

## University of Minnesota Dairy Milk-House Wastewater Treatment

The University of Minnesota is currently conducting a comparison utilizing three alternative technologies for the treatment of Milk-House waste at selected Minnesota dairies. These studies are ongoing, but data gathered to this point has now been submitted by Principal Investigator Sara Christopherson to the ASAE annual conference. The following is a synopsis of these data along with a recent update.

Each dairy in the comparison received Milk-House waste, high in milk solids and manure, in a 3,786 gallon septic tank. Two dairies were fitted with FAST systems, operating with a 1.5 HP blower in a 10,220 gallon treatment tank. Two dairies were fitted with Nibbler systems, operated with a 1.5 HP blower in a 13,626 gallon treatment tank. One dairy was fitted with a Pirana ABG, operated with a 0.1 HP air pump, in a 3,786 gallon treatment tank. Disposal from the Pirana unit was with a Geoflow drip emitter system.

The following table demonstrates the treatment efficiencies with the flow and retention time for each system.

Table 1. Flows, BOD loads, BOD reductions and residence times for the comparative systems.

System	Daily Flow	Tank Capacity	Retention Time	BOD Influent	BOD Effluent
FAST -1	1,363 L	10,220 L	7.50 days	489 mg/l	131 mg/l
FAST -2	1,438 L	10,220 L	7.11 days	3145 mg/l	574 mg/l
NIBBLER -1	2,063 L	13,626 L	6.60 days	2755 mg/l	1584 mg/l
NIBBLER - 2	784 L	13,626 L	17.38 days	1329 mg/l	112 mg/l
PIRANA	636 L	3,786 L	5.95 days	754 mg/l	174 mg/l

As can be seen, the reduction of BOD in the systems was variable, with all systems achieving a substantial improvement.

A more informative comparison can be made by calculating the Kg of BOD removed per day as a function of both the energy consumption (HP) and the retention time of treatment. This is presented in Table 2.

Table 2. BOD removal efficiency as a function of energy consumption and treatment time.

System	Kg BOD removed/day	Kg BOD removed per unit HP	Kg BOD/HP removed / aeration days
FAST - 1	0.49	0.33	0.044
FAST - 2	3.70	2.46	0.346
NIBBLER - 1	2.42	1.61	0.244
NIBBLER - 2	0.95	0.63	0.036
PIRANA	0.37	3.70	0.622

When the energy consumption and the retention time in the aeration basin is factored in the Pirana system proves to be almost twice as efficient as the best reading achieved by the other systems, and almost four times the average of the other systems.

Recent data shows that Pirana treatment efficiency is increasing with increased load as the septic tank begins to mature. The most recent measurement showed an influent BOD of 1,200 mg/l and an effluent BOD of 90 mg/l. Using these newest data we have 0.71 Kg/day removal, a 7.08 Kg removed/HP and a 1.19 Kg/ HP/ day treatment. This is nearly a seven fold increase over the average of the FAST and Nibbler treatment systems.

Other considerations are the comparative cost with FAST at \$11,000, the Nibbler at \$14,000 and the Pirana at \$5,000.

Fats, oils and greases (FOG) are a significant problem with dairy milk wastes. Table 3 presents the FOG removal rates for the systems.

Table 3. FOG concentration in septic effluent (mg/l) and after treatment along with percent removal.

System	FOG Influent mg/l	FOG effluent mg/l	Percent removal
FAST - 1	89	13	85
FAST - 2	1196	69	94
NIBBLER - 1	572	267	53
NIBBLER - 2	384	12	95
PIRANA	135	3	98

Again, the Pirana appears to have the highest FOG removal efficiency, particularly when one considers the lower energy and retention times for these comparisons. The low absolute value of FOG is largely what allows the Pirana to be used along with Geoflow drip emitters, even with this high strength waste.