

RESEARCH SUMMARY



INFILTRATOR®
systems inc.

Effluent Distribution in Chambers and Perforated Distribution Pipe

July 2005

Multiple studies conclude that perforated distribution pipe does not provide “equal distribution” within gravity fed onsite wastewater trenches.

Wastewater Distribution within a Chamber Trench

Research on the distribution of septic tank effluent within a trench system (gravity flow) demonstrates that uniform distribution across the trench bottom is achieved without a perforated pipe. As wastewater enters the chamber at the inlet end, it flows over the biomat which has formed on the trench bottom. This biological growth forms progressively from the inlet end of the trench and extends to the full trench length to form a mature on-site system (Figure 1). Due to the relatively low permeability of the biomat, wastewater typically ponds achieving a uniform elevation along the trench length. The biomat provides infiltration along the entire length of the trench, and is the mechanism by which uniform distribution is achieved. Therefore the biomat provides equal distribution, not the perforated pipe.

Wastewater Distribution within a Gravel and Pipe Trench

The mechanisms that provide distribution of septic tank effluent in a chamber trench are identical to the mechanisms working within a gravel and perforated pipe trench flowing under the force of gravity. As with chambers, water enters the stone and pipe trench at a single point. Due to the low flow rates (approximately 1.6 gallons/minute at peak flow, which is washer discharge) wastewater discharges from a single location along the perforated pipe (Figure 2). The single discharge location may correspond to either a low point along the axis of the pipe (perforations oriented in the 4 and 8 o'clock positions), or the first few perforations that wastewater encounters upon entering the pipe (perforations oriented in the 6 o'clock position). From the point discharge location, distribution within the drainfield is provided by the biomat, as discussed above for a chamber system.

Figure 1: Progressive Clogging of the Infiltrative Surfaces of Subsurface Absorption Systems (Bouma et al. 1972)

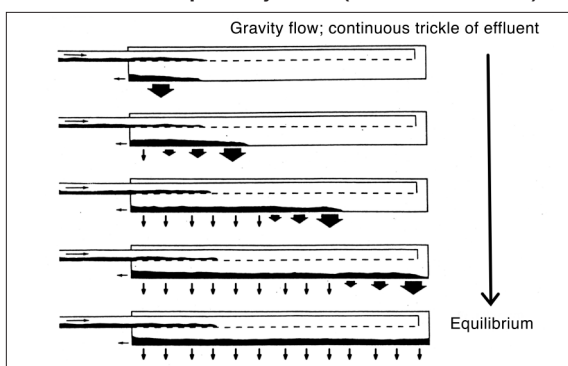
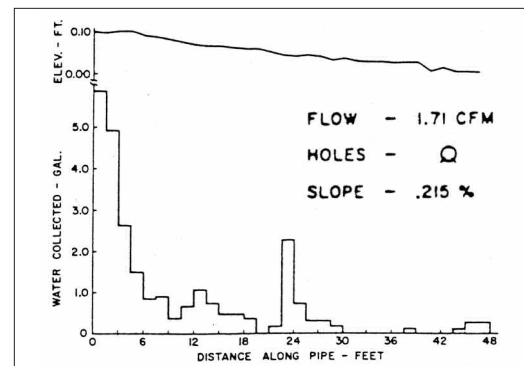


Figure 2: Distribution of Water Pumped at 12.71 gpm Along a 4-inch Perforated Bituminous Pipe (Converse 1974)



Does a chamber provide uniform distribution on the trench bottom under gravity flow?

- Yes, chamber systems with a mature biomat provide uniform distribution of septic tank effluent.

How is septic tank effluent distributed in a chamber under gravity flow?

- From the inlet location a biomat is formed, then effluent flows over the biomat and ponds with increased system usage/age.
- As the biomat matures toward the end of the trench, effluent continues to follow the “path of least resistance” until effluent equilibrium is achieved.
- As the effluent level in the chamber fluctuates, ponding occurs, with wastewater equalizing at a uniform elevation along the trench axis.
- For a ponded condition, water covers the entire trench bottom, providing uniform distribution.

How does effluent distribution compare for a chamber vs. stone and perforated pipe?

- Under gravity flow, these systems work based upon the same principles that biomat provides equal distribution.
- Water flows from the inlet point over the biomat, to a uniform ponding height, which results in even coverage of wastewater over the trench bottom.

Doesn't perforated pipe distribute water along the entire trench?

- No – perforated pipe provides a point discharge.
- For holes oriented downward (6 o'clock position), wastewater flows out of the first several holes at the inlet end of the trench. This is due to the low flow rates within the 4-inch-diameter pipe.
- For holes oriented on the sides of the pipe (4 and 8 o'clock positions), wastewater flows out of the holes located at the low point along the pipe, which is where wastewater accumulates, until reaching a level where it flows out of the holes.

Effluent Distribution in Chambers and Perforated Distribution Pipe

Documentation of Wastewater Flow in Perforated Pipe

Results of study by Machmeier and Anderson, "Flow Distribution by Gravity Flow in Perforated Pipe":

- "The term 'distribution pipe' as used for the pipe now commonly installed in drainfield trenches or seepage beds is definitely a misnomer with reference to liquid distribution."
- "With one row of perforations at the 6 o'clock position, effluent will be discharged into the drainfield rock near the head of trench or bed."
- "With perforations at the 4 and 8 o'clock positions, and the pipe absolutely level...effluent will concentrate at some random location where the perforations are at the lowest elevation."
- "If a pipe has a uniform slope it will concentrate at the far end."
- "...it is not likely that a perforated pipe will be installed as carefully in the field as for these tests, resulting in a random location for the concentration of effluent."
- "If pipe is necessary in a drainfield trench, it must be serving some function other than distributing effluent."

Results of study by Dee Mitchell, "Non-uniform Distribution by Septic Tank Systems":

- "...it was determined that flows less than one gallon per minute could not be uniformly distributed by the commercially available four inch diameter PVC pipe..."
- "The fluid either came out of one hole or all ran to the exit."
- "The surface tension was observed to be sufficient at each hole to prevent fluid from exiting."
- "...the liquid just flowed on each side of the hole...Any time surface tension was broken, all the liquid flowed out of the hole."
- "Poor distribution also occurred in the 4" diameter pipe even at a flow rate of 2.5 gpm..."
- "The fluid exited through only three of the nine holes ..."
- "...with this type of pipe, only the first 10-15 feet of a 60-100 foot lateral will receive septic tank effluent."
- "Even with dosing, uniform distribution in the lateral lines cannot be achieved using commercially available 4" diameter pipe."

Results of a study by Otis et al, "Effluent Distribution":

- "Many different distribution network designs have been used in a soil absorption system all with the intent of uniformly applying liquid...This is rarely achieved..."
- "Very poor distribution resulted with most of the water leaving the pipe at the inlet."
- "...when water was pumped in this pipe at a rate of 13 gpm, 97% of the water was distributed over 53% of the bed..."
- "Rotating the pipe 180 degrees...Gravity distribution through a 4" pipe with one row of holes at the crown gave poor distribution..."
- "The results indicate that the function of the 4" perforated pipe is merely to convey the effluent to the trench or bed."
- "Laying the pipe at a prescribed uniform slope and spacing is of no value because the effluent will exit the hole of lowest elevation."
- "Dosing does not greatly improve distribution because of the large number of holes."

References:

Machmeier, R.E. and J.L. Anderson, "Flow Distribution by Gravity Flow in Perforated Pipe," Onsite Wastewater Treatment: Proceedings of the Fifth National Symposium on Individual and Small Community Sewage Systems, American Society of Agricultural Engineers (St. Josephs, MI, 1988), pp. 224-231.

Mitchell, Dee, "Non-Uniform Distribution by Septic Tank Systems", Arkansas On-Site Domestic Wastewater Renovation Project (Fayetteville, Arkansas: University of Arkansas, 1983).

Otis, R.J., J.C. Converse, B.L. Carlile, and J.E. Witty, "Effluent Distribution," Proceedings of the Second NHSTS, American Society of Agricultural Engineers (1977), pp. 61-85.



INFILTRATOR[®]
systems inc.

www.infiltratorsystems.com
1-800-221-4436

U.S. Patents: 4,759,661; 5,017,041; 5,156,488; 5,336,017; 5,401,116; 5,401,459; 5,511,903; 5,716,163; 5,588,778; 5,839,844 Canadian Patents: 1,329,959; 2,004,564 Other patents pending. Infiltrator, Equalizer and SideWinder are registered trademarks of Infiltrator Systems Inc. Infiltrator is a registered trademark in France. Infiltrator Systems Inc. is a registered trademark in Mexico. Contour, MicroLeaching, PolyTuff, ChamberSpacer, MultiPort, PosiLock, Quick4, QuickCut, QuickPlay, SnapLock and StraightLock are trademarks of Infiltrator Systems Inc. © 2005 Infiltrator Systems Inc. All rights reserved. Printed in U.S.A.