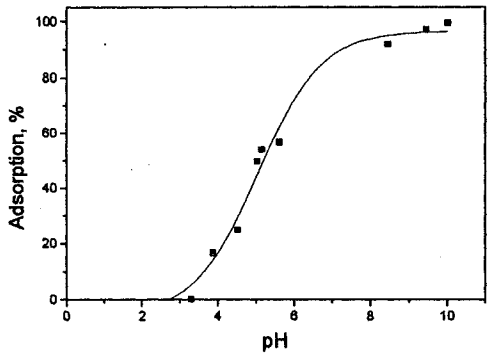
Solutions of different pH values (2-11) and concentrations ($2.5x10^{-6}$-$1x10^{-4}$M), fresh for each experiment, were prepared from nitrates of zinc and cadmium (p.a. quality). 0.1g of ACC was immersed into 40 ml of zinc or cadmium solutions and agitated using a mechanical shaker, at 22±2°C. Concentrations of the ions were measured by atomic absorption spectrometry method. The equilibration time, as determinated in preliminary experiments, was less than 2 hours [2].

## Results and discussion

Effects of pH on the adsorption of zinc and cadmium ions from $1x10^{-5}$M solutions on ACC are presented in Figures 1(a) and 1(b).




(a)




(b)

Figure 1. Percentage of (a) zinc and (b) cadmium adsorption on ACC. $C_{init}=1x10^{-5}mol/dm^3$

Amount of adsorbed ions increases with an increase in pH value of solutions. This may be explained by a mechanism involving hidrolysis of $Zn^{2+}$ and $Cd^{2+}$ to give hydrollysis products.

Adsorption of $Zn^{2+}$ and $Cd^{2+}$ ions as $\log K_d$ vs. pH is presented in Figures 2(a) and 2(b). The distribution coefficiant, $K_d$, was calculated from:

$$K_d = \frac{C_0 - C_e}{C_e}\frac{V}{W} \qquad (1)$$

where $C_0$ and $C_e$ are the initial and the equilibrium metal ions concentrations, respectively, V is the volume of solution and W is the amount of ACC. For the zinc adsorption., Fig. 2(a), slope of $\log K_d$ vs pH is close to 1, which indicates that zinc ions are adsorbed as positive monovalent ion species. The adsorption mechanim of zinc ions on ACC may be represented as:

$$Zn^{2+} + H_2O = ZnOH^+ + H^+ \qquad (2)$$

$$SH + ZnOH^+ = S^-ZnOH^+ + H^+ \qquad (3)$$

where S is a site on the ACC surface. Neglecting activity coefficients, the mass law expression of reaction (3) becomes:

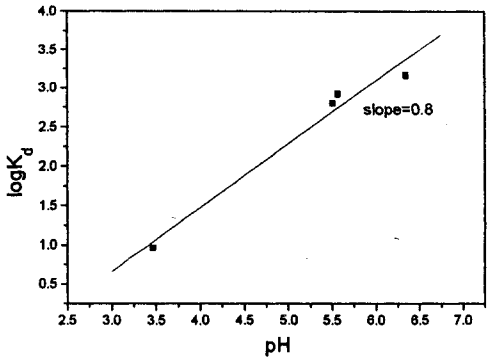
$$K = \frac{\left[S^-ZnOH^+\right]\left[H^+\right]}{\left[SH\right]\left[ZnOH^+\right]} \qquad (4)$$

where K is the equilibrium constant. Using logarithms, Eq.(4) becomes:

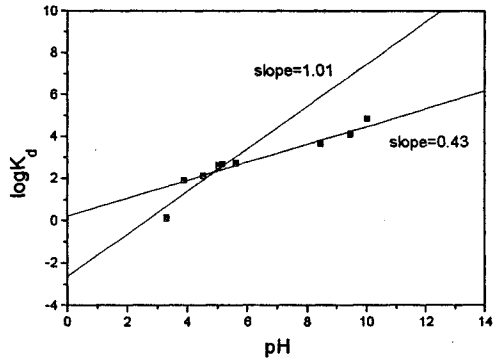
$$log\ K_d = log\ K + log[SH] + pH \qquad (5)$$

Equation (5) shows a linear relationship between $logK_d$ and pH.

Fig. 2(b) shows that at pH< 6 cadmium is adsorbed as positive monovalent ion species (slope =1), and ,at pH> 6, $Cd(OH)_2$ precipitates on the surface of ACC (slope=0.43).




(a)



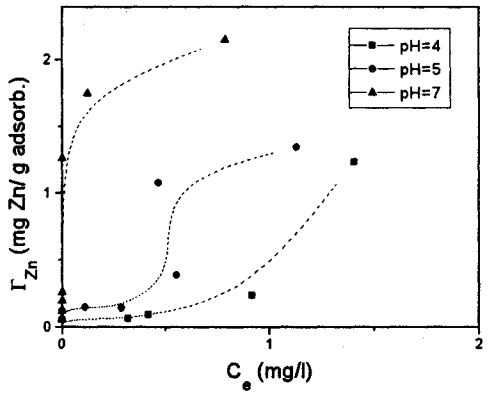

(b)

Figure 2. $LogK_d$ vs pH value for (a) zinc and (b) cadmium adsorption on ACC. $C_{init}=1x10^{-5}mol/dm^3$

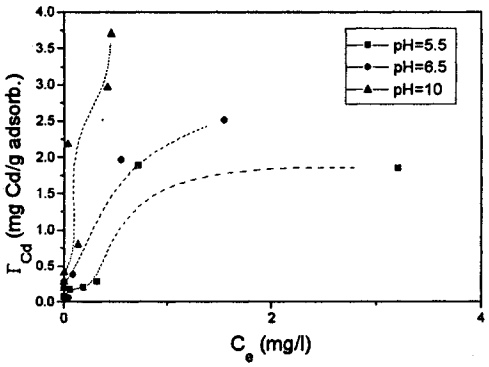
Adsorption isotherms are presented in Figures 3(a) and 3(b). In both cases adsorption increases with an increase in pH values of solution. According to the classification of Giles et al. [3], isotherms at lower pH might be included in the type S4, and those at higher pH values in H1 type. Since the adsorption is expressed as a function of pH and concentrations of the solutions, the shapes of isotherms are very complex.

## Conclusions

Adsorption of zinc and cadmium ions from aqueous solutions on activated carbon cloth were studied. Adsorption isotherms, at different pH values, were obtained.




(a)




(b)

Figure 3. Adsorption isotherms for (a) zinc and (b) cadmium ions on ACC at various pH values.

The amount of adsorbed metal ions increases with an increase in pH value of solutions. The adsorption mechanism of zinc and cadmium ions on activated carbon cloth is proposed.

## Acknowledgments

The work was partially supported by the Scientific Fund of Serbia, Belgrade.

## References

1. Đuričić LJ., Polovina M. and Marinković S., *High Temp.- High Press.*, 1981, 13, 201
2. Babić B., Milonjić S., Čupić S., Polovina M. and Kaluđerović B., *Procc of 40th conf. ETRAN*, Budva, YU, 1996, book 4, pp 501-503
3. Giles C. H., Mac Ewan T. H., Nakhwa S. N. and Smith D. S., *J. Chem. Soc.*, 1960, 3973