

# Comparison of adsorption properties of high-carbon fly ash precursor, zeolite-carbon composite and pure zeolite relative to heavy metal ions



Wiśniewska M. <sup>1,\*</sup>, Medykowska M. <sup>1</sup>, Szewczuk-Karpisz K. <sup>2</sup>, Panek R. <sup>3</sup>

<sup>1</sup>Department of Radiochemistry and Environmental Chemistry, Institute of Chemical Sciences, Faculty of Chemistry, Maria Curie-Skłodowska University in Lublin, M. Curie-Skłodowska Sq. 3, 20-031 Lublin, Poland, e-mail: wisniewska@hektor.umcs.lublin.pl

<sup>2</sup>Institute of Agrophysics, Polish Academy of Sciences, Doświadczalna 4, 20-290 Lublin, Poland,

<sup>3</sup>Department of Geotechnical Engineering, Faculty of Civil Engineering and Architecture, Lublin University of Technology, Nadbystrzycka 40, 20-618 Lublin, Poland.

The adsorption properties of HiC FA (high carbon fly ash), Na-P1 zeolite and its Na-P1(C) carbon composite in relation to Zn(II) and Pb(II) ions were examined. These solids were characterized using the following techniques: XRD, SEM-EDS, TEM, porosimetry, SLS, electrophoresis and potentiometric titration. The heavy metal concentration was determined by applying ICP-OES spectroscopy. Adsorption/desorption and electrokinetic measurements were performed in the single and mixed adsorbate systems. The molecular sieving effect is responsible for higher adsorption of Pb(II) ions. The largest adsorption capacity relative to Pb(II) ions was observed for pure zeolite (407 mg/g). In mixed adsorbate systems, there is a significant reduction in the amount of adsorbed Zn(II) ions, whereas the amount of adsorbed Pb(II) ions is practically not affected.

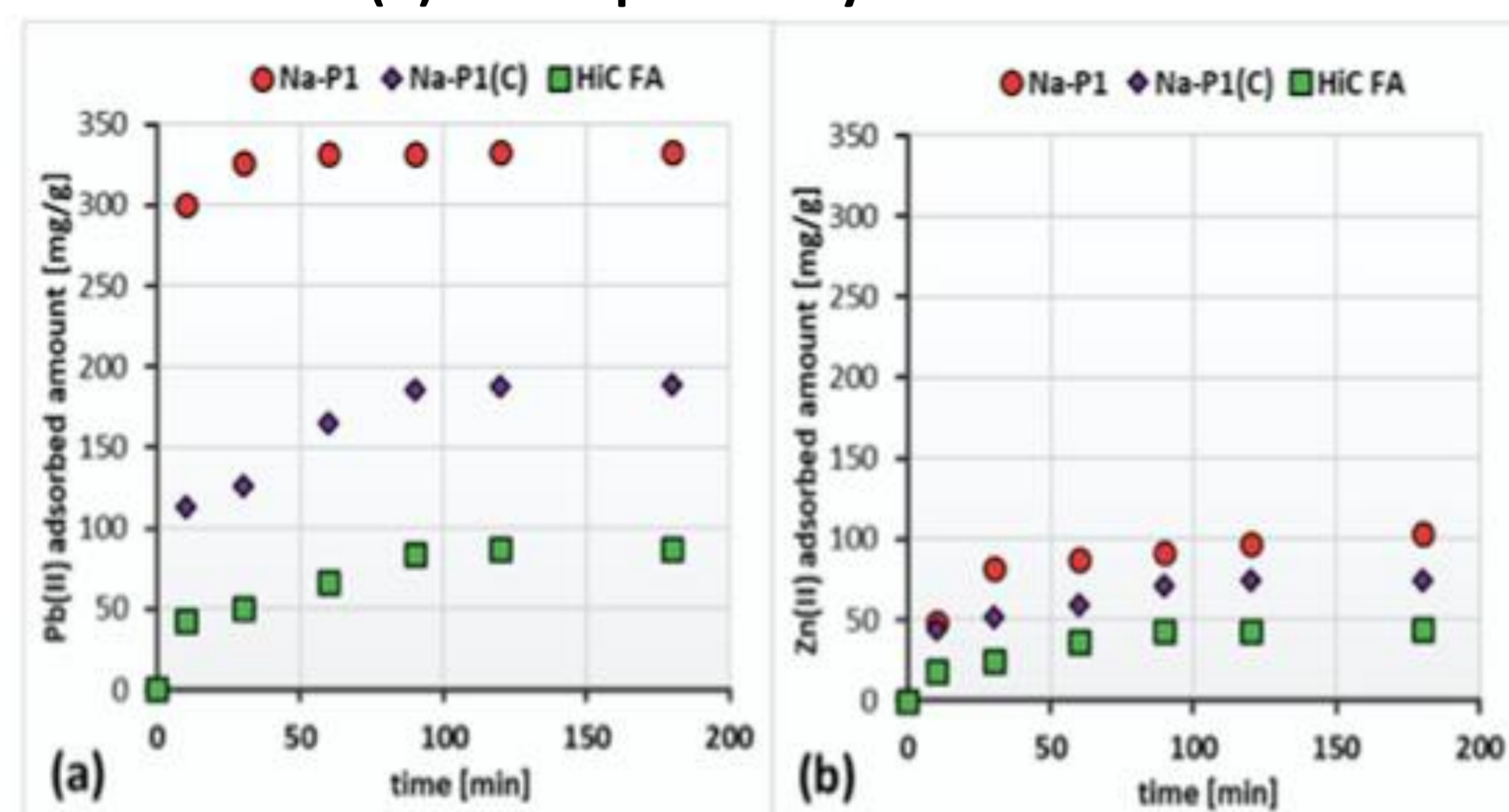


Figure 1. Adsorbed amounts of Pb(II) (a) and Zn(II) (b) on the HiC FA, Na-P1 and Na-P1(C) surfaces in the single systems as a function of time, at pH 5.

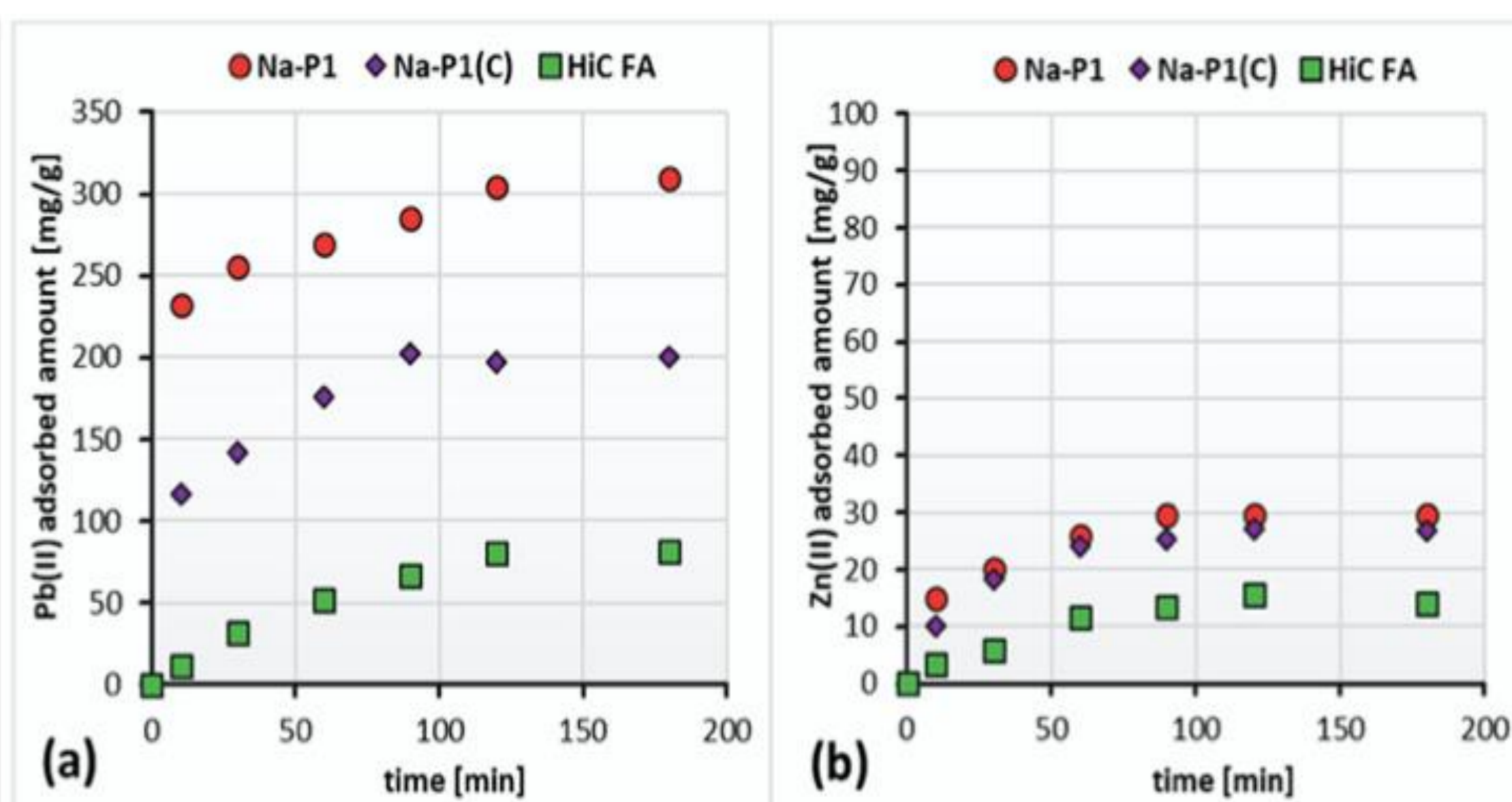


Figure 2. Adsorbed amounts of Pb(II) (a) and Zn(II) (b) on the HiC FA, Na-P1 and Na-P1(C) surfaces in the mixed systems as a function of time, at pH 5.

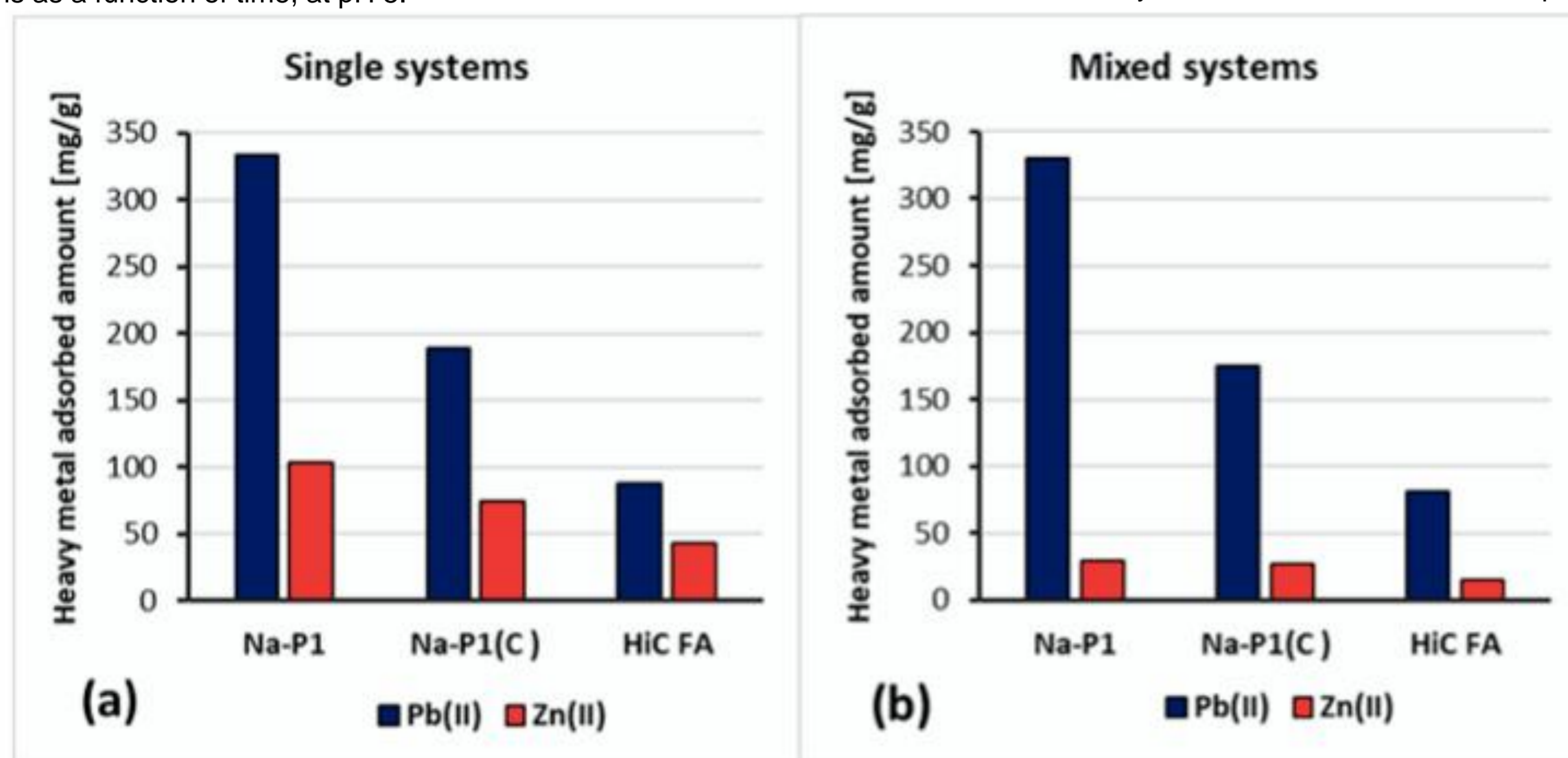


Figure 3. Amounts of Pb(II) and Zn(II) ions adsorbed on the HiC FA, Na-P1 and Na-P1(C) surfaces in the single (a) and mixed (b) systems at pH 5.

**Conclusions:** Pure zeolite Na-P1 and its carbon composite Na-P1(C) were obtained from HiC FA waste material. The most effective adsorption of studied heavy metal ions was shown by pure zeolite (407.34 mg/g for Pb(II)), whereas the least effective was high carbon fly ash (78.67 mg/g for Pb(II)). Lead(II) ions were absorbed in larger amounts than zinc(II) ones and their bonding occurs fast. Based on the desorption studies, it can be concluded that the used adsorbents can be effectively regenerated with hydrochloric acid.

#### References:

1. Sahoo, T.R.; Prelot, B. Adsorption processes for the removal of contaminants from wastewater. *Nanomater. Detect. Remov. Wastewater Pollut.* 2020, 161–222.

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