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REMOVAL OF *E. COLI* DURING INTERMITTENT FILTRATION OF WASTEWATER EFFLUENT AS AFFECTED BY DOSING RATE AND MEDIA TYPE

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Abstract—Wastewater effluent dosing rates of 25 and 50 mm/day were intermittently applied in eight daily doses of 3.125 or 6.25 mm each, to 15-cm diameter 80 cm high columns packed with two types of Light Weight Aggregates (LWA) and one type of activated carbon aggregates. After three months of wastewater effluent application at 25 mm/day to stabilize the filter systems, *Escherichia coli* was spiked once each day onto the surface of the columns and wastewater effluent was applied at 25 mm/day for the months. The same procedure was repeated for effluent application rate of 50 mm/day. During operation, hydraulic behavior was monitored by moisture tensiometers located 5, 10, 20 and 40 cm below the filter surface as well as by radiotracer studies. Removal behavior was assessed by sampling and analysis of the column percolate and media within the column. The removal of *E. coli* was decreased as a result of increasing the dosing rate for all three media. In all media, the highest removal rates were observed in the upper part of the columns. Sorption head measurements showed that each effluent dose rapidly penetrates through the upper part of the filters, until a steady state, unsaturated flow was established in the lower sections. Different flow patterns were observed for the two dosing rates. For the dosing rate of 50 mm/day, the flow was penetrating faster, and to a deeper level before establishing steady unsaturated flow. Fast flow through the upper part of the filter, where the bacterial removal is most effective, may explain the significantly lower removal for the dosing rate of 50 mm/day. The dynamic behavior of the filter columns showed that most of the water movement took place right after dose application, during intermittent dosing. This indicates that dose size may be just as important for bacterial removal as the daily dosing rate. © 1999 Elsevier Science Ltd. All rights reserved

Key words—*E. coli*, dosing rate, porous media, purification of bacteria, unsaturated flow, wastewater filtration

INTRODUCTION

Wastewater treatment systems involving intermittent filtration through porous media, including engineered media filters and natural soil infiltration systems, have attracted much attention because of their high purification performance with respect to organics, nutrients and bacteria. However, unless properly designed and operated, infiltration systems may pose a bacterial pollution risk to groundwater and neighbouring drinking water supply sources. Past studies have indicated cases of diseases which were attributed to groundwater contaminated by wastewater disposal (Craun, 1985; Yates and Yates, 1988).

The removal of bacteria in infiltration systems can be attributed to the interaction of complex processes including wastewater infiltration and percolation processes coupled with constituent associated physical/chemical and biological processes. Intermittent infiltration of wastewater can lead to development of a clogging zone at the infiltrative surface due to filtration of suspended solids and the accumulation of organic matter from biological processes. Development of this zone can enhance purification by an increase in biogeochemical reactions within the zone as well as reducing infiltration rates and creating unsaturated conditions beneath it (Siegrist, 1987). Bacterial removal is also impacted by clogging zone development at and near the wastewater infiltration surface. Gerba (1975) reported that the greatest removal occurred near the soil surface, within the biological clogging zone, reaching 2–6 cm down. The mechanisms were physical straining and adsorption. Stevik *et al.* (1988a), observed a higher amount of bacteria and protozoa in the clogging zone.

Several environmental factors have been identified which affect the transport and fate of bacteria

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