Polymers and metal ions adsorption on the surface of biochars obtained from the nettle and sage herbs

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Introduction

Polymers and metal are wide use in the industry. However they are often very toxic and for that reason they should be removed from the water waste. Adsorption is one of the wastewater treatment methods. Biochars are solids obtained from biomass during pyrolysis, they are natural and enviromnetally friendly adsorbents. Main aim of presented studies was to use biochars derived from the nettle herb (NE_B) and the sage herb (SA_B) to adsorbed poly(acrylic acid) (PAA), polyethylenimine (PEI), Cd(II) and As(V) from thier single and binary water solutions.

Methods

Adsorption studies were carried out at pH 3, at 25°C for 24h. The polymers adsorbed amount were determined using the static method based on the change of the adsorbate concentration in the solution before and after the process, using 10ml of suspension containing $0.001 mol/dm^3$ NaCl (supporting electrolyte), 100ppm of polymer and 0.1g of solid. The PAA and PEI concentrations were measured using UV–Vis spectrophotometer Carry 100 (Varian). Polyethylenimine was determined based on its reaction with $CuCl_2$ resulting in formation of white-coloured complex absorbing light at wavelength 285 nm [1]. In turn, the poly(acrylic acid) concentration was determined based on its reaction with hyamine 1622, which gives white-coloured complex absorbing light at wavelength 500nm [2]. The metals adsorbed amount were examined using 15ml of suspension containing $0.001 mol/dm^3$ NaCl (supporting electrolyte), 100ppm of polymer and 0.15g of solid. Cd(II) and As(V) concentration were determined using Inductively Coupled Plasma-Optical Emission Spectrometry (iCAP™ 7200 ICP-OES analyzer, Thermo Scientific).
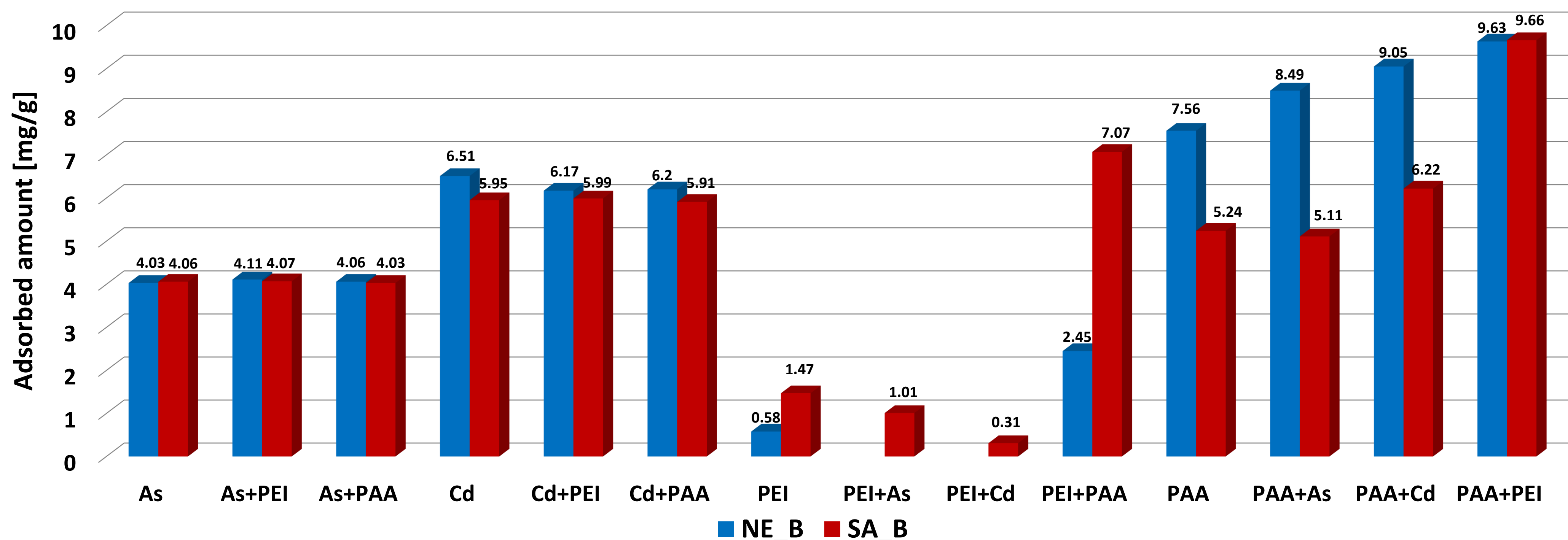
Results

Fig. 1. Cd(II), As(V), polyethylenimine and poly(acrylic acid) adsorber amount from single and binary solution onto NE_B and SA_B surface (pH 3, C_0=100ppm).

Conclusions

- Maximum adsorber amount are: As(V) – 4.11mg/g (NE_B+As+PEI), Cd(II) – 6.51mg/g (NE_B+Cd), PEI – 7.07mg/g (SA_B+PEI+PAA), PAA – 9.66mg/g (SA_B+PAA+PEI).
- Presence of polymers has no significant effect on metals adsorption.
- PAA have positive influence on PEI adsorber amout on both biochars surface.
- Metals adsorbed amount are similiar onto both biochars surface, polyethyelenimine is more efficient adsorbed onto SA_B surface and poly(acrylic acid) onto NE_B.

References

1. Patkowski, J., Myśliwiec, D., Chibowski, S. (2016). Validation of a new method for spectrophotometric determination of polyethylenimine. International Journal of Polymer Analysis and Characterization, 21(6).
2. Crummett, W. B., Hummel, R. A. (1963). The determination of traces of polyacrylamides in water, Journal of the American Water Works Association 1, 55(2), 209–219.