Floating Treatment Wetland Technology: Total Phosphorus Removal from Wastewater

This case study illustrates the Floating Island International (FII) patented floating treatment wetland (FTW) technology and its ability to reduce total phosphorus levels in wastewater. Constructed of post-consumer polymer fibers ("matrix") and vegetated with native plants, FTWs mimic the ability of natural wetlands to clean water by bringing a "concentrated wetland effect" to any water body.

Since their initial implementation nearly a decade ago, one of the primary objectives of FII's floating treatment wetlands has been to reduce objectionable nutrient levels. Potential applications include waterways degraded by agricultural runoff, ponds and lakes impacted by waterfowl and/or septic systems, polishing of municipal wastewater and even treatment of raw wastewater.

Table 1 illustrates total phosphorus removal in five studies equipped with FTWs. The table includes phosphorus concentrations, percent removals and removal rates in pounds of total phosphorus removed per year per cubic foot of FTW material.

TABLE 1. FTW TOTAL PHOSPHORUS REMOVAL

	Phosphorus Concentration (mg/L)			Percent Removal		Removal Rate (lb/yr/ft^3)	
Study	**Influent**	**FTW**	**Control**	**FTW**	**Control**	**FTW**	**Control**
MBRCT Tank Test	15.9	1.5	NA	91%	NA	0.52	NA
MBRCT Test Pond	13.6	5.2	6.4	62%	53%	0.13	0.08
Wiconisco	8.1	4.7	5.1	42%	37%	0.30	0.26
Shepherd Pond	0.6	0.2	NA	67%	NA	0.05	NA
Yingri Lake	0.93	0.29	NA	69%	NA	NA	NA

The earliest study conducted by FII researchers for a Montana Board of Research and Commercialization Technology (MBRCT) grant was a small-scale FTW (tank test), which did not include a "control" lagoon. The MBRCT Test Pond and Wiconisco system are relatively small wastewater systems that included "control" lagoons, which were parallel lagoons treating the same influent wastewater but without FTWs. The Shepherd Pond and Yingri Lake are lake restoration efforts which do not have "control" conditions.

Total phosphorus removal ranged from 42% to 91% in the five systems. FTWs in the MBRCT and Wiconisco studies improved phosphorus removal by 9% and 5% compared to the control lagoons. Efforts are currently underway at FII to further enhance FTW phosphorus removal through biological, chemical and physical mechanisms.

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The Wiconisco system was one of the first full-scale FTWs installed in 2005 and treats an average flow rate of 16 gpm. The Yingri Lake system was installed in 2010 and is shown in Figure 1.

Figure 1. Floating Islands at Yingri Lake, Jinan, China 2010

Researchers have estimated that approximately 80% of the FTW efficacy is due to bacteria attached to plant roots and the FTW polymer matrix itself, with the other 20% attributed to nutrient uptake by plants. The plants create the platform for biological activity in a biofilm, while also contributing nutrient uptake and aesthetic benefits. This is illustrated in Figure 2.

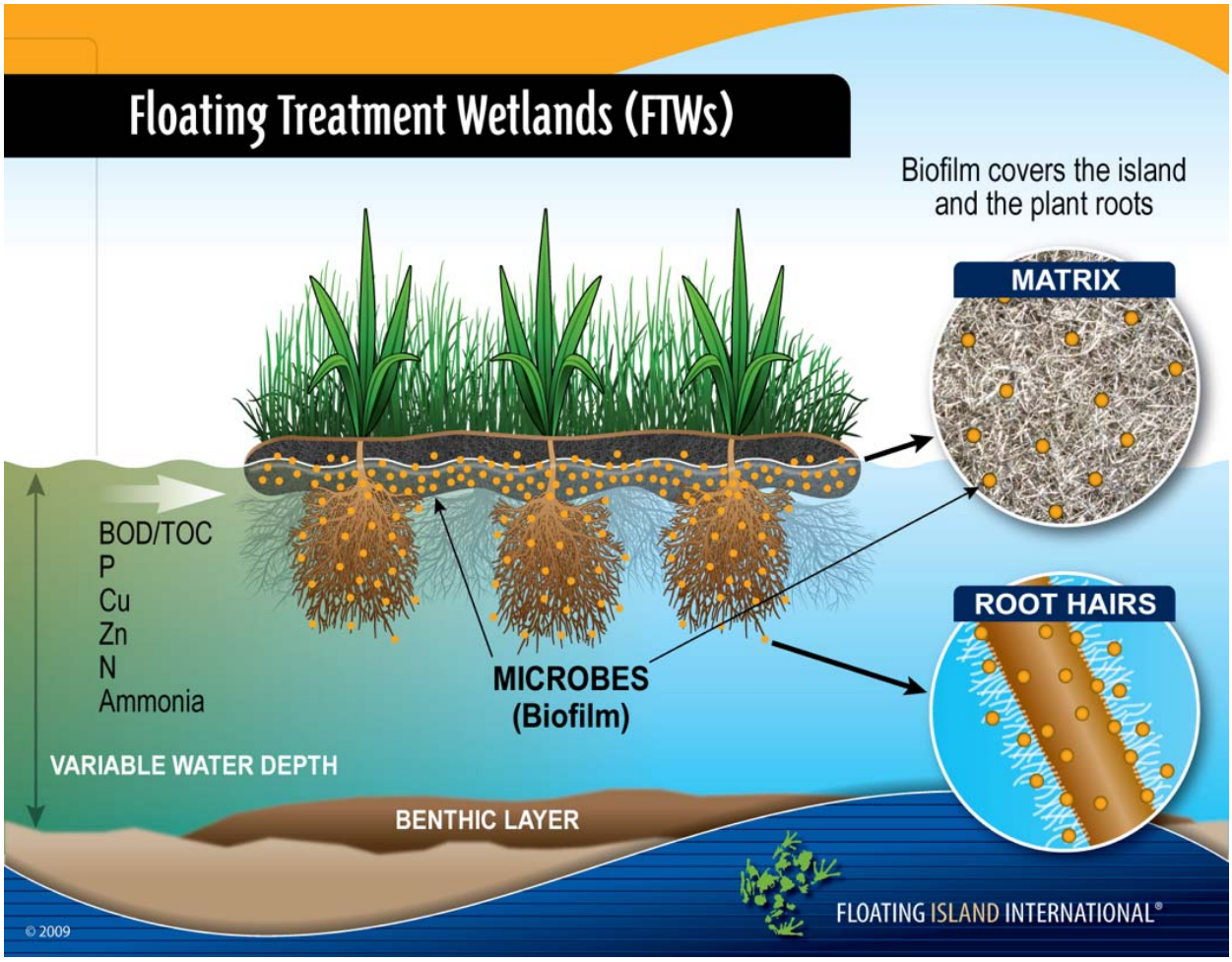

Figure 2. Illustration of FTW biological activity

Conclusion:

The need to reduce nutrient levels in wastewater is increasingly critical as rivers, lakes and coastal waters become more nutrient-loaded worldwide. This is the entry point for cutting edge, "green" floating treatment wetland (FTW) technology.

Although traditional wastewater lagoons can reduce BOD and TSS, their ability to remove nitrogen and phosphorus from municipal wastewater is limited. FTW technology enhances these lagoons with the "concentrated wetland effect," facilitating compliance with increasingly stringent wastewater nutrient, BOD and TSS criteria.