Research Summary on Infiltration Efficiency of Gravelless Drainfields Compared to Gravel Aggregate Drainfields

January, 2009

Research Study	Description of Study	Increase factor in hydraulic loading in Gravelless vs. Gravel Aggregate $K_{gl} = F*K_g$
Sweeny, Robert. 2008. Field Inspection and Evaluation of the Hydraulic Performance of EZflow 1201P Gravel Substitute Drainfield Systems in Clackamas, Marion, Multnomah and Deschutes Counties, Oregon. Presented at 2008 OR DEQ Technical Advisory Committee meeting	436 field evaluations of 103 EZflow systems over a five year period for determining product failure rate	2.0
Christopherson et al. 2008. Field Comparison of Rock-Filled and Chambered Trench Systems in Journal of Hydrologic Engineering, Vol. 13, No. 8,	Field evaluation of over 100 gravel and chamber systems 5 to 10 years old	No failures detected for either system type
Lowe et al. 2008. Controlled Field Experiment for Performance Evaluation of Septic Tank Effluent Treatment during Soil Evaluation, , Journal of Environmental Engineering,	Two-year field study of 30 pilot-scale test cells.	1.4 – 1.8
Walsh, R. 2006. Infiltrative Capacity of Receiving Media as Affected by Effluent Quality, Infiltrative Surface Architecture, and Hydraulic Loading Rate, Master Thesis at Colorado School of Mines	One dimensional column study	3.2
Uebler et al. 2006. Performance of Chamber and EZ1203H Systems Compared to Conventional Gravel Septic Tank Systems in North Carolina, , Proceedings of NOWRA	Field evaluation of failure rates of approximately 300 of each type system (gravel, chamber, EPS) 2-12 years old	1.33
Radcliffe et al. 2005. Gravel and Sidewall Flow Effects in On-Site System Trenches, , Soil Science Society of America Journal	Two dimensional computer model (HYDRUS-2D)	1.5 – 1.93
Siegrist et al.2004. Wastewater Infiltration into Soil and the Effects of Infiltrative Surface Architecture, , Small Flows Quarterly	Two one dimensional column studies and pilot-scale field study	1.5 – 2.0
White and West. 2003. In-Ground Dispersal of Wastewater Effluent: The Science of Getting Water into the Ground. Small Flows Quarterly, 2003	Literature Review and One dimensional column study measuring the impact of gravel and fines (clean water)	2.5
King et al. 2002. Surface Failure Rates of Chamber and Traditional Aggregate-Laden Trenches in Oregon, Small Flows Quarterly	Field evaluation of failure rates of 198 chamber systems and 191 gravel systems 2-5 years old	1.6
Burcham, T. 2001. A Review of Literature and Computations for Chamber-Style Onsite Wastewater Distribution Systems, , Report commissioned by the Mississippi Department of Health	Literature review and computer model	1.43– 2.0

Joy, Douglas. 2001. Review of Chamber Systems and Their Sizing for Wastewater Treatment Systems, Ontario Rural Wastewater Centre Report, University of Guelph	Literature Review	1.67
Van Cuyk et al, 2001. Hydraulic and Purification Behaviors and their Interactions During Wastewater Treatment in Soil Infiltration Systems", Journal of Water Resources	Three-dimensional lysimeter study of treatment performance	1.67
Casper, Jay. 1997. Final Report: Infiltrator Side-by-Side Test Site, Killarney Elementary School, Winter Park, Florida. Report to State of Florida, Department of HRS.	Pilot-scale side-by-side study of 15 trenches (gravel and chamber).	1.6 – 2.3
Keys, JR. 1996. Septic Tank Effluent Infiltration and Loading Rates for Gravel and Chamber Absorption Systems. MS Thesis. University of Wisconsin-Madison	Triplicate comparison of 8 year old gravel and chamber systems i. No difference in performance of silt loam systems even though chambers loaded 1.65 x higher. No comparison made in sand.	1.65
Tyler, EJ, Milner, M, Converse, JC. 1992. Soil Acceptance of Wastewater from Chamber and Gravel Infiltration Systems, in Proceedings of 7th Northwest On-site Wastewater Treatment Short Course and Equipment Exhibition, University of Washington, Seattle, WA. September 1992, Pp. 93-104.	Earlier report (after 4 years) on study described above.	No conclusions made.
Barranco, EJ, Sherman, KM, 1991. Florida's Onsite Sewage Disposal (OSD) Experimental System Protocol, in On-Site Wastewater Treatment: Proceedings of 6th National Symposium On Individual and Small Community Sewage Systems, American Society of Agricultural Engineers, St. Joseph, MI, December 1991, Pp. 266 - 275	Field performance assessment of 50 Florida chamber systems (no gravel control) with an average age of 16.8 months. Success rate was 82%. Recommendations on effective evaluations (side-by-side) were incorporated in Casper evaluation described above.	No conclusions made
Amerson, RS, Tyler, EJ, Converse, JC. 1991. Infiltration as Affected by Compaction, Fines and Contact Area of Gravel, *in* On-Site Wastewater Treatment: Proceedings of 6th National Symposium On Individual and Small Community Sewage Systems, American Society of Agricultural Engineers, St. Joseph, MI, December 1991	Evaluation of 30 soil cells to assess impact of gravel compaction, contact area and fines. Ratios are the clean water infiltration rate ratios of an open soil surface (control) compared to one with gravel compaction, embedment, and fines.	2.1 – 2.6

Other References

2006. Uniform Plumbing Code.	International Standard	1.43
Siegrist, Robert. 2006. Evolving a Rational Design Approach for Sizing Soil Treatment Units, Small Flows Quarterly. Summer 2006	Proposed design methodology that takes into account BOD loading, soil type and infiltrative surface architecture.	1.33 – 2.0
2001. U.S. EPA Decentralized Systems Technology Fact Sheet – Septic Tank Leaching Chambers.	Literature Review and Recommended Usage	1.33