

Floating wetlands as an innovative approach for onsite treatment

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Growing concerns of contaminants in surface and ground waters has led to water quality improvement becoming an emerging priority. Nutrient loadings and environmental contaminants of concern are mainly from animal wastes through land deposition, and surface runoff from streets and residences. As a result, nutrients including nitrogen and phosphorus, as well as pathogens are being discharged into lakes and rivers potentially leading to eutrophication. These enriched water bodies are ideal for algal growth which in turn results in poor water quality. A significant health concern with the increased algal growth is the potential for microcystins. Microcystins are cyanotoxins produced by cyanobacteria (also known as blue-green algae) and can cause serious damage to the liver at relatively high levels of exposure. Current treatment systems such as wastewater lagoons and retention basins aid in the removal of nutrients and solids by retaining the wastewater for a period of time to ensure that the solids settle out of the water. This, however, presents the problem of algal growth as a result of high nutrients, stagnant water and increased temperatures within these basins. A second problem with these conventional onsite systems is their inability to remove soluble pollutants which can then enter downstream waterways when the wastewater is removed from the basins.

An innovative approach for improved onsite treatment for algal control and contaminant removal in lagoons and retention basins is being evaluated at Fleming College's Centre for Alternative Wastewater Treatment. Working in Collaboration with Queen's University and C&M Aquatic Management Group, researchers are looking into the efficiency of using floating vegetated wetlands for the removal of pollutants and contaminants as an improvement to onsite treatment systems. This research (supported by both OMOE and NSERC) began in the summer of 2010 and is separated into two separate sections; a large field scale study (figure 1) and a lab scale study for controlled conditions. The research will continue into 2012.



Figure 1: Aerial view of study site located at Fleming College, Lindsay, ON.

Floating Wetland Research

Floating vegetated wetlands, as the name implies, are buoyant structures planted with aquatic vegetation such that the roots penetrate through the structure and are hydroponically immersed in wastewater.

Various companies worldwide manufacture variations of these wetlands. Some of the more well known technologies within North America are Biohaven® Technology and Beemats. Although using different approaches for design, the technologies serve the same purpose; restoration, aesthetics and temperature mitigation. Mimicking natural wetlands, floating wetlands can serve as a method of bioremediation with the roots serving as a substrate for microbes; the structure serving as a flotation device and the vegetation above the mats serving for aesthetic purposes. These wetlands allow the wastewater to pass through the roots of the plants thereby filtering the water of contaminants.

The introduced vegetation (in this study *Typha angustifolia*) which is installed at the surface of a water body is being investigated for its effect on various water quality parameters including total phosphorus, orthophosphate, nitrate/nitrite, ammonia, dissolved oxygen, temperature, pH, chlorophyll a, *Escherichia coli*/ total coliform and microcystins.



Figure 2: View of Floating wetland on one of the fifteen test ponds.

The field scale study is composed of fifteen ponds averaging 57m³ where nine of these fifteen ponds have been retrofitted with floating vegetated wetlands. Nine of the ponds (six ponds with vegetated wetlands and three without wetlands) are dosed monthly with simulated wastewater. The field study will provide a good indication of the performance of floating wetlands as implemented in a natural environment both in summer and winter. Field studies can prove to be challenging especially when looking at nutrients and pollutant removal as natural variability can increase or decrease these amounts indirectly. Therefore, the second part of this research involves the study on a smaller, indoor lab scale study to increase control of natural variables. The lab scale study is composed of fourteen 140L bins with four of the bins retrofitted with vegetated wetlands, four with wetlands (without vegetation) and six without vegetated wetlands. The purpose of this study is to introduce nutrients and contaminants that are regularly found in retention basins and lagoons, allow for ideal growth conditions of blue-green algae, and evaluate whether the floating wetlands can effectively remove both microcystins and *E.coli* without the unpredictability of nature.

Preliminary results suggest that under high nutrient conditions, wetland growth in the floating islands displaces algal growth.