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Investigation of phytoremediative ability of macrophytes and a design of a phytofiltration system for Singapore's waterways

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Abstract

Nitrates and phosphates cause eutrophication when present in high concentrations.

This project aims to employ macrophytes to reduce such macronutrients in water bodies via growth and kinetic studies, which is a unique fusion of methodologies. It also involves a novel design and analysis of several enclosure prototypes to introduce macrophytes into waterways and their effects on the waterway's ability to convey storm water rapidly away from flood-prone areas.

Tropical macrophytes (emergent macrophytes Typha angustifolia and Cyperus haspan, submerged macrophytes Hydrilla verticillata and Cabomba aquatica, floating macrophytes Lemna minor) were grown in simulated wastewater with high nitrate and phosphate concentrations. Analysis of the growth and uptake kinetics of the macrophytes showed a correlation between high growth rate and high nitrates and phosphates uptake. C. aquatica had the highest uptake rate for nitrates and phosphates as well as the highest growth rate of 6.11 ± 1.2 % day-1 . The remaining macrophytes were proven to exhibit good phytoremediative properties, with emergent macrophytes C. haspan and T. angustifolia having great affinity (as indicated by a low Km value) for phosphate and nitrate respectively. An analysis of the phytoremediative abilities of each macrophyte was done to provide recommendations for growth in different aquatic areas.

A total of eight nettings, made from different materials-linen and plastic, and pore sizes were used to design the enclosure prototypes. These enclosures possess a metal skeletal structure for greater stability. Results show that a combination of 2 different nettings provided the best trade-off between ensuring that the macrophytes were contained within the enclosures and minimising the enclosure's impact on the flow

velocity of the waterways. Enclosures could then be attached to existing infrastructure like the float booms as a platform for large scale phytoremediation locally.

評語

本研究開發一套有效之植物吸收水中磷酸塩和硝酸塩之系統，並成功在水道中驗證其效果。若繼續深入開發，有希望成為具產業效益之生物濾水方法。