BMP's for Stormwater Runoff in Confined Spaces

Introduction. Stormwater runoff from confined spaces poses a unique challenge to water resources engineers. Traditional BMP selection and design requires land which is either extremely expensive or non-existent. Several new filter-based approaches have been proposed using various methods and media for separating pollutants from stormwater. This report expands upon these methods to look at the performance of various media materials in terms of both pollutant removal and hydraulic efficiency. The overall objectives of this project are to provide data concerning performance, operation and maintenance requirements for confined area BMPs and to evaluate the effectiveness of BMPs which use a combination of filter media in vaults or existing medians. Such data will allow water resource specialists to specify stormwater quality improvement projects that satisfy water quality goals with the least cost, the highest likelihood of success, and the greatest environmental benefit.

Research Approach. Fifteen filter media were tested in laboratory column experiments to establish hydraulic and pollutant treatment capabilities in terms of cadmium, copper, lead, and zinc as total metals, nitrate, orthophosphate, pH, TSS, and TPH. The intent of this study was to investigate filter media options that are commonly (versus commercially) available, with an emphasis on recycled or alternative use materials. The materials tested were aquarium rocks, cedar bedding, charcoal, corn cobs, garden bark, glass beads, kitty litter, iron oxide coated sand, peat moss, persolite, sand, sand/steel wool, WSU compost, CH zeolite, and XY zeolite. Effluent samples were analyzed over time to determine removal efficiencies, and, thereby, potential field application maintenance requirements. The top performing media was used for vault design recommendations.

Conclusions and Recommendations. The results of the column experiments provide conclusions regarding the hydraulic and pollutant removal performances of several potential stormwater vault and related confined spaces BMPs filter materials. Hydraulic performance is based on two media characteristics: infiltration rate and clogging potential. Slower infiltration rates can be compensated for by increasing the number of vaults installed at a particular site. Clogging potential is more difficult to address. Combinations of media or layers of media may be required to reduce the rate of filter clogging. The clogging of the filter material cannot, and should not, be eliminated. As demonstrated in the column studies, the majority of pollutant removal comes from the filtering of pollutants adsorbed to sediments. This can be seen by the relatively poor removal of the dissolved nitrate concentration.

Because of the clogging potential, use of filter media approaches may not be appropriate for mountainous regions where snow and ice require the application of large amounts of sand and gravel. Pretreatment or pre-settling of suspended solids will greatly enhance the viability of several media types. However, experience has shown that in areas subject to extensive sanding operations, the pretreatment area would have to be enormous or frequently emptied.

Pollutant removal abilities varied greatly among the media tested. Persolite appeared to have the greatest potential, however it should be pointed out that these results are based on a synthetic stormwater runoff applied at a constant rate. This is not the same as an actual precipitation event. Field testing using actual runoff conditions are needed to evaluate the true efficiency of the various media. Nonetheless, based on the laboratory results, filter vaults show promise as a confined spaces BMP for reducing pollutant concentrations typically found in highway runoff.

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