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| 学位（専攻分野） | 博士（工学） |
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| 学位記授与の要件 | 学位規則第 4 条第 1 項該当 |
| 学位論文題目 | Adsorptive removal of nitrate and phosphate ions from aqueous solution with nitrogen-doped carbonaceous materials（窒素ドーピング炭素材料による水溶液中からの硝酸・リン酸イオンの吸着除去） |
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論 文 内 容 の 要 旨

Nitrate and phosphate ions are widely present in water systems around the world. Such water pollution not only leads to eutrophication but also poses health risks to humans. This study aimed to develop efficient carbonaceous adsorbents to address this type of water pollution. Nitrogen-doped surface modification method was applied during the preparation of the adsorbents to enhance the adsorption capacities for nitrate and phosphate ions. Firstly, the adsorption performance of the developed glucose-based adsorbent for nitrate ions was studied in detail using both batch adsorption and fixed-bed column adsorption modes. The results showed that the maximum adsorption capacity (X_m) predicted by the Langmuir isotherm model was 1.58 mmol/g at pH 3.0, indicating excellent adsorption performance. It also exhibited significant adsorption efficiency in the fixed-bed column adsorption mode. Subsequently, the adsorption performance of the glucose-based adsorbent for phosphate ions was investigated. It demonstrated high adsorption capacity (Q_e) for phosphate ions in acidic solution ($\text{pH} < 4.5$), overcoming the limitation of commercial anion exchange resin HP555 which cannot be used effectively in acidic environment. Finally, the transition of the preparation materials for the glucose-based adsorbent from dual nitrogen sources to a single nitrogen source was successfully achieved, while also reducing the required preparation temperature by 100° C. Meanwhile, the Q_e for nitrate adsorption reached as high as 0.76 mmol/g in a solution at pH 5.0.