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Trace Metals in Urban Stormwater Runoff and their Management

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In past decades, due to the rapid urbanization, land development has replaced forests, fields and meadows with impervious surfaces such as roofs, parking lots and roads, significantly affecting watershed quality and having an impact on aquatic systems. In this study, non-point source pollution from a diesel bus loop was assessed for the extent of trace metal contamination of Cu, Mn, Fe, and Zn in the storm water runoff. The study was carried out at the University of British Columbia (UBC) in the Greater Vancouver Regional District (GVRD) of British Columbia, Canada. Fifteen storm events were monitored at 3 sites from the diesel bus loop to determine spatial and temporal variations of dissolved and total metal concentrations in the storm water runoff. The dissolved metal concentrations were compared with the provincial government discharge criteria and the bus loop storm water quality was also compared with previous studies conducted across the GVRD urban area. To prevent storm water with hazardous levels of contaminants from being discharged into the urban drainage system, a storm water catch basin filter was installed and evaluated for its efficiency of contaminants removal. The perlite filter media adsorption capacities for the trace metals, oil and grease were studied for better maintenance of the catch basin filter.

Dissolved copper exceeded the discharge criteria limit in 2 out of 15 cases, whereas dissolved zinc exceeded the criteria in 4 out of 15 cases, and dissolved manganese was below the criteria in all of the events sampled. Dissolved Cu and Zn accounted for 36 and 45% of the total concentration, whereas Mn and Fe only accounted for 20 and 4% of their total concentration, respectively. Since they are more mobile and have higher bioaccumulation potentials, Zn and Cu are considered to be more hazardous to the aquatic environment than Fe and Mn. With high imperviousness (100%) and intensive traffic at the UBC diesel bus loop, trace metal concentrations were 3, 0.7, 9, and 3.2 times higher than the GVRD urban area limits for Cu, Mn, Fe, and Zn, respectively. The filter showed high and stable capture efficiencies in total metals (Cu 62%, Mn 75%, Fe 83%, Zn 62%), dissolved metals (Cu 39%, Mn 37%, Fe 47%, Zn 32%), turbidity (72%), and suspended solids (74%) removal during the first month of operation. After that, there was gradual degradation. The catch basin filter performance improved significantly for the suspended solids and total metal removal after cleaning. However, the perlite filter medium showed poor performance for dissolved metal removal in the second study period. Based on the findings, a catch basin filter is effective in storm water management to control suspended solids loading from storm water runoff.