CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE STUDIES

The main objective of this study is to investigate the effects of initial pH and MC of the composting process on the characteristics and heavy metal adsorption performances of grass clippings compost. Synthetic metal solutions (Cd, Cu, Pb, and Zn) were used to represent runoff samples. The study consisted of grass composting and batch adsorption. Manila grass (*Zoysia matrella Merrill*) was composted at 25 different conditions (5 moisture contents × 5 initial pH) to prepare sorbent composts. The batch adsorption isotherm was tested to determine the metal sorption performances of the composts. The CEC of the composts and the volume reduction during the composting were also examined.

During the 63 day composting, mushrooms were found in the composter and were removed by manual picking. The grass composted at 30% MC and initial pH 7 had the maximum volume reduction percentage. To achieve high volume reduction of the grass compost, the moisture content had to be either low (30-40%) or high (70%). The 30% MC compost also provided high CEC values while between 40 and 70% MC, MC and initial pH had very limited effects on the CEC of the compost. The noncomposted grass clippings, which were tested as a control, had much lower CEC than the compost.

The batch adsorption consisted of two sections: preliminary study for equilibrium time determination and isotherm test. The preliminary study was conducted using 3, 5 and 15 hour contact time. This study was performed to affirm the sufficient equilibrium time for sorbent-solution contact time in the isotherm test. Five hours was used for contact time in the isotherm test based on the results of the preliminary study.

The Freundlich model could describe the isotherm data well. Among the four heavy metals, Cd has the strongest sorbate-sorbent interaction based on the smallest n value. The interaction strength to grass clippings compost was found to be in the order Cd > Zn > Pb > Cu which differed from the order of stabilities of the different metal-humic complexes. Humic substances might not be the major component of the compost in this study.

The Freundlich coefficients, removal percentages and q (mg sorbate/g sorbent) were used to compare removal performances of the composts. The Freundlich coefficients ranges of Cd, Cu, Pb and Zn were 4.72-9.20, 0.16-14.05, 2.45-43.28, and 3.78-8.79 L/g, respectively. The removal percentages ranges of Cd, Cu, Pb and Zn were 36.28-84.10, 52.51-87.98, 94.93-57.17, and 64.62-88.96%, respectively. The q values ranges of Cd, Cu, Pb and Zn were 0.72-15.30, 0.06-7.49, 0.01-7.55 and 0.49-11.89 (mg metal/g compost), respectively.

The Freundlich coefficients of the composts did not share similar trends (in term of the effects of initial pH and MC) as the removal percentages, which were analogous to q values. In general, the composts removed Cu > Zn > Cd > Pb. Moreover, the grass composted at initial pH 9 and 30% MC had high removal percentage for all metals. These conditions were also the optimal conditions for high volume reduction during composting and high CEC of the compost. The non-composted grass was distinctively inferior to the composted grass in all adsorption performance criteria. Composting increased the heavy metal removal ability of the grass clippings.

It would be interesting to conduct a similar study on the other grass types or plant leaves. Effects of C/N ratio or other characteristics of composted material on the sorption performances should be investigated. A study on other metals and/or competition condition is recommended. Moreover, the mechanisms of microbial activities and humic substances production during composting at different conditions should be studied to elucidate how pH and MC influence volume reduction, CEC, and adsorption performances. The practical application of the grass compost for stormwater filtration should be investigated on the service time of the compost, and

the possible release or desorption of constituents such as suspended solids, color, desorbed metals, and organics.