



“Gheorghe Asachi” Technical University of Iasi, Romania



---

# COMPARISON OF NITROGEN REMOVAL OF SUBSURFACE VERTICAL UP-FLOW AND DOWN-FLOW WETLAND MESOCOSMS

**Chan Dong<sup>1,2\*</sup>, Ying-Hao Huang<sup>3</sup>**

*<sup>1</sup>School of Environment and Safety Engineering, Nanjing Polytechnic Institute, Nanjing 210048, P.R. China*

*<sup>2</sup>Jiangsu Engineering and Technology Research Center of VOCs Treatment, Nanjing Polytechnic Institute, Nanjing 210048, P.R. China*

*<sup>3</sup>Geotechnical Engineering Department, Nanjing Hydraulic Research Institute, Nanjing, P.R. China*

---

## Abstract

Constructed wetlands are an inexpensive approach in wastewater treatment. The total nitrogen (TN) removal in constructed wetlands varies widely depending on the type of constructed wetland. To determine what processes lead to greater efficiency of nitrogen removal, the discrepancy in nitrogen removal performance between two types of constructed wetlands was studied: a down-flow and an up-flow vertical subsurface flow system. The results demonstrate that pollutant concentrations of water at the outflow and at different depths of the mesocosms fluctuated in both down-flow and up-flow systems. Ammonia and TN total removal of down-flow systems were 0.53 and 0.85 g·m<sup>-2</sup>·d<sup>-1</sup> respectively. And they were 2.24 and 2.82 g·m<sup>-2</sup>·d<sup>-1</sup> for up-flow systems. Pollutant removal efficiency was greater in the up-flow system compared with the down-flow system. There are three potential reasons for the observed difference. First, greater oxygen levels lead to more nitrification in up-flow systems compared with down-flow systems. Secondly, in the down-flow systems, when wastewater with higher dissolved oxygen was added to the top layer, the resulting dominant process was aerobic organic matter decomposition, while ammonia removal was restricted. In the up-flow system, although the oxygen level of the inflow was consumed for organic matter degradation, the oxygen released from roots allowed nitrification and denitrification to occur. Finally, the results reveal that nitrification in up-flow constructed wetlands was positively related with higher total nitrogen removal.

**Key words:** constructed wetlands, dissolved oxygen, nitrification, nitrogen

*Received: June, 2023; Revised final: November, 2023; Accepted: December, 2023*

---

---

\* Author to whom all correspondence should be addressed: e-mail: chan\_dong@163.com; Phone: +86-025-58370734