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論 文 要 旨

THESIS SUMMARY

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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

The major challenge of adsorbent application in water/wastewater treatment is competitive adsorption with non-target pollutants (e.g., natural organic matter, NOM) and the problem of adsorbent's porous blockage, resulting the adsorption decrease **(Chapter 1)**. Therefore, to overcome this adverse effect, layered double hydroxide (LDH) materials are considered to be the efficient adsorbent as its high specific surface area, large porosity, and large number of active sites. Moreover, the benefit of the layer material is the active sites in interlayer are not completely blocked by any substance due to flexibility of many interlayer channels. Literature review **(Chapter 2)** identified two research gaps: (1) a few studies have reported synthesize magnetic-layered double hydroxide (MLDH) with the one step-solvothermal method which is convenient and less time-consuming. and (2) no study has reported the selective adsorption efficiency of LDH in the presence of NOM or real wastewater. Specific objectives are (1) to evaluate the potential benefits of interlayer space and surface charge of LDHs in antibiotic removal under NOMs and water matric conditions, (2) to synthesize magnetic-layered double hydroxide (MLDH) and optimize if for antibiotic adsorption, and (3) to investigate the selective adsorption efficiency MLDH adsorbents for antibiotic in the presence of NOMs.

MLDH was successfully prepared by a one-step thermal method which is convenient and less time-consuming compared to the conventional two-step method **(Chapter 3)**. The XRD analysis confirmed that MLDH contained the typical structure of LDH similar to MLDH synthesized by conventional method (C-MLDH). In the observation with SEM, the appearance of MLDH differed from C-MLDH, the separated grains of MLDH were smaller than C-MLDH, which was a possible reason for the higher efficiency of MLDH for the OTC adsorption. Among the four different Fe:Mg ratios of MLDH, which were set the ratios at 1:1, 1:2, 1:3 and 1:4 and were named as MLDH11, MLDH12 and so forth, MLDH13 showed maximum adsorption efficiency of Oxytetracycline (OTC) (217 mg/g) under pH 7, which was characterized by monolayer chemisorption. In addition, the experimental results showed that the OTC adsorption of MLDH was only slightly affected by the competing anions (decreased by 2.0% - 4.1%), except for carbonate ion, indicating that MLDH could be potentially applied for wastewater treatment such as hospital wastewater containing large amount of nitrate ion.

NOMs slightly affect to OTC adsorption on MLDHs **(Chapter 4)** because of the competitive

adsorption. The selectivity (α) value of all MLDHs indicated high selective adsorption ability, except MLDH14. It is because its large interlayer space of MLDH14 allowed wide range of OMPs to intercalate resulting the large molecule of NOM was removed instead of OTC in mixture solution. In order to further investigate the size selectivity of MLDH, size exclusion analysis revealed the proportion of removed OTC and NOMs in each molecular weight (MW). The size-selectivity of MLDH11, MLDH12, MLDH13, and MLDH14 were in ranges of <100Da, 100 Da - 300 Da, 300 - 600 Da, and >1000 Da, respectively. All NOM conditions did not significantly affect the size exclusion ability of MLDHs, which means that the removal range of each MLDH were similar in every mixture condition based on the size of adsorbed pollutant molecules. MLDH13 mainly adsorb organic pollutant with size in range of 300 - 600 Da which is the average MW of antibiotic pollutant containing in natural water and wastewater. Those results clarified the adsorption ability of MLDH and extended the benefit of interlayer space and concluded that the intercalating layers of LDH not only increase its specific surface area but also serve as a sieve for OMPs separation and removal.

The potential selectivity of antibiotics by MLDH and other LDHs composite was also investigated for the condition with NOMs for predicting LDHs performance **(Chapter 5)**. The maximum selective efficiency of MLDH for OTC removal in the condition of presence of NOMs was estimated as its potential for further applications. The results suggested that MLDH13 could be applied in the condition of OTC initial concentration lower than 150 µmol/L for the high OTC selective adsorption in the presence of NOMs. MLDH13 showed the possibility to remove 59% of common antibiotic by the size exclusion. The molecular weight distribution of NOMs affected the relative sensitivity (range: 0-1), which indicated the potential selectivity for removing coexisting antibiotics. Moreover, the antibiotic component ratio in wastewater also affected the relative sensitivity of LDH. As result, the relative sensitivity of LDHs was in the range of 0.4 - 0.6, indicating their possibility for antibiotic removal from water containing a different type of NOM.

Overall, the selective adsorption of antibiotic in water containing dissolved natural organic matter was investigated using MLDH materials. This study presented the benefits of the limited interlayer space of MLDHs, which offers the selectivity for OMP in water, and indicated the potential applicability of MLDH in water/wastewater treatment for antibiotic removal **(Chapter 6)**.