電子檔

計劃編號：NSC 88-2621-Z-041-001

計劃名稱：綠色環保技術之研發及策略研究-溼地對水資源之保育管理及永續利用-子計畫三：水產養殖廢水之人工溼地處理及循環再利用之研究(I)

計劃名稱：Treatment and Reuse of Aquaculture Wastewater by A Constructed Wetland System

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關鍵詞：人工溼地、養殖業廢水、蘆葦、氨氮、磷酸鹽、化學需氧量、懸浮固體、循環再利用。

關鍵詞：constructed wetland, aquaculture wastewater, reed, ammonium, phosphate, COD, SS, reuse.

摘要：

本研究之主要目的為建立試驗規模的人工濕地處理系統，以現場漁塭池水為處理目標，進行連續進流之處理操作，在不同水力負荷的操作試程下，探討人工濕地對養殖池水中各項污染物之去除效能, 以評估人工濕地作為漁塭養殖系統淨水處理設施的可行性。人工濕地系統由一個自由水層溼地（FSF）串聯另一個表層下溼地（subsurface flow，SSF）所構成。漁塭池水以定量抽水機導入 FSF 系統進水區，而出流水則溢流，並靠重力導至 SSF 系統進水區處理。FSF 系統種植水草類植物，SSF 系統種植蘆葦類之挺水性植物。

系統從啟動至目前為止已連續操作達 6 個月，此期間進行 3 個操作試程(Stage 1-3)，水力負荷分別為 0.018、0.023 及 0.034 $m^3/m^2/d$ (總系統水力停留時間為 15、12 及 8 d)，進流水各項污染物濃度並隨養殖過程而顯著增加。由操作結果顯示，系統啟動初期(操作前 3 個月，Stage 1)，FSF 系統由於植物生長尚未穩定，處理功能不佳，而 SSF 系統所種植的蘆葦生長良好，加上碎石之過濾功能，其單槽處理能力較為顯著。整個系統之 COD、SS、磷酸鹽、葉綠素 a 之平均去除率分別為 33.5、76.0、69.6、90.6 %。然而，出流水氨氮濃度甚至比入流水還高。

待 FSF 槽之植物生長達穩定後(Stage 3)，此槽之各類污染物去除效率亦伴隨提高，使整個系統之 COD、SS、氨氮、磷酸鹽、葉綠素 a 之總平均去除率提升到分別為 57.1、88.3、98.5、64.5、86.6%。氨氨的去除相當完全，無亞硝酸氮及硝酸氮的累積。上述結果顯示，植物的生長在人工溼地的淨化功能上扮演重要角色。此外，主要污染物之放流水質十分穩定，不隨水力負荷及入流水濃度增加而改變，不僅可達養殖業放流水標準，亦可考慮循環再利用。

摘要：

A pilot-scale constructed wetland system (CWS) consisting of a free surface flow wetland (FSF) and followed by a subsurface flow wetland (SSF) was employed to treat the aquaculture water in this study. The FSF planted with non-identified aquatic grass specie, whereas the SSF planted with common reed. The removal performances of potential pollutants for the constructed wetland system were investigated under various hydraulic loading rates. The feasibility of the constructed wetland system being a water treatment process in aquaculture was also evaluated.

The CWS was continuously operated with 3 Stages for over than 6 months in the present work. The hydraulic loading rates were maintained at 0.018, 0.023, and 0.034 $m^3/m^2/d$, respectively, for Stage 1, 2, and 3; that is, the hydraulic retention times of system were equivalent to be 15, 12, and 8 day. When the macrophyts did not grow well during the start-up stage (Stage 1), the removal efficiencies of pollutants in the FSF were poor. Meanwhile, good removal of pollutants was achieved in the SSF due to the filtration ability. The overall reductions in concentrations of COD, SS, soluble phosphate, and chlorophyll a in Stage 1 were found to be 33.5, 76.0, 69.9, and 90.6 %, respectively. But, ammonium was even increased in the effluent of the CWS.

When the macrophytes of the FSF grew gradually stable in the vegetation season (July 1999), the performances of this wetland was improved significantly. The overall reductions in concentrations of COD, SS, ammonium, soluble phosphate, and chlorophyll a were recorded, respectively, to be 57.1, 88.3, 98.5, 64.5, and 86.6% in Stage 3. Ammonium was removed without accumulation of nitrite and nitrate. Accordingly, macrophytes in the CWS play important role in removal of potential pollutants. After Stage 2 operation, the qualities of CWS effluent were gradually stable and could meet the requirements of Effluent Standards approved by EPA of Taiwan. Furthermore, the reuse of the wetland treated water for aquaculture is expected.