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NUMERICAL ANALYSIS OF THE PERFORMANCE OF HORIZONTAL AND WAVY SUBSURFACE FLOW CONSTRUCTED WETLANDS*

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Abstract: A three-dimensional numerical model is proposed for modeling the TP transport in the Horizontal Subsurface Flow (HSSF) and Wavy subsurface Flow (WSSF) constructed wetland in this article. Both numerical simulations and physical experiments indicate that the removal efficiency of WSSF is higher than that of HSSF. The difference of performance in removing pollutants, e.g., Total Phosphorus (TP), between HSSF and WSSF is numerically analyzed from three interactive aspects, that is, the hydraulic behavior, the substrate and the plant roots. It is shown that the dead zone volume in WSSF is smaller than in HSSF with less short circuiting. The soil in the top layer is more used in WSSF than in HSSF. The TP uptake by the plant roots in WSSF is higher than that in HSSF.

Key words: numerical model, constructed wetland, hydraulic behavior, Retention Time Distribution (RTD), removal efficiency

Introduction

Constructed wetlands have recently been widely used all over the world in wastewater treatments. There are two general categories of constructed wetlands, the Free Water Surface (FWS) system, and the Subsurface Flow (SSF) system. SSF includes two conventional types: Horizontal Subsurface Flow (HSSF) and Vertical Subsurface Flow (VSSF). The hydraulic behavior is a most important factor for the removal efficiency in constructed wetlands. Due to the importance of the hydraulic design of constructed wetlands, the hydraulic performance in improving the removal efficiency should be studied. Among factors that influence the hydraulic behavior in constructed wetlands are the configuration of inlet and outlet, the wetland shape, the obstruction designation[1,2].

Recently, a new type of SSF was proposed, which is called the Wavy Subsurface Flow (WSSF) to improve the flow distribution, and thus to improve the removal efficiency[3]. Numerous experiments were carried out to study the mechanism of WSSF in pollutants removal and it is concluded that the removal efficiency of WSSF is higher than that of HSSF. Numerical models can also serve as an efficient platform to test the newly designed WSSF

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