TNT and Nutrients Removal in the Constructed Wetlands

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Abstract

This study was carried out to investigate the removal of 2,4,6-trinitrotoluene, nutrients such as nitrogen, phosphorous compounds in the wetland microcosms. Microcosm study indicated that TNT nutrients were more fastly reduced in the anaerobic condition. The major reductive transformation products included 2,4diamino-6-nitrotoluene (2,4-DANT) 2,6diamino-4-nitrotoluene (2,6-DANT) 4diamino-2,6-nitrotoluene (4-ADNT) 2diamino-4,6-nitrotoluene (2-ADNT). The experimental results for nitrogen removal showed that denitrification from NO_3^- to NH_3 was dominant process at the bottom of marsh, but nitrification from NH_3 to NO_3^- was dominant on the top of marsh.

Keywords : Wetlands, Microcosms, Pond, TNT, Nutrients

Introduction

TNT and Nutrients removal from wastewater has become very important in the view of the adverse impacts of pollutants on mankind and in the environment. Constructed wetlands have recently been suggested as an alternative for treating contaminated aquifers (Baker, 1998). In this study, the removal of 2,4,6-trinitrotoluene, nutrients such as nitrogen, phosphorous compounds in the wetland microcosms such as marsh or pond system was investigated. Degradation efficiency and byproduct formation of TNT in each system were compared.

Materials and Methods

In this study, marsh (35cm in diameter 50cm in height) and pond microcosms (35cm in diameter 60cm in height) were respectively constructed with acrylic plastic and located in an environmental chamber (Figure 1). The substratum zones were filled with three different types of media: one was gravel (10kg, size 40-60um) at the bottom, another was small size gravel (15kg, size 10-20um) in the middle and the other was sand (15kg, 2-4um) on the top, all of which were at a depth of 30cm. Microcosm study was conducted with addition 10ppm TNT and natural level of nitrogen and phosphorous compound into the reactor.

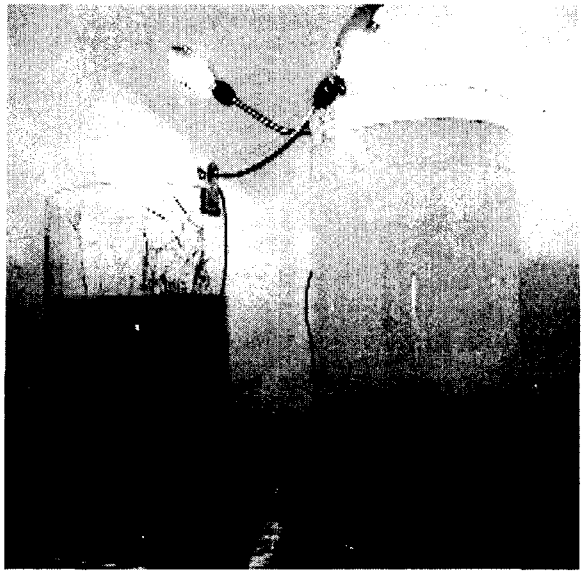

Fig. 1. Schematic representation of the 25L marsh (left) and 50L (right) pond microcosms setup.

The TNT and degradation byproducts concentrations were analyzed employing Thomas, B. et al method[3]. Analysis for Total nitrogen and phosphorous compounds follows standard method (AIHA). Inorganic nitrogens such as NH_3^+, NO_2^-, NO_3^- were detected using an ion Chromatography (Dionex).

Results and Discussion

Some TNT removal in the contaminated water occurred in each sampling site. (Fig.2). Marsh microcosms study indicated that the decrease of TNT in the marsh top and the bottom during 33 days was 55% and 99%, respectively. There was a significantly greater removal rate of TNT at the bottom compared to the top of marsh during the experiment. The major reductive transformation products were 2,4diamino-6-nitrotoluene (2,4-DANT) 2,6diamino-4-nitrotoluene (2,6-DANT) 4diamino-2,6-nitrotoluene (4-ADNT) 2diamino-4,6-nitrotoluene (2-ADNT). This results suggest that reductive transformation of TNT is significantly increased under the anaerobic condition, bottom of the system, as would be expected since the in saturated soils are reduction reactions.

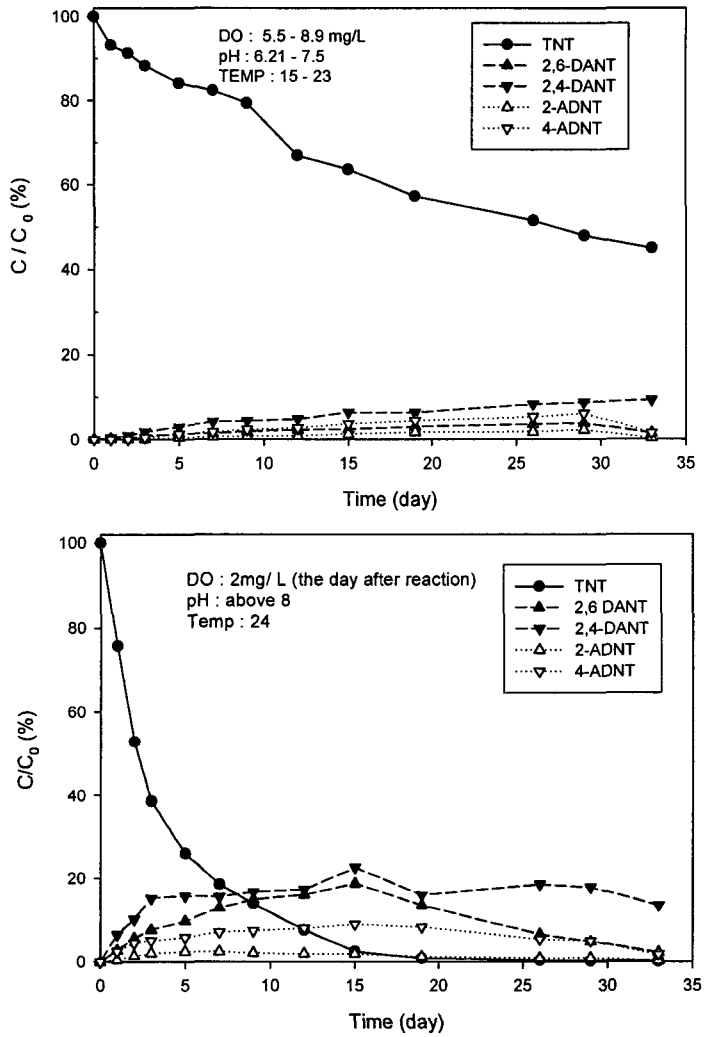

Fig. 2. TNT concentration and reductive transformation products on the top (left) and at the bottom (right), respectively, during the experiments.

The experimental results for nitrogen removal in the constructed wetland system are shown in figure 3. The results showed that denitrification was dominant process in marsh bottom, while nitrification was dominant on the top of the marsh. At the experimental results of pond, degradation trend was similar to that of marsh system, but showed somewhat higher efficiency in the pond.

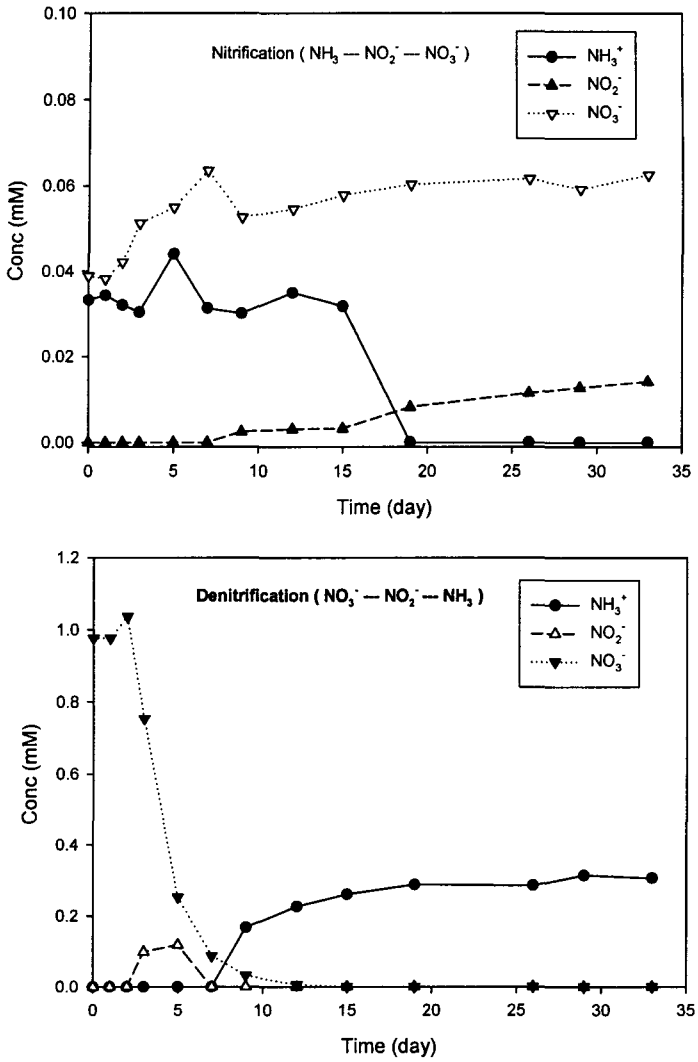

Fig. 3. The experimental results for nitrogen removal on the top (left) and at the bottom (right) during the experiments.

Table 1. Summary of Rmoval efficiency, First-order kinetic, and Total Percent of TNT Transformation for the marsh and pond during the experiments.

Wetland microcosms		Percent of TNT removal	Percent of TN removal	Percent of TP removal	Percent of TNT Transformation	Degradation kinetic of TNT
Marsh	Top	55	89.5	26	20.1	- 0.026 day-1
	Bottom	99	96	58	52	- 0.218 day-1
Pond	Top	50	97	-	12	- 0.023 day-1
	Bottom	99.5	100	55.3	67	- 0.254 day-1

Conclusions

The research described here showed TNT, nutrients containing nitrogen compound can be efficiently treated with wetlands system. In the system, we know reduction is accomplished by diverse treatment mechanisms including nitrification and denitrification, sedimentation, filtration, chemical precipitation and adsorption, microbial interactions and uptake by vegetation. Further study is carried out to examine what coordination between marsh and pond, when joining each system, would be well to enhance the treatment efficiency.

Acknowledgment

This subject is supported by Ministry of Environment as "The Eco-technopia 21 Project"

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