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論文 / 著書情報
Article / Book Information

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種別(和文)	論文要旨
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（博士課程）
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論 文 要 旨

THESIS SUMMARY

系・コース： Department of, Graduate major in	融合理工学 地球環境共創	系 コース	
学生氏名： Student's Name	Rosamond Rosalie Marigold Setswa Tshumah-Mutingwende		

申請学位（専攻分野）： Academic Degree Requested	博士 Doctor of （ 工学 ）
指導教員（主）： Academic Supervisor(main)	高橋 史武
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要旨（英文 800 語程度）
Thesis Summary (approx.800 English Words)

This thesis is comprised of the following chapters. Chapter 1 is the introductory chapter and it gives a general overview of the scope of the project, an outline of the problem statement together with the motivation for the research. A thorough literature review together with the research gaps are given. The objectives of this study are also outlined in this chapter. In chapter 2, the effect of pH, Hg0 droplet specific surface area and agitation rate; hence, Reynold number (Re) on the Hg0 dissolution rate coefficient was investigated. Due to the tendency of Hg0 droplets to settle in bottom sediments and sediment-water interfaces which are usually poorly-lit to dark environments, the dissolution tests were conducted in a 'dark chamber'. Laboratory investigations revealed that an increase in medium pH resulted in a decrease in the dissolution rate, whereas, a large Hg0 droplet specific surface area (SSA) and high Reynolds number (Re) resulted in a faster dissolution. A multivariate first order dissolution model of the form: was proposed (adjusted R2 = 0.99). The Breusch-Pagan and White heteroscedasticity tests for error terms revealed that the model residuals are homoscedastic at the 5% significance level. Parameter sensitivity analysis suggests that slow Hg0 dissolution in aquatic systems might mask emerging environmental risk of Hg. Even after Hg0 use in ASGM is banned, Hg0 dissolution and following contamination will continue for about 40 years or longer owing to previously discharged Hg0 droplets. In chapter 3, the effect of humic substances on mercury dissolution is presented. Owing to the abundance of humic substances in freshwaters, their tendency to interact with Hg species, thus influencing different aspects of the Hg biogeochemical cycle such as solubility, toxicity and speciation; their effect on the Hg0 dissolution rate coefficient was investigated. Since fulvic acids are more abundant in the freshwater column than humic acids, the effect of humic substances on the Hg0 dissolution rate coefficient was tested by using commercially available Suwannee River fulvic acid (SRFA). Dissolution tests revealed that acidic conditions in the presence of SRFA enhance the dissolution of Hg0 in freshwaters. However, the concentration of Hg-SRFA soluble organic complexes (HgOC) increased with increase in pH. The total dissolved Hg (HgT) concentration, dissolution rate coefficient and the HgOC concentration were proportional to the SRFA concentration. Ionic strength (0 – 3.0 mM KCl) did not result in any significant increase in the Hg0 dissolution rate coefficient, HgT and HgOC concentrations. A multivariate first-order dissolution model of the form: was proposed (Adjusted R2: 0.99). The Breusch-Pagan and White heteroscedasticity tests for error terms revealed that the residuals are homoscedastic at the 5% significance level. Though Hg0 dissolution is rapid in the presence of humic substances (it is expected to continue for at least 31 years); more Hg will be released into the water column, hence, there is need to pay close attention to Hg environmental risk. In chapter 4, Cladophora sp. biosorption of metal-contaminated water is presented. The performance of a common freshwater living green algae, Cladophora sp. for remediation applications was assessed by investigating various parameters which included the influence of contact time, pH, initial Hg2+ concentration and the presence of competing cations. A rapid uptake of Hg2+ by Cladophora sp. was displayed. At least 99% of Hg2+ in solution was removed within the first 5 min of contact and equilibrium was attained after 10 min. High adsorption capacity of 800 mg kg-1 was observed under acidic conditions (pH 3) at the optimum Hg2+ concentration of 1.0 mg L-1; and this decreased with increase in pH. The pseudo-second order kinetic model and Langmuir equilibrium isotherm best explained the experimental data. The dimensionless separation factor (of 0.04 revealed that the adsorption of Hg2+ by Cladophora sp. algae is favorable. Thus, Cladophora sp. algae can be successfully used as a low cost but highly effective sorbent material for the removal of Hg2+ from contaminated waters. In chapter 5, simulated mercury release and biosorption by Cladophora sp. Algae is presented. Based on the results obtained in Chapters 2 – 4; Hg release was simulated and a batch reactor for the adsorption of Hg from contaminated waters by Cladophora sp. algae was designed. The mass of algae required in a 1000 L batch reactor in order to reduce the initial Hg2+ concentration (simulated Hg release) to 0.0006 mg-Hg L-1 (World Health Organization (WHO) threshold for inorganic Hg in drinking water) was determined. The overall multivariate dissolution model of the form: was obtained (Adjusted R2: 0.98). About 4 kg of Cladophora sp. algae is required to achieve the WHO standard of 0.006 mg-Hg L^{-1} in a 1000 L batch reactor when the initial Hg2+ concentration is 0.26 mg-Hg L-1. In chapter 6, conclusion and recommendations are presented.

備考 ： 論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。
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