

FECAL COLIFORM REDUCTIONS IN PIRANA TEST INSTALLATIONS

Pirana devices have been installed in septic tanks at two municipal WWTP's, one in Buzzard's Bay, Mass. and the other at the Comax-Squamish WWTP in British Columbia.

In both instances the septic tanks are loaded using the NSF protocol for testing. Raw influent into the WWTP is fed to the septics at a rate of 330 gpd and timed to mimic a standard household load schedule.

At Buzzard's Bay two separate systems were studied. In one a single septic tank with a Pirana installed was used to load 14 foot long leach trenches using tire chips in place of aggregate. This system is designated as TC in the spread sheet. The other system consists of three septic tanks, F1, F2, and F3. A Pirana is installed in F2 while the others act as septic controls. Each tank discharges to a 14 foot standard aggregate filled leach trench with a washed sand bottom. Beneath the sand layer of each trench at 2 feet below the bottom of the trench is a pan that captures percolate from the trench, and at 4 foot depth below the entire system is an impermeable membrane leading to a sump where effluent from the three trenches is collected. Percolate from the TC system is collected from a pan 12" beneath the washed sand bottom of the trenches.

The septic tanks are 1,000 gallon single chambers without a baffle. They flow to a D-box that can split loads so the load to the trenches can be varied. At the onset of the experiment all trenches received $\frac{1}{4}$ the daily load or 82.5 gpd. The control trenches were maintained at that load throughout the trial. The Pirana tank (F2) received incremental flow increases until it was finally loaded with the entire daily load of 330 gpd to just a 14 foot leach trench.

Fecal coliform was measured as MPN/100 ml and is presented in the following tables. Sample points include the raw influent, readings at the D-box, readings from the 2 foot pan beneath the leach trenches, and the 4 foot sump, and in the TC system from pans 12" below the leach trench bottom. Daily effluent loads to the leach trenches are included in the table for comparison.

Table 1. Fecal coliform readings at the Buzzard's Bay test site for the F2 and F3 systems. Leach trenches of 14 feet length and a two foot sidewall were filled with aggregate. F2 is the Pirana and F3 is standard septic control.

F2 system					
Date	Raw Inf.	D-box	2 ft	4 ft	Load/gpd
6/26/2002		620,000	50		82.5
7/3/2002	6,300,000	750,000			82.5
7/10/2002	4,100,000	1,070,000	200		110
7/17/2002	4,500,000	700,000	400		165
7/24/2002	2,200,000	730,000	100		165
7/31/2002	4,000,000	240,000	50		165
8/21/2002		1,150,000	1,600		330
8/28/2002	10,300,000				330
9/4/2002	9,700,000	790,000	14,700		330
9/18/2002	7,100,000	260,000	100		330
9/25/2002	3,100,000	100,000	9,500		330
10/2/2002	4,850,000	130,000	600		330
10/9/2002		340,000	1,500	5	330
10/16/2002	3,150,000	230,000	8,600	0	330
10/30/2002	4,900,000	40,000	50	10	330

F3 system					
Date	Raw Inf.	D-box	2 ft	4 ft	Load/gpd
6/26/2002			2,500		82.5
7/3/2002	6,300,000				82.5
7/10/2002	4,100,000		50		82.5
7/17/2002	4,500,000		50		82.5
7/24/2002	2,200,000		50		82.5
7/31/2002	4,000,000		50		82.5
8/21/2002					82.5
8/28/2002	10,300,000				82.5
9/4/2002	9,700,000				82.5
9/18/2002	7,100,000		50		82.5
9/25/2002	3,100,000		50		82.5
10/2/2002	4,850,000		10		82.5
10/9/2002		460,000		5	82.5
10/16/2002	3,150,000	640,000		0	82.5
10/30/2002	4,900,000	1,000,000		10	82.5

At the onset of the trial both F2 and F3 leach trenches had ponding of about 8". By 6/26 the F2 trench had no ponding and never developed ponding during the rest of the trial despite increase in loads. Fecal removal rates at the 2 foot level in the Pirana system (F2) was equivalent to the control (F3) despite unclogging of the leach trench biomat, even with a doubling of loading rates. At four times loading some breakout of fecals occurred in the F2 trench at 2 feet, however, at the 4 foot level fecal removal was almost total.

Table 2. Fecal measurements in the TC system at the Buzzard's Bay test site.

TC system					
Date	Raw Inf.	D-box	12 inches	Load/gpd	
6/26/2002		820,000	600		82.5
7/3/2002	6,300,000	450,000	3,800		82.5
7/10/2002	4,100,000	170,000	1,000		110
7/17/2002	4,500,000	680,000	600		165
7/24/2002	2,200,000	450,000	1,600		165
7/31/2002	4,000,000	240,000	260		165
8/21/2002		60,000	330		330
8/28/2002	10,300,000		1,770		330
9/4/2002	9,700,000	6,720,000	1,120		330
9/18/2002	7,100,000	140,000	930		330
9/25/2002	3,100,000	120,000	360		330
10/2/2002	4,850,000	50,000	790		330
10/9/2002		170,000	770		330
10/16/2002	3,150,000	50,000	160		330
10/30/2002	4,900,000	70,000	120		330

Fecal removal rates in the TC system are consistent with the findings of the F2 system exhibiting a 1-2 log reduction in the mixed tank and another 2 log reduction in the first 12 inches of washed sand under the trench. Again, load increases did not significantly affect removal rates.

Comax-Squamish Test center, British Columbia

A Pirana installation in a septic tank at the Comax-Squamish WWTP in British Columbia, Canada was fed raw influent using the same protocol and loading as at Buzzard's Bay. The primary difference between the installations was that the BC tank is a 1,200 gallon two chambered septic with baffle. The Pirana is installed in the 800 gallon inlet chamber. Samples were taken from the outlet tee of the second chamber and analyzed for fecal counts (MPN/100 ml). This system did not have a leach disposal test trench.

As can be seen the reduction in fecal concentration in the tank is at or above the 2 log reduction typically seen in NSF approved ATU systems, even though the Pirana system has no separate trash tank associated with it and is, instead, placed directly into the septic tank.

Influent fecal concentration = 2,390,000 CFU/100 ml

Effluent fecal concentration = 26,000 CFU/100 ml on 9/10/02
9,200 CFU/100 ml on 9/19/02

Discussion

There has been some concern in the regulatory community that the rapid recovery of percolation associated with installation of the Pirana may affect pathogen removal in the soil. This is based on the widespread concept that

clogging of the soil in a leach trench is a necessary component of pathogen removal by the biomat. The results at the Buzzard's Bay test site demonstrate that the increases in percolation after soil opening by the Pirana bacterial treatment have no affect on pathogen removal, as measured by fecal coliform concentrations. This is true even when the improved trenches are tested by increases in load. With 4 feet of separation in washed sand fecal removal is almost total even at the unusually high load of 330 gpd in a 14 foot long trench. This trench has 56 sq.ft. of infiltrative surface so the above load translates to almost 6 gpd/sq. ft.

The reductions in the tank show that fecal removal occurs at a rate equivalent to that seen in the NSF-40 standard for typical ATU's, even though the Pirana is placed directly in the trash tank of the system. A standard ATU is fed with effluent that has already received primary septic settling. At the Buzzards Bay site the reduction in the tank were lower than at Comax-Squamish, but this is due to the fact that the tanks at Buzzard's Bay were single chambered and completely mixed. At Comax the tank has two chambers, more typical of modern septic systems. Of particular interest is the fact that soil porosity opened and continued to improve even though there was no quiescent zone in the tanks and the tanks were fully mixed.

It can be concluded from this that the slime layer that clogs a typical anaerobic septic leach trench is not an essential component of pathogen filtration. A biomat composed of facultative aerobes in the Pirana Blend™ is able to remove fecal coliform at a comparable rate even with as much as 4 times the loading.

Pirana System
2004