Adsorption Properties of Phenolic Compounds by Organic Sulfonic Modified Layered Double Hydroxides

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Layered double hydroxides (LDH) can impart various functions by modifying organic anions between layers[1]. Therefore, in order to further enhance the functionality of LDH, we focused on the CH / π interaction that occurs between the organic anion modified to LDH and the aromatic organic compound to be captured. By utilizing the strength of this interaction, it can be expected that the target organic resources could be selectively recovered from the wastewater. In this study, we synthesized Cu-Al LDH with linear 1-octane sulfonic acid anion (OS^-) and cyclic sulfonated-β-cyclodextrin anion (SCD^{13-}) with hydrophobic cavities, and investigated the adsorption characteristics of *m*-aminophenol (AP) and *m*-nitrophenol (NP).

Using the coprecipitation method, each Cu-Al LDH (Cu/Al molar ratio is 3:1) was synthesized with the stoichiometric ratio of OS and SCD according to the chemical reaction formulas being 2.0. The obtained substance was phase-identified by X-ray diffraction, and its composition was analyzed by ICP-AES and TOC. Each Cu-Al LDH was added to AP and NP solutions (an initial concentration is 8 mM), and shaken at 20°C for 2 hours. After solid-liquid separation, the concentration of phenol in the liquid phase was measured.

Table 1 Chemical composition of ach Cu-Al LDH

Sample	Cu/Al[-]	OS or SCD[wt%]	OS or SCD /Al[-]
OS•Cu-Al LDH	3.08	33.7	1.25
SCD•Cu-Al LDH	3.16	29.6	0.0984

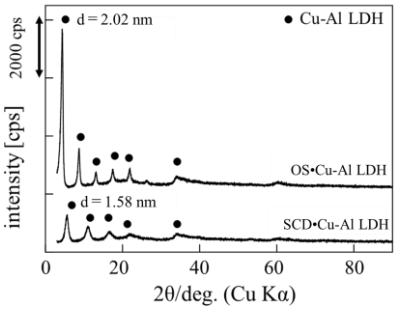

Fig 1 XRD patterns of each Cu-Al LDH

Table 1 and Fig. 1 show the analysis results of each Cu-Al LDH. It was found that each Cu-Al LDH contained OS and SCD. Moreover, it was confirmed that each Cu-Al LDH had an LDH structure. Compared with NO_3•Cu-Al LDH (layer spacing d=0.90 nm), the layer spacing was increased in each Cu-Al LDH, confirming intercalation between OS and SCD layers. Fig 2 shows the adsorption ratio of AP and NP by each Cu-Al LDH. With OS•Cu-Al LDH, NP was selectively adsorbed by hydrophobic interaction. On the other hand, in SCD•Cu-Al LDH, AP having a higher electron density of aromatic rings had a higher adsorption ratio than NP. Since SCD has more CH groups than OS and is cyclic, and AP is included, CH/π interaction works bidirectionally, and it is considered that adsorption selectivity is caused by the difference in electron density of aromatic rings.

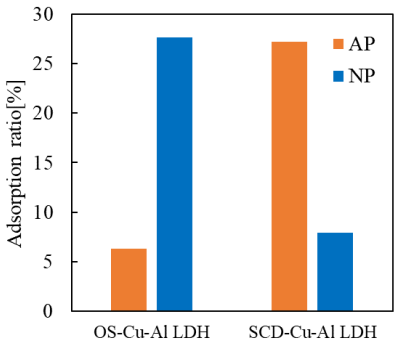

Fig 2 Adsorption ratio of AP and NP by each Cu-Al LDH

1） T. Kameda, T. Uchiyama, T. Yoshioka, *Fresenius Environ. Bull.*, **26**, 854-858 (2017)