学位論文内容の要旨

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学位論文題名

Influence of Dissolved Organic Matter on the analysis of a solution of anionic surfactant, Dodecylbenzenesulfonate

（陰イオン界面活性剤ドデシルベンゼンスルホン酸溶液
分析に及ぼす溶存有機物の影響）

Every day a billion liters of untreated effluent are released into the soil-water system of our environment from industrial and household cleaning activities. Most of those cleaning agents are detergent, soap, and shampoo based on anionic surfactants such as Dodecylbenzenesulfonate (DBS). The untreated discharge of DBS into the natural water bodies increases pollutant load in the soil–water system, hampers the soil physico-chemical properties, and becomes deadly to micro and macro living entities in the natural ecosystem. Precise measurement of DBS is crucial for understanding its interaction with Dissolved organic matter (DOM) and soils, transport, toxicity, fate, and its application in the soil reclamation.

In this study, we proposed and improved a precise estimation method of DBS using UV/UV-vis spectrometry for the DBS-DOM complex solution. Dissolution characteristics of DOM from the highly humic volcanic ash soil with electrolyte solutions were also investigated.

1. Dissolution of DOM from highly humic volcanic ash soil affected by shaking periods

DOM dissolution from highly humic volcanic ash soil was studied in relation to the agitation period and extractants' nature. DOM removal was found intensified in proportion to the shaking periods. Linear increase of absorbance at 222.5 nm UV 400 nm UV-vis spectra with the increase of shaking periods confirms the increase of benzene group components of DOM in solution and so the dissolution rate of DOM. The extractant of 1 mmol/L NaCl at pH 6.0 was found capable of extracting more DOM

than that of 100 mmol/L NaCl at pH 5.0. The use of 222.5 nm UV and 400 nm UV-vis wavelength are proven efficient as the index for DOM assessment in the aqueous solution.

2. Precise estimation of DBS in aqueous solution containing DOM extracted from soil using UV-spectrometry

DBS can be identified under the UV spectrum of the spectrophotometer by detecting its benzene ring, following conventional UV-spectrometry. However, similar benzene group components of DOM in contaminated water also absorb UV light and falsely measure the excess quantities of DBS. The influence of DOM on the UV absorbance value of the DBS–DOM complex solution can be eliminated by using a linear regression model between 222.5 nm UV and 400 nm UV-vis absorbances from the DBS-free DOM solution. The proposed method is simple, rapid, efficient, requires no reagent, and can be used for precise DBS estimation in soil water, streams, or industrial effluents.

3. Influence of high pH state of DBS and DOM complex solution on the UV-spectrometry of DBS

Conformation of humic substances under alkaline conditions may alter the absorbance characteristics of DOM at higher pH conditions. The accuracy and applicability of the proposed DBS estimation method at lower pH (5.5 and 6.5) and higher pH (12.5) conditions were compared for validation. Spectrometric measurement of DBS for DBS-DOM complex solution in different pH conditions was investigated, measuring the absorbances of 222.5 nm UV and 400 nm UV-vis spectra. The 222.5 nm UV absorbance under higher electrolyte concentration became larger when pH increased; however, the influence decreased with the increase in DBS and DOM concentrations. The UV-vis absorbance at 400 nm decreased when pH increased, owing to the conformational change in DOM. Despite the contrasting trends of the absorbances in 222.5 nm UV and 400 nm UV-vis spectra, the newly developed method was proven to be equally applicable and efficient, even under higher pH conditions.