Form 2

Dissertation Abstract

Report no.	(Course-based) No.1147	Name	Gajanayaka Mudalige Pradeep Kumara
Dissertation title	Utilization of Construction and Demolition Waste （CDW） and Industrial By-products （IBPs） as Low-cost Adsorbents for Simultaneous Removal of Heavy Metals in Wastewater （汚染水中の複数種重金属同時除去を可能とする低コスト吸着材への建設廃棄物及び産業副産物の活用）		

Abstract

※ The abstract should be in keeping with the structure of the dissertation (objective, statement of problem, investigation, conclusion) and should convey the substance of the dissertation.

This study is aiming to give an added value for the selected construction and demolition waste (CDW) and industrial by-products (IBPs) to use as low-cost adsorbents for the simultaneous removal of Cd^{2+} and Pb^{2+} from wastewater. However, many researchers have been concluded, simultaneous removal of Cd^{2+} using low-cost adsorbent is impossible under the batch as well as continues flow conditions. Especially with the presence of Pb^{2+} and Cu^{2+} in wastewater, Cd^{2+} removal is difficult, and it is always hampering in the system. Thus, it is appreciated to find out low-cost adsorbents which are potential to simultaneous removal of commonly available HMs like Cd, Pb, and Cu in wastewater. Therefore, main objectives of this study are (i) to set an added value for the selected CDW and IBPs materials as low-cost adsorbents to treat industrial wastewater, (ii) to investigate the metal adsorption mechanism onto selected CDW and IBPs materials, and (iii) to investigate the simultaneous removal potential of Cd^{2+} and Pb^{2+} by the selected CDW and IBPs materials under the batch adsorption condition. A series of batch adsorption experiments were carried out using selected CDW and IBPs to examine the effects of the particle size (<0.105, 0.105-2, 2-4.75 mm), initial metal concentration (0-5000 mg/L), initial pH (3-11), ionic strength (0-0.1), metal desorption, contact time (0-192 h), and competitive metals (binary and multi-metals). Then, based on the materials adsorption capacity of each metal and adsorption

mechanism, best-performed materials were selected for the simultaneous removal experiments. Based on the results in this study, autoclaved aerated light-weight concert (AAC) and steel slag (SS) were shown the high capacity to remove harmful heavy metals from wastewater. Noticeably, AAC showed higher affinity with Pb^{2+} (>250 mg/g). In contrast, SS showed greater affinity with Cd^{2+} (>300 mg/g). However, both individual adsorbents were exhibited poor performance on simultaneous removal of Cd^{2+} and Pb^{2+} from binary and multi-metals solution. Thus, the mixture of AAC and SS was tested with different proportions on the simultaneous removal of Cd^{2+} and Pb^{2+}. The AAC+SS [1:1] mixture was showed 100 % removal of Cd^{2+} and Pb^{2+} simultaneously, in the binary and multi-metals solution up to S:L ratios of 1:60 and 1:10 respectively, by eliminating the low-cost adsorbents major drawback, which was always Cd^{2+} hampering and Pb^{2+} domination in the binary and multi-metals systems. Therefore, AAC+SS [1:1] mixture is strongly recommended for future studies on heavy metal removals from wastewater. AAC fines main adoption mechanisms are ion exchange, surface complexation, and surface precipitation. Especially, Ca^{2+} ion exchange on the hydrated adsorbent surface is the dominant adsorption mechanism of Cd^{2+} and Pb^{2+} adsorption for tested AAC fines at the early stage of adsorption. The dominant mechanisms for Cd^{2+} and Pb^{2+} adsorption onto SS are Ca^{2+} ion exchange, surface complexation along with surface precipitation. The solution equilibrium pH mainly controls Pb^{2+} adsorption onto SS fines and its mixtures. At the very high pH (≥12), only Ca^{2+} ion exchange reaction act as the dominant mechanism, but the equilibrium pH<12, surface precipitation playing a significant role to remove Pb^{2+} from the metal system. Thus, it is recommended to pay attention to solid: liquid ratios in batch adsorption studies, which is highly controlling the simultaneous removal of metals from the multi-metals solution.