Chapter 8
Phytoremediation of Nitrogen and Phosphorus in Municipal Wastewater by Cyperus alternifolius Planted Constructed Wetland

Hossein Farraji
University Saiens Malaysia (USM), Malaysia

ABSTRACT

Nowadays municipal wastewater (MWW) treatment by phytoremediation techniques goes as an emerging technique in the USA and many European countries. Cleaning wastewater with constructed wetland (CW) is an advanced type of phytoremediation. Low concentration of hazardous metallic elements in this major wastewater caused its capability for treatment by CW. This treatment method highly depends on the presence of macrophytes, media, and operating factors which have high influences in the efficiency of this technology. This chapter will discuss on engineering controls that traditionally are available and practically could be used in the commonly CW. Recirculation, dry to wet duration, artificial aeration, absorbent application, dilution and carbon source addition through this eco-friendly decontamination method. The concentration of this manuscript will be on Cyperus alternifolius as a well-known rapid growth plant species which often known as an ornamental plant. This review on try to illustrate practical ways to enhancing efficiency of decontamination of MWW in CW

INTRODUCTION

Municipal wastewater fundamentally divided into two types black water and gray water. Gray water is from kitchen wastewater, sink, washing machine and bathroom. This wastewater can reach up to 75% of the total wastewater generated in the household (Hernández et al., 2011). Black water comes from toilets with high concentrations of nitrogen and phosphorus (Zeeman et al., 2008). This kind of domestic
wastewater should be considered as one of critical environmental problem since through the quality and quantity, it can contaminate the environment, interfere human health and other creatures. An increasing number of domestic wastewater causes negative impact on environment quality since it generally discharge directly to natural water like as river and lakes so it can cause increasing pollutant load on the water bodies. Constructed wetlands provide a greater level of pollutant control to discharge effluent to surface waters (Kadlec & Wallace 2008). The sewage discharge from the domestic sewage treatment plant is typically subjected to the local, state and federal regulations and standards. In December 2009, the Department of Environment (D.O.E) Malaysia has revised the Environmental Quality (Sewage) Regulations 2009, which significantly reduced the discharge limit of ammonia-nitrogen from 50 mg/L to 5 mg/L. In addition, a new discharge limit was also set for nitrate at 10 mg/L (Kutty et al., 2011).

LITERATURE REVIEW

Constructed Wetland

Types of Constructed Wetland

It have been proven that, constructed wetlands are suitable wastewater treatment system for many developing countries in tropical areas where land is available at low cost and warm temperatures are suitable for biodegradation (Kantawanichkul et al., 2013). Simulating a natural wetland ecosystem in terms of constructed wetland, the treatment system can make use of the assimilation capacity of soil (living media) and aquatic plants (main up taker) to remove both pollutants (organic and inorganic compounds and microbial pathogens) and nutrients without additional energy demand (Inamori et al., 2007). Constructed wetlands are alternative wastewater treatment systems which are low-cost, easy operation and maintenance than conventional technologies (Stefanakis et al., 2014; Stefanakis et al., 2011). The correct functioning of a constructed wetland (CW) depends on the interaction between plants, substrate and microorganisms in relation to the type of structure and wastewater treatment being used (Stefanakis et al., 2011). In most of literatures pay attention vastly on engineering aspects of constructed wetland, however plant species make a significant contribution to natural decontamination of process of wastewater (Stottmeister et al., 2003). Removal of total nitrogen in different types of constructed wetlands varied between 40 and 55% with removed load ranging between 250 and 630 g Nm⁻²Yr⁻¹ depending on CWs type and inflow loading (Vymazal, 2007). Removal of phosphorus in all types of constructed wetlands is low unless Special substrates with high absorption capacity are used. Removal of total phosphorus varied between 40 and 60% in all types of constructed wetlands with removed load ranging between 45 and 75 g Pm⁻²y⁻¹ depending on CWs type and inflow loading (Vymazal, 2007).

Horizontal Flow Constructed Wetland (HFCW)

By preparing suitable preplanning process both of HFCW and VFCW can effectively remove 90% of organic pollutants and all concentration of N and P from wastewater (Luederitz et al., 2001) meanwhile HFCW could be considered as an advanced performance for long time P removal system. CWs with free water surface (FWS) units remove substantially more total nitrogen as compared to other types of hybrid constructed wetlands (Vymazal, 2013). These systems are good for suspended solids removal
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