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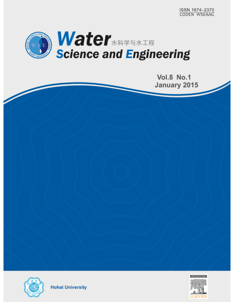

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Fate of nitrogen in subsurface infiltration system for treating secondary effluent

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Abstract

The concentration of total nitrogen (TN) is reported to vary between 20 and 35 mg/L in domestic wastewater. In raw wastewater, ammonia nitrogen (NH_4^+-N) is the main nitrogen form, accounting for 70% to 82% of the TN concentration. Organic nitrogen, nitrite nitrogen (NO_2^--N), and nitrate nitrogen (NO_3^--N) are present as well. For years, due to the lack of regulatory limits on nitrogen concentration in surface waters, nitrogen from secondary effluent has posed a significant threat to the health of aquatic ecosystems. Researchers have made substantial efforts to reduce the nitrogen concentration in secondary effluent. As a kind of advanced wastewater treatment technology, the subsurface infiltration (SI) system has been widely used, owing to its advantages, which include low operation cost, easy maintenance, and low energy consumption. This review discusses the fate of various forms of nitrogen in SI treatment, including organic nitrogen, NH_4^+-N , NO_2^--N , and NO_3^--N . Major biological processes involved in nitrogen removal and the main factors influencing its transformation are suggested. Finally, it is shown that ammonification followed by nitrification-denitrification plays a major role in nitrogen removal. Further research needs to focus on the emission characteristics of gaseous nitrogen (generated from the nitrification, denitrification, and completely autotrophic nitrogen-removal over nitrite (CANON) processes) with respect to their greenhouse effects.

Keywords: Wastewater treatment; Natural treatment technology; Subsurface infiltration; Nitrogen; Biological process

1. Introduction

In China, thousands of scientists and engineers have made substantial efforts in water pollution control. A number of technologies and procedures for municipal wastewater treatment have been developed and applied (Yuan and He, 2015). Of those, the activated sludge technology and biofilm treatment method are most commonly used for centralized wastewater treatment in big cities.

However, due to the lack of legal restraints, conventional sewage treatment processes, such as activated sludge and trickling filters, are known to be less efficient for nitrogen removal, compared with the removal efficiency of organic matter. Therefore, after a secondary treatment, wastewater discharge can be a major source of nutrients that cause eutrophication in lakes and rivers. Various physio-chemical processes such as filtration or adsorption have been employed for nutrient removal, but such processes are often costly and difficult to maintain (Bali et al., 2010; Curia et al., 2011). In an increasingly restrictive economic climate, especially in rural areas, capital resources for implementation and operation of such wastewater treatment infrastructure and facilities are limited. Therefore, natural treatment systems, such as wetlands, oxidation ponds, and subsurface infiltration (SI) systems, have emerged as appropriate alternatives. Compared with conventional systems, natural systems require less energy and less skilled labor (Sun et al., 2006). In SI, a kind of natural treatment system, wastewater is first treated by conventional physicochemical and/or biological treatment and then allowed to infiltrate through the aerated unsaturated zone, where it gets purified through processes such as filtration, adsorption, chemical processes, and biodegradation (Ji et al., 2012). SI systems have the advantages of low construction and operation costs, no aeration, low energy consumption, the ability to utilize fertilizer resources in wastewater, and simultaneous wastewater treatment and ecological service. Since 1990, large-scale SI systems have been

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