

## BioHaven® Technology: Ammonia Removal in Aerated Wastewater Lagoons

Ammonia removal with BioHaven® floating treatment wetlands (FTWs) is summarized in this study. Removal rates in aerated wastewater lagoons were improved up to nearly 200% compared to control lagoons without FTWs.

Since their initial implementation nearly a decade ago, one of the primary objectives of BioHaven technology from Floating Island International (FII) has been to reduce 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 ammonia removal at five sites equipped with FTWs. The table includes ammonia concentrations, percent removals and removal rates in pounds of ammonia-nitrogen removed per year per cubic foot of FTW material.

**TABLE 1. FTW AMMONIA REMOVAL**

Study	Ammonia-N Concentration (mg/L)			Percent Removal		Removal Rate (lb/yr/ft <sup>3</sup> )	
	Influent	FTW	Control	FTW	Control	FTW	Control
MBRCT Tank Test	149	40	NA	73%	NA	0.4	NA
MBRCT Test Pond	172	22	112	87%	40%	0.9	0.4
Wiconisco	47.8	19.3	25.6	60%	51%	2.5	1.9
Rehberg Ranch	44.1	7.2	18.7	84%	58%	1.3	0.9
Elayn Hunt Correctional Facility	16.0	10.0	NA	38%	15%	5.3	1.8

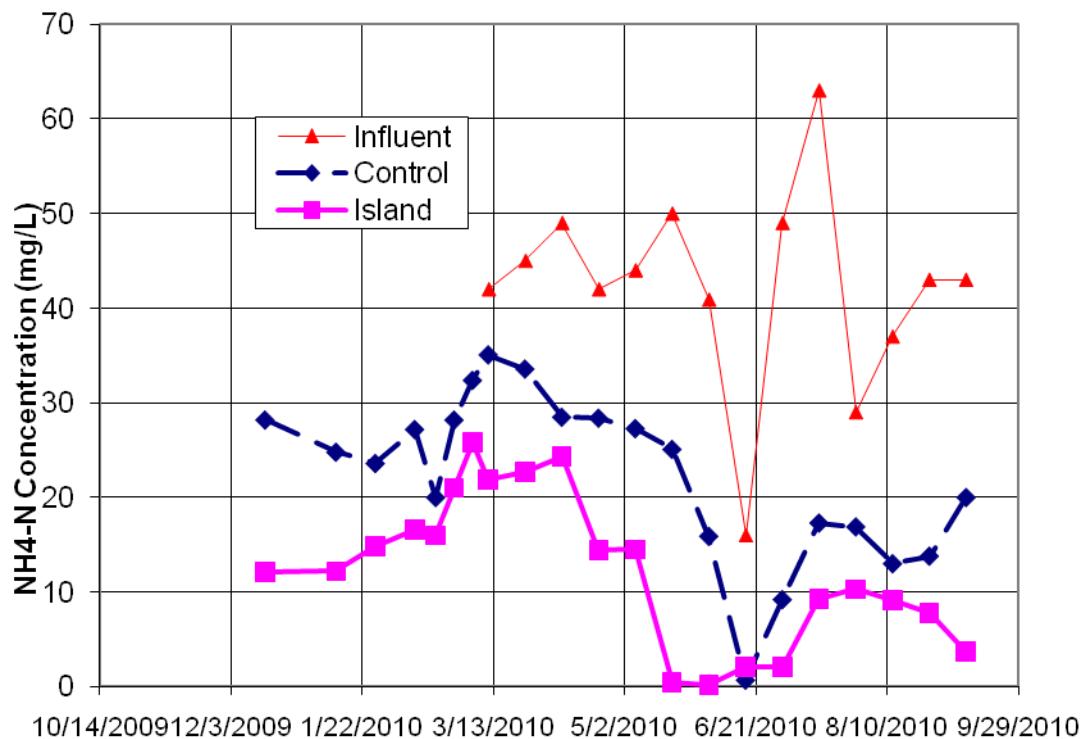
All five systems presented in Table 1 are variations of wastewater lagoons at different scales. The earliest study conducted by FII researchers for a Montana Board of Research and Commercialization Technology (MBRCT) grant was a small-scale BioHaven which did not include a “control” lagoon. The next three studies included controls, which were parallel lagoons treating the same influent wastewater but without FTWs. The Wiconisco and Rehberg Ranch FTWs are small systems treating average flows of 16 and 12 gallons per minute (gpm), respectively. The Hunt Facility FTW is a full-scale production system in Louisiana treating about 200 gpm.

Ammonia removal ranged from 38% to 87% in the five systems. The Rehberg Ranch FTW removed 26% more ammonia than the control lagoon (84% vs. 58%), while the Wiconisco

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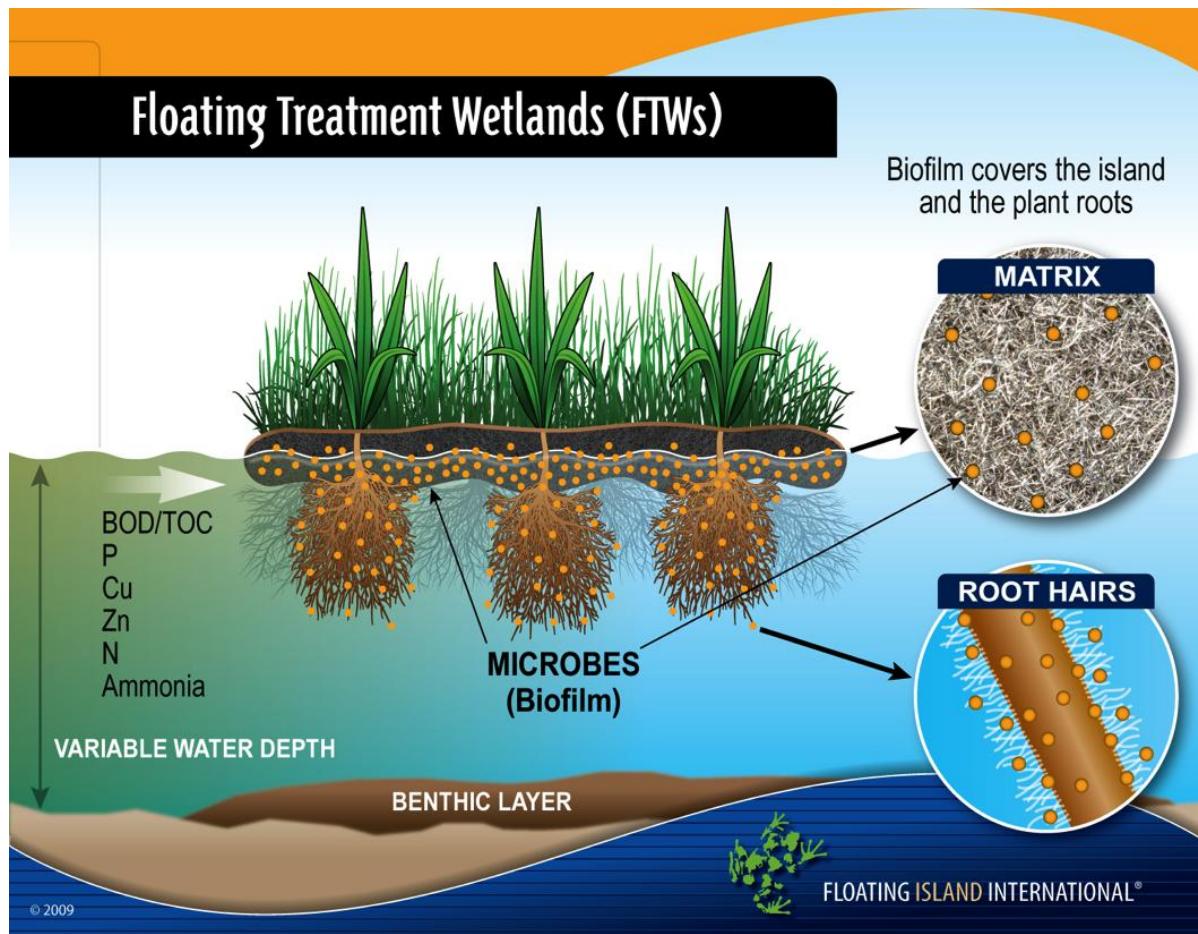
FTW was 9% better than the control. The highest ammonia removal rate, 5.3 lb/ft<sup>3</sup>/yr, was measured in the Hunt system, which was installed in 2011. This rate was 194% higher than the control removal rate measured before BioHaven installation.

Ammonia concentrations at Rehberg Ranch are illustrated in Figure 1.



*Figure 1. Rehberg Ranch - Ammonia*

Nitrification (biological conversion of ammonia to nitrate under aerobic conditions) is the primary mechanism for ammonia removal in these systems. Both the Wiconisco (Pennsylvania) and Rehberg Ranch (Montana) FTWs are located in cold-weather climates, which has traditionally limited biological ammonia removal. Researchers have estimated that approximately 80% of 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*

The Rehberg Ranch system, installed in late 2009, is a new-generation FTW called Leviathan™ that includes a pump for circulation and aeration. The Wiconisco system was one of the first full-scale BioHavens installed in 2005 and a solar-powered aeration system was added in 2008. The FTWs at Rehberg Ranch (Billings, Montana) and Wiconisco (Pennsylvania) are shown in Figures 3 and 4.

## 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 such as BioHavens.

Although traditional facultative and aerated lagoons can reduce Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS), their ability to remove nitrogen and phosphorus from municipal wastewater is limited. BioHaven technology enhances these lagoons with the “concentrated wetland effect,” facilitating compliance with increasingly stringent wastewater nutrient, BOD and TSS criteria.



*Figure 3. Rehberg Ranch FTW, July 2010*



*Figure 4. Mature BioHavens at Wiconisco, 2009*