



WATER RESOURCES RESEARCH GRANT PROPOSAL

Project ID: 2002PA3B

Title: Water Reuse: Using Crumb Rubber for Wastewater Filtration

Project Type: Research

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Abstract

Pennsylvania has been in drought emergency conditions in four of the last six years. Using reclaimed wastewater for beneficial application is an attractive alternative to the development of new natural water resources. To ensure the removal of residual pollutants, including pathogens, organics, and/or inorganics, wastewater must be properly treated according to the standards established for the designed reuse. Wastewater filtration is an essential treatment process for wastewater reuse.

An innovative filter medium consisting of crumb rubber from recycled tires was developed in the Environmental Engineering Laboratories at Penn State Harrisburg. This medium differs from conventional sand or anthracite filters in several ways. First, crumb rubber is compressible which allows the porosity of the filter bed to decrease through the filter. This medium configuration is ideal for down-flow filtration. The crumb rubber filter allows greater depth filtration and it then allows a greater filtration rate (>10 gpm/ft²) and significantly reduces headloss across the filter. Second, the medium compresses, which results in smaller pore sizes, as headloss increases allowing for better effluent quality late in the filter run. Third, the relatively low density of crumb rubber allows a lower filter backwash rate and simple backwashing procedure. Last but not least, the significantly light weight of crumb rubber filters could be an advantage for them to be used in mobile and in-vessel treatment facilities. In a preliminary study, the filter performance of a crumb rubber filter was compared with that of a dual-media sand/anthracite filter using synthetic wastewater. In comparison to the sand or anthracite filter, the crumb rubber filter favors in-depth filtration and allows longer filtration times and higher filtration rates. For turbidity and total suspended solids removal, the crumb rubber filter performed similarly to the sand/anthracite filter. Because of its longer filtration times and higher filtration rates the use of crumb rubber as a filter media could significantly increase filtration efficiency.

The research will be conducted in two phases. Phase I consists of laboratory studies to evaluate the effects of size and depth of crumb rubber on the filter performance. Phase II consists of field studies to evaluate the filter performance using a secondary effluent. Under the phase I, effects of crumb rubber size and filter

bed depth will be studied using synthetic secondary effluent wastewater. The study will establish the relationships between filter performance, including filtration rate, headloss, run time, and SS removal efficiency, and size of the crumb rubber and depth of the filter bed. These relationships are critical for determining the proper crumb rubber size and filter bed depth for tertiary filtration. The field study will be conducted at the University Park Wastewater Treatment Plant to verify the application of crumb rubber filters in wastewater filtration. The field study will provide side-by-side comparison between crumb rubber filter and dual-media sand/anthracite filter.

Using crumb rubber for wastewater filtration reduces scrap tire problems, and more importantly, it provides a new filtration technology which is far more effective than the current dual-media sand-anthracite filters. The highly efficient and light weight crumb rubber filter could be used in small wastewater treatment plants, mobile or in-vessel treatment facilities.