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Investigation of Media Effects on Removal of Heavy Metals in Bioretention Cells

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Heavy metals are the most toxic elements at high concentrations, although some of them such as Cu and Zn are essential to plants, humans, and animals within a limited value. However, some heavy metals, such as Pb, have adverse effects even at low concentrations. Therefore, it is known that the toxic metals such as Zn, Cu and Pb in storm water runoff are serious threat for aquatic organisms. It is very important to control and reduce heavy metal concentration in urban storm water runoff. There are several methods to remove the aforementioned toxic metals such as electrolyte extraction, chemical precipitation, ion-exchange, reverse osmosis, membrane filtration, adsorption, cementation, and electrochemical treatment technologies. However, these methods are highly expensive and hard to implement for treatment of big volumes of water such as storm water. For this purpose, Low Impact Development (LID) Best Management Practices (BMPs) have become popular to collect, infiltrate, and treat toxic metals in storm water runoff in recent years. LID-BMP is a land planning method which is used to manage storm water runoff and improve water quality by reducing contaminant in storm water runoff. Bioretention is an example of LID-BMP application of which usage has recently been started in storm water treatment. Researchers have been investigating the advantages of bioretention systems and this study contributes to these research efforts by seeking for the media effects of bioretention on heavy metal removal. For this purpose, batch sorption experiments were performed to determine the distribution coefficients and retardation factor of copper (Cu), lead (Pb), and zinc (Zn) for bioretention media such as mulch, turf, local or vegetative soil, sand and gravel. Furthermore, sorption reaction kinetics of Cu, Pb and Zn are tested in order to assess the sorption equilibrium time of these metals for 5 bioretention media. The results of sorption test show that turf has higher sorption capacity than mulch and local soil for heavy metals used in the experiment. On the other hand, sand and gravel have relatively lower sorption capacities. Linear equilibrium isotherm represents sorption of these metals for all bioretention media. The highest sorption is observed for Pb followed by Cu and Zn for all bioretention media. The time required for reaching equilibrium conditions for bioretention column media is ranged from 1 to 6 hours for each metal investigated.