Bio-material based adsorbent for radioactive copper separation

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Abstract

Radioactive isotopes have been studied because they have properties suitable for the diagnosis and treatment of diseases. Radioactive copper is a promising nuclide that can be used as a radiopharmaceutical because it can simultaneously perform diagnosis and treatment. ^{64}Cu is a beta and positron emitter with a half-life of 12.7 hours and is used for positron emission tomography (PET) imaging and radiation therapy, and ^{67}Cu has a half-life of 61.8 hours, enabling targeted radiotherapy and single photon emission computed tomography (SPECT) imaging. In this study, an absorbent for radioactive isotopes separation was synthesized using Pectin and Chitosan, which are environmentally friendly, biodegradable, biocompatible, inexpensive and available in large quantities. It was prepared by mixing pectin and chitosan in various ratios, and finally a bead form of 4:6, which is a stable ratio of durability and acid resistance, was obtained. The physicochemical properties of the synthesized PC beads were evaluated through FTIR, SEM, and EDS, and the structural properties formed a mesoporous structure with an average diameter of about 1.5 mm. As a result of adsorption experiments on Co, Ni, Cu, Zn and Ga for the adsorption experiment, selective adsorption on Cu was performed. In order to confirm the maximum adsorption of Cu, it was carried out under various conditions (reaction time, pH, concentration), and it was confirmed that the Cu selective adsorption of PC beads was improved at pH 2. Based on the research results, the possibility of using PC beads as an adsorbent for radioactive copper separation.

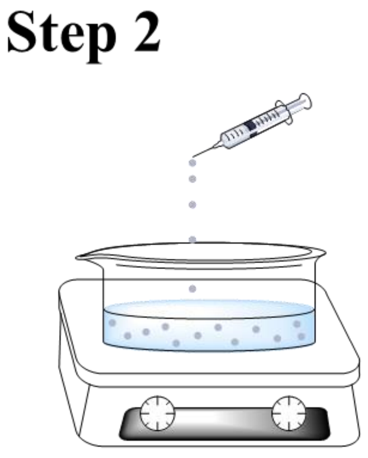
Methods

Step 1

- Pectin 100%
- Pectin + Chitosan 8:2
- Pectin + Chitosan 6:4
- Pectin + Chitosan 4:6
- Pectin + Chitosan 2:8
- Chitosan 100%

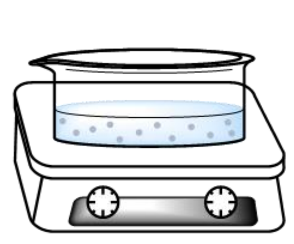
(total weight : 3g)

Step 2



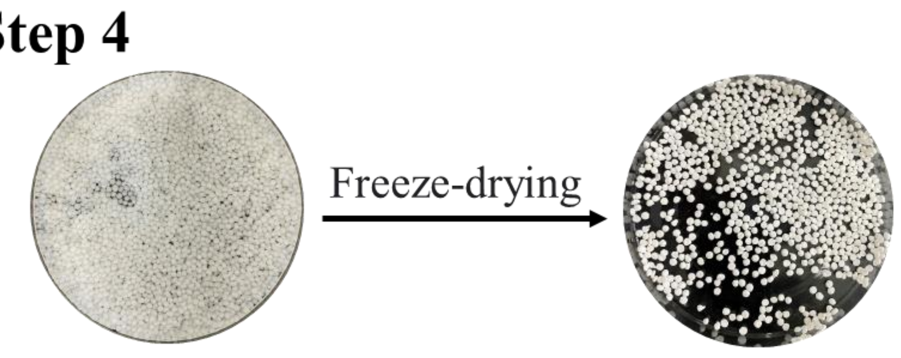
Drop-wise

Step 3



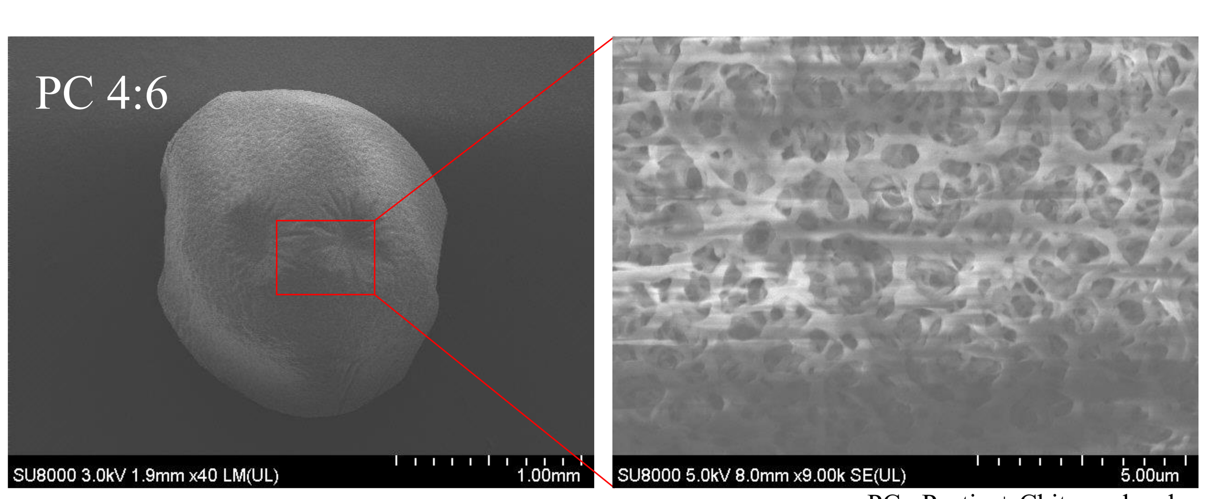
Crosslinking & Rinse

Step 4

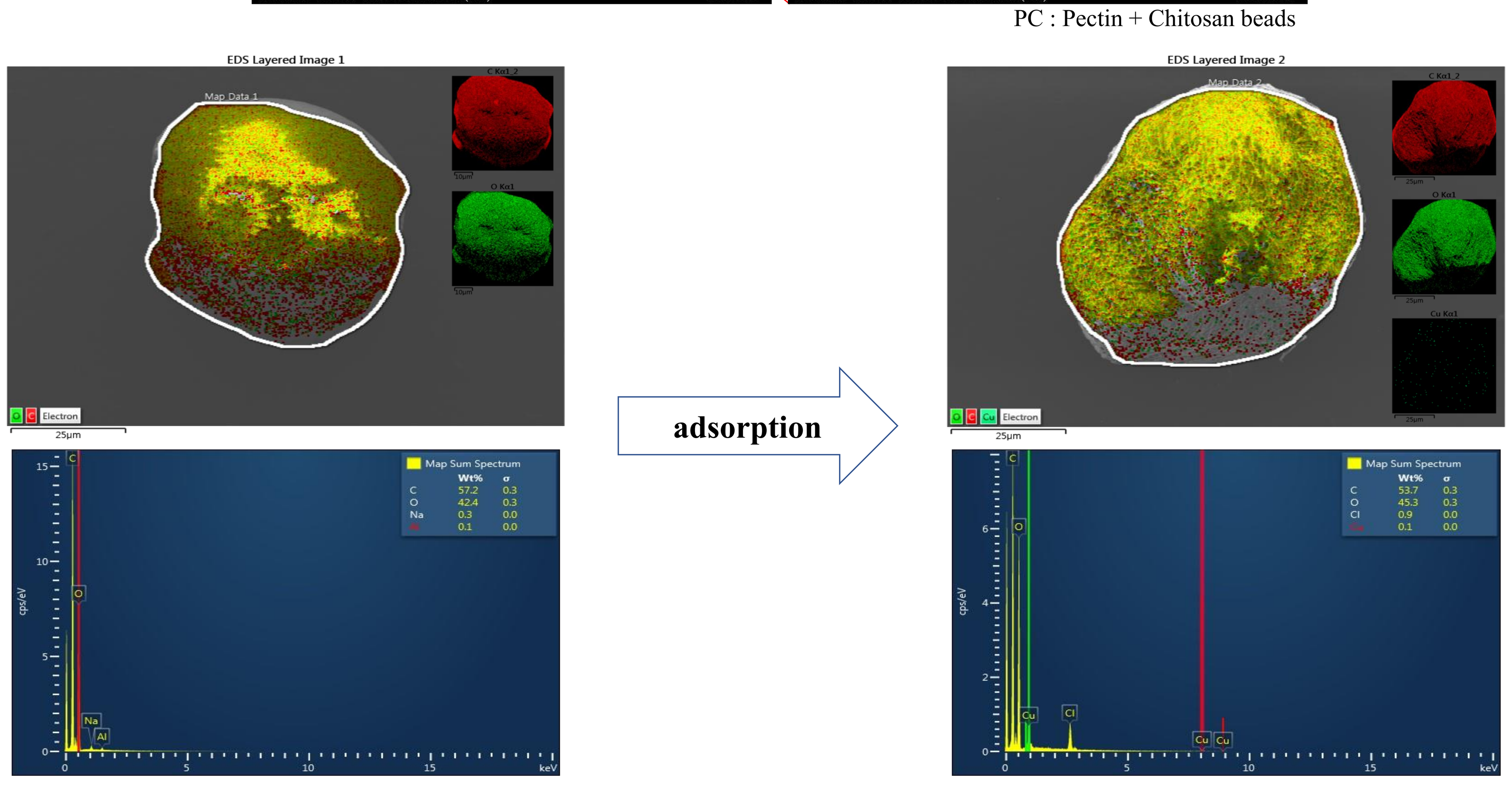


Characterization

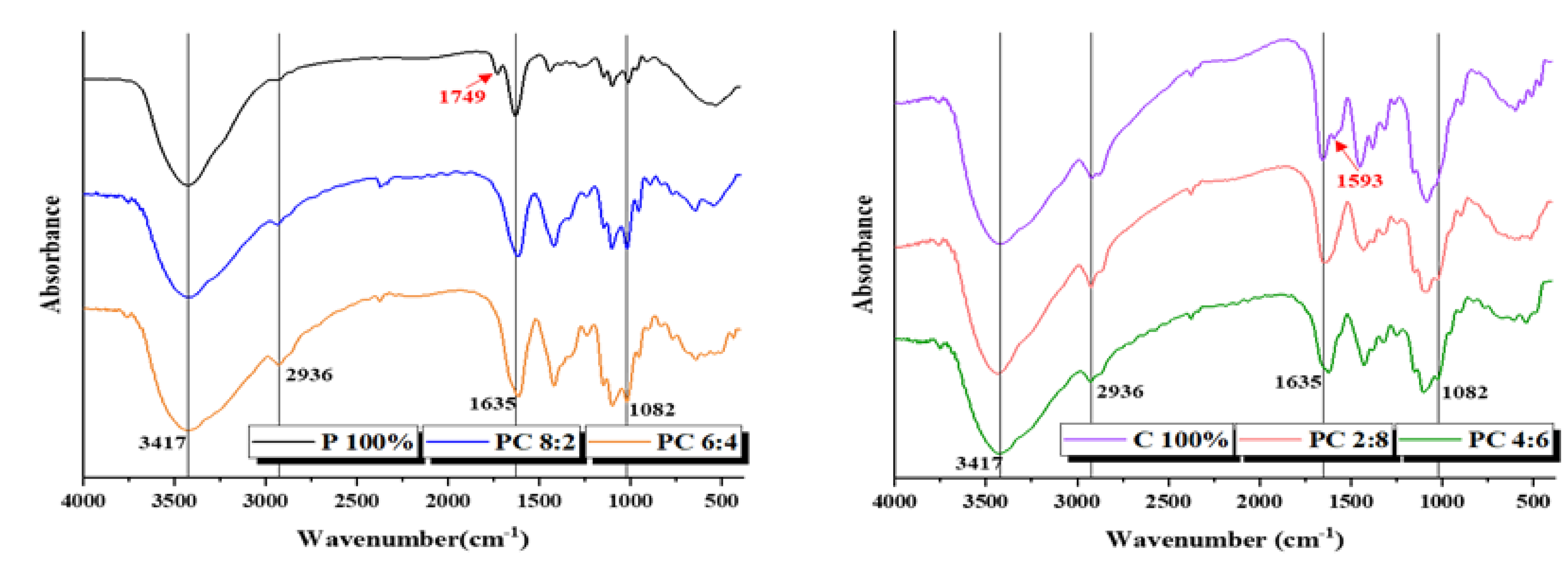
▶ SEM & EDS (diameter of beads and elements)



PC : Pectin + Chitosan beads

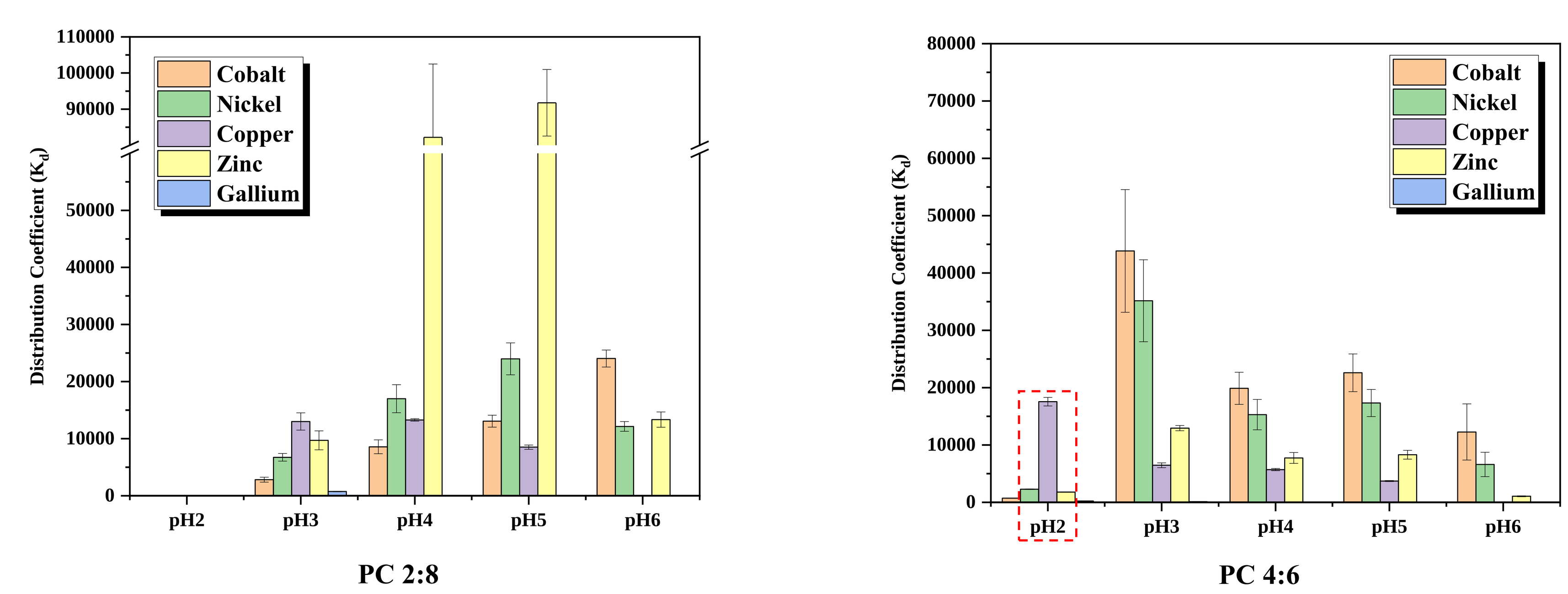


▶ FT-IR

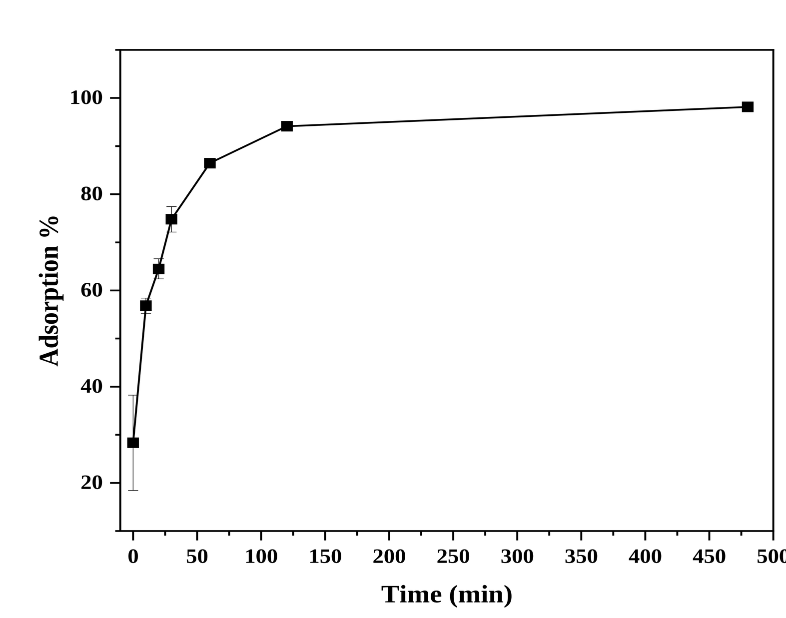


▶ Distribution coefficient : K_d

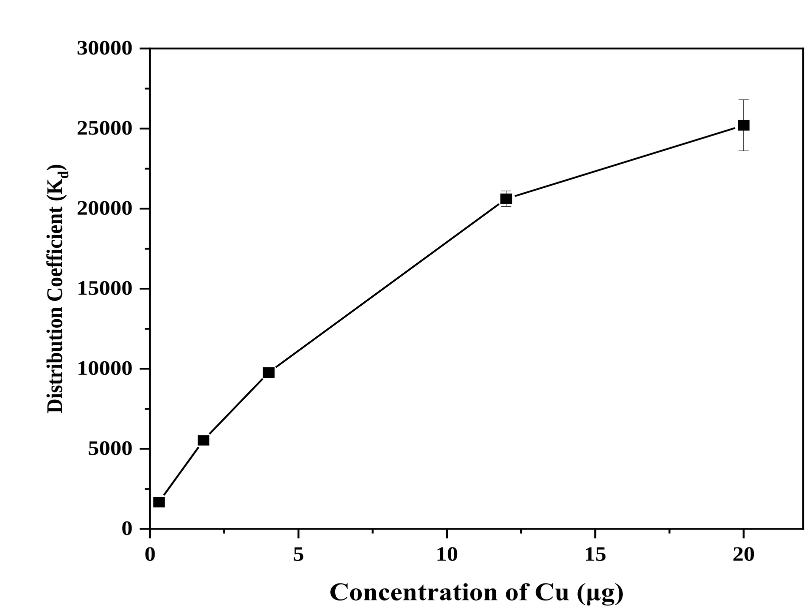
► Comparison of adsorption according to pH



► Adsorption according to reaction time (PC 4:6)



► Adsorption according to concentration of copper



Conclusion

In this study, an adsorbent with a diameter of 1.5 mm was prepared using Pectin and Chitosan. As a result of SEM analysis of the adsorbent, it showed a porous shape on the surface, and functional groups (carboxy group, amine group, hydroxyl group) capable of binding to metal ions were confirmed through FT-IR measurement. Under the condition of pH 2, Cu among Co, Ni, Cu, Zn, and Ga was selectively adsorbed, and the reaction time was within 2 hours. Therefore, this study is expected to have the possibility of self-separation without dependence on technology and the possibility of use in the separation process of radioactive copper (^{64}Cu, ^{67}Cu) using a Bio-material based adsorbent.

Reference

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