LEACHING BEHAVIOUR OF NATURAL "LOW COST" SORBENTS SATURATED WITH ZINC AND COPPER

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ABSTRACT

The leachability of zinc and copper from natural *low-cost* sorbents through saturation and leaching study was examined in order to investigate their possible application as materials for permeable reactive barrier (PRB). Examined *low cost* sorbents were natural and iron-modified zeolite (IMZ), apatite, concentrated apatite, kaolin and raw bentonite. The highest saturation ability towards zinc and copper was detected with raw bentonite and IMZ. Leaching of zinc and copper has been confirmed from all saturated sorbents at pH=2.94, while at pH=6.46 was not detected. This indicates that among investigated sorbents, raw bentonite and IMZ are the most promising materials for removal of zinc and copper in PRB.

Keywords: *low-cost* sorbent, leachability, permeable reactive barrier, zinc, copper

INTRODUCTION

Natural *low-cost* sorbents such as zeolite, clay and apatite have great potential as materials for *in situ* remediation of contaminated groundwater using permeable reactive barrier (PRB). However, retention strength of sorbed ions in saturated sorbents is very important in application of these materials as PRB. Therefore, the present study is focused on investigation of leaching properties of the natural and iron-modified zeolite (NZ and IMZ), apatite, concentrated apatite, kaolin and raw bentonite saturated with copper and zinc.

EXPERIMENTAL

Materials: Natural zeolite (NZ) was supplied from Zlatokop deposit in Vranjska Banja (Serbia), bentonite was originated from Šipovo deposit (Bosnia), apatite from ore deposit Lisina, near Bosilegrad (Serbia), while kaolin was obtained from plant for production of quartz sand in Rgotina (Serbia). Iron-modified zeolite (IMZ) and concentrate apatite was prepared from original zeolite and apatite, respectively, according to well-known procedures.[1,2]

Saturation experiment: The saturation of sorbents with zinc and copper was examined from simulated wastewater with the similar initial metal concentrations, c_o(Zn) = 10.107 mmol/l and c_o(Cu) = 10.083 mmol/l, at S/L ratio 10 g/L, during 48 hours at room temperature, using batch mode. As our previous experiment showed that copper in system of Cu-IMZ is precipitated, thus the pH values of initial copper solutions in this system were adjusted at pH=2.52.[3] During all experiments, pH values were recorded, and concentrations of heavy metals were determined before and after experiment.

Leaching experiment: The leaching experiment included evaluation of metal retained by the saturated sorbents in ultrapure water with adjusted pH values at 2.94 and 6.46, at S/L ratio 10

g/L, during 24 hours at room temperature. During experiments, pH values of solutions were recorded, and concentrations of heavy metals after experiment were determined.

RESULTS AND DISCUSSION

Saturation experiment

Time-dependent saturation experiment is monitored by pH values of solutions in Fig. 1, while amounts of loaded heavy metals on different sorbents are given in Fig. 2.

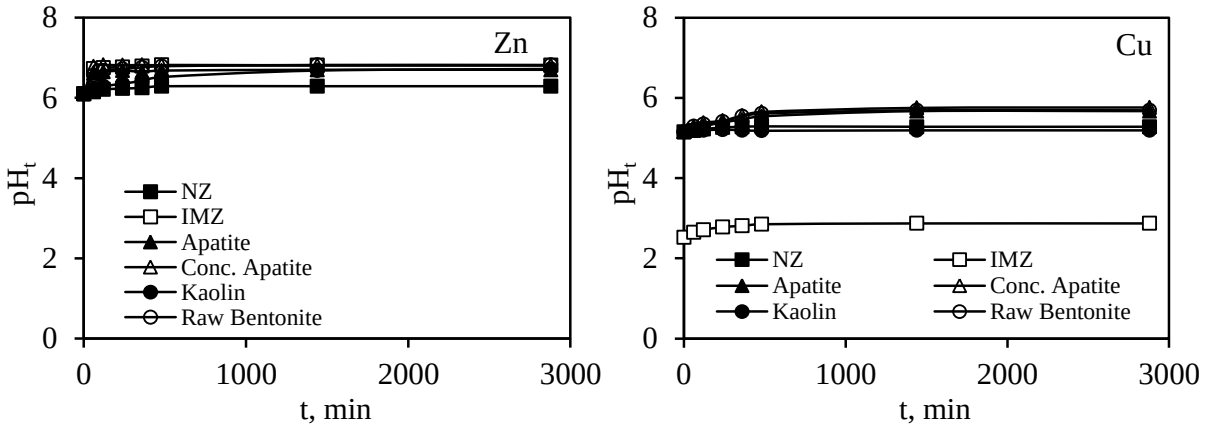

Fig. 1. pH values of solution during saturation experiment.

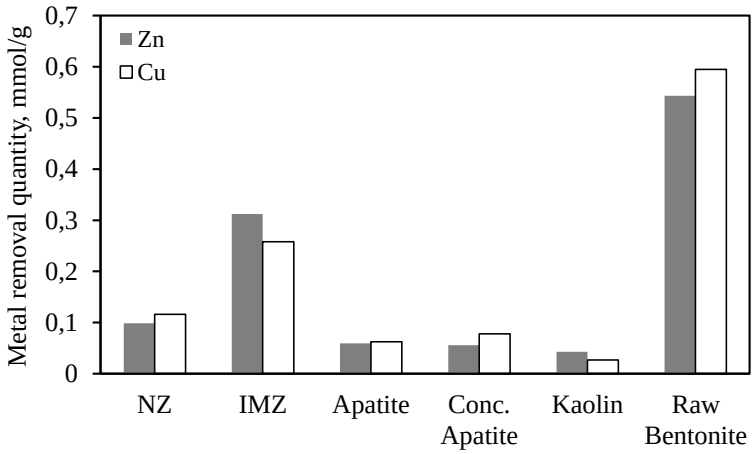

Fig. 2. Amount of loaded zinc and copper on different sorbents.

Slightly increase of pH of solutions in all examined systems were evident, which is connected with decrease of metal concentration in solution and diminishing influence of hydrolyse reaction of metal ions. Almost similar amounts of zinc and copper were sorbed onto investigated sorbents, confirming their similar affinities.

The highest sorbed amount of heavy metals was detected with raw bentonite, followed by IMZ, while lower amount was sorbed by NZ, conc. apatite and apatite. The lowest amount of sorbed heavy metals was observed for kaolin.

Leaching experiment

Time-dependent leaching experiment was followed by measuring the pH values of solutions (Figs. 3 and 4), while leaching of zinc and copper from metal-saturated sorbents in ultrapure water solution of pH=2.94 and 6.46, is given in Fig. 5.

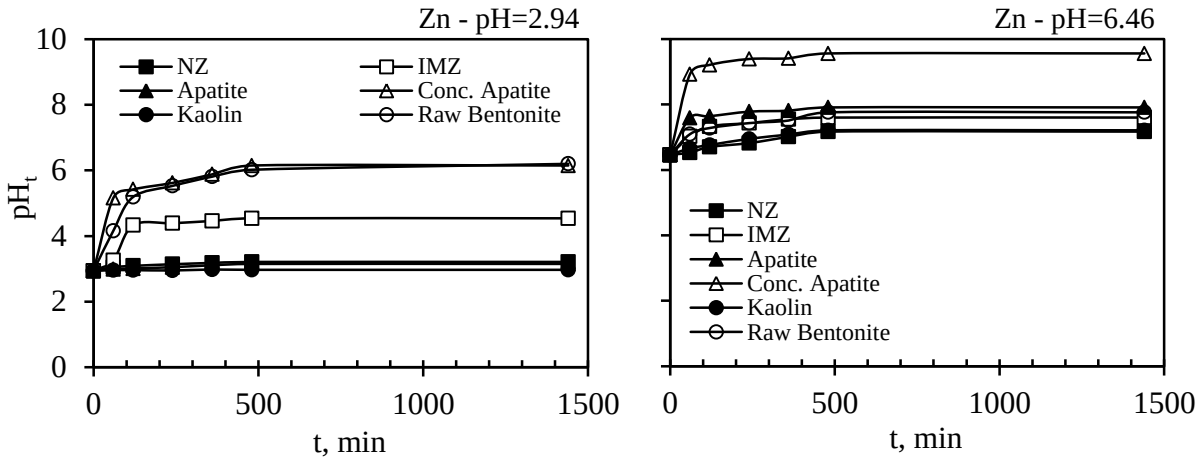

Fig. 3. pH values of solution during Zn leaching experiment from solution of pH=2.94 and 6.46.

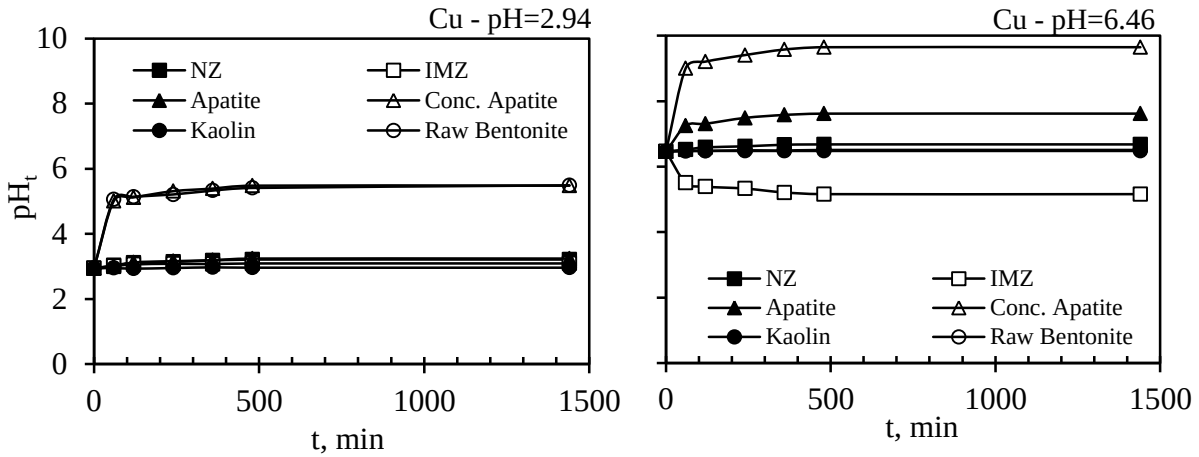

Fig. 4. pH values of solution during Zn leaching experiment from solution of pH=2.94 and 6.46.

Fig. 3 shows that at pH_o=2.94, slight increase of pH values is evident in system of metal ions with IMZ, conc. apatite and raw bentonite. At pH_o=6.46, slight increase is evident for all examined system, and is most pronounced for IMZ.

At pH_o=6.46, leaching of zinc and copper is not recorded. At pH_o=2.94 leaching of Zn and Cu is evident for all examined sorbents except leaching of Zn from kaolin. Lower pH values encourage competition of H^+ ions, thus leaching of Zn and Cu was more pronounced. Absence

of zinc leaching from kaolin is a consequence of lower amount of sorbed Zn during saturation experiment.

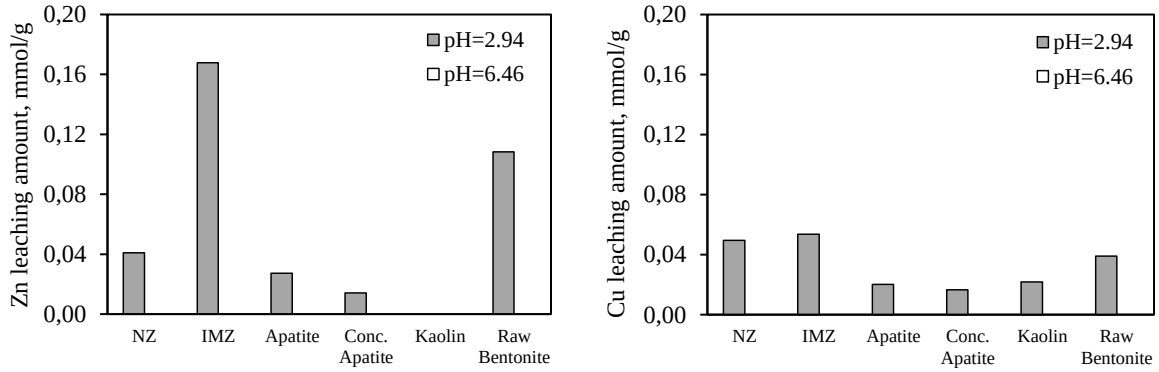

Fig. 5. Leaching amount of zinc and copper from saturated sorbents in solution of pH=2.94 and 6.46.

CONCLUSION

Saturation and leaching of zinc and copper at pH_o=6.07 for all examined sorbents are performed in slightly acidic to neutral solution, indicating their suitability for *in situ* application. Due to presence of higher amounts of H^+ ions at pH=2.94, leaching of Zn and Cu is recorded from all saturated sorbents. Among examined sorbents, raw bentonite and IMZ showed the highest sorption of zinc and copper confirming their potential as materials in PBR. However, further experiments should be focused on the investigation of hydraulic properties, satisfactory mechanical properties for safe performance, in order to ensure a smooth flow of contaminated groundwater through the barrier without disturbing the natural flow.

Acknowledgement

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