RESEARCH SUMMARY

"Surface Failure Rates of Chamber and Traditional Aggregate-Laden Trenches in Oregon"

INFILTRATOR® systems inc.

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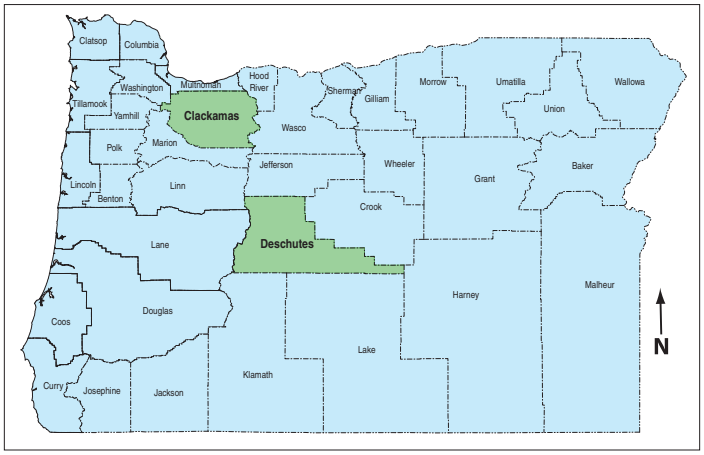
Oregon field study shows no statistical difference in failure rates between chambers installed with 50% basal area reduction and natural aggregate

Figure 1: Oregon Eastern (Deschutes) and Western (Clackamas) Study Areas (in green)



A field assessment was conducted to determine whether Infiltrator® Systems' Equalizer® 24 chambers (15"W x 12"H) performed equivalent to traditional natural aggregate trenches (24"W x 12"H). As part of this study, a total of 398 wastewater soil absorption systems were evaluated within two physiographic provinces/climates in Oregon (**Figure 1**: West - humid/temperate, East - semi-arid/high desert), and within a range of soil permeabilities (defined as low, medium and high) (**Table 1**). For 198 Equalizer 24 chamber systems and 191 natural aggregate trench systems, hydraulic failure rates for both system types were less than 2 percent (**Table 2**). Onsite systems included in the study were an average of 4 years old, varying in age from 2.9 to 5 years (**Table 3**), and sized at a 50% sizing reduction compared to aggregate systems (see opposite side for discussion). Results of the study indicate that there was no statistically significant difference in hydraulic failure rates between the two technologies. The study provides an assessment of real-life performance for chamber technology outside the laboratory, demonstrating that chamber systems provide performance reliability that is consistent with conventional aggregate technology.

Table 1: Distribution of Randomly Selected System Sites

	West region		East region	
Permeability	Chamber	Aggregate	Chamber	Aggregate
High	0	0	74	77
Moderate	36	36	39	38
Low	70	70	0	0
Total	**106**	**106**	**113**	**115**

Table 2: Hydraulic Function Statistics for Equalizer 24 Chamber and Natural Aggregate Trenches

	Chamber Trench		Natural Aggregate Trench	
	Number of Failed Systems	Number of Systems	Number of Failed Systems	Number of Systems
Soil Permeability				
High	1	39	0	44
Moderate	0	71	2	74
Low	1	88	1	73
Region				
West	1	99	2	91
East	1	99	1	100
Totals	2	198	3	191

How did chamber and aggregate failure rates compare?

- Hydraulic failure rates for both system types were less than 2%
- No statistically significant difference in failure rates was identified between the two technologies

How many systems hydraulically failed?

- Equalizer 24 chamber – 2 failures out of 198 total systems (1.0%)
- Natural Aggregate – 3 failures out of 191 total systems (1.6%)

What criteria were used to define a system failure?

- Hydraulic failure was defined as surface discharge of sewage on the ground surface at the time of evaluation

What was the size of the chamber vs. aggregate systems?

- Chamber systems were installed 50% percent smaller than aggregate trench systems

Were both system types installed in different soil types?

- Yes, installations were in low, medium and high permeability soil

Who conducted the study and why?

- Work was performed by experienced on-site wastewater scientists from The On-Site Corporation and Cpec Environmental, Inc., working with the Oregon Department of Environmental Quality (ORDEQ) and local county regulators
- The study was conducted as part of Infiltrator Systems' Equalizer 24 product approval in Oregon and at the request of the ORDEQ

Has the research been peer reviewed?

- Yes, the information was published in *Small Flows Quarterly* as a juried article (citation shown at bottom of page)

Table 3: System Age by Type and Location

Region	EQ24	Gravel	Total
West	99	91	190
East	99	100	199
Total	198	191	389
Avg. Age (yrs.)	3.8	4.0	4.0
Age Range (yrs.)	2.9-4.8	2.9-5.0	2.9-5.0

Text and graphics based on "Surface Failure Rates of Chamber and Traditional Aggregate-Laden Trenches in Oregon," *Small Flows Quarterly,* Fall 2002, Volume 3, Number 4. To request a copy of the *Small Flows Quarterly* article, contact Infiltrator Systems Inc. at 1-800-221-4436.

"Surface Failure Rates of Chamber and Traditional Aggregate-Laden Trenches in Oregon"

System Size Versus Performance Characteristics

Table 4: Minimum Length of Equalizer 24 Chamber Trench Required for a Four Bedroom Home

State	Length of Equalizer 24 Chambers Required for a 4 Bedroom System (feet)	State Soil Description	Equalizer 24 Approval Description
Oregon	300	Soil Group B	Equivalent to 24" Aggregate Trench
Maine	234	Medium	4.0 square feet/ linear foot
Idaho	333	B-2 (Loam, Silt Loam)	Equivalent to 24" Aggregate Trench
Kentucky	346	Soil Group 2 - Loam	Equivalent to 24" Aggregate Trench
New York	433	30 mpi	Equivalent to 24" Aggregate Trench
Illinois	464	30 mpi	2.5 square feet/ linear foot

Source of System Sizing Differences

Chamber system sizing criteria vary between regulatory jurisdictions in the United States and Canada. These variations translate to differences in the minimum length of systems constructed using the Equalizer 24 and other chamber models. The primary source of sizing differences is the magnitude of the sizing reduction allowed under the applicable regulations.

Scientifically, a chamber system that is 40 percent as large as a natural aggregate system provides approximately equal open trench bottom area to natural aggregate. This equates to a 60 percent sizing reduction. State and county regulators build factors of safety into regulations by allowing sizing reductions that are comparatively less than the proven maximum. In the United States, typical sizing reductions for chambers are 40 percent, as compared to the 60 percent proven maximum.

Table 4 exemplifies the range of sizing that occurs between states where the Equalizer 24 chamber is approved for use. Sizing shown in the table is based on similar soil permeabilities, and a four bedroom home. As a result, differences in system size result from jurisdictional differences in the allowable reduction for chamber systems, as well as differing soil loading rates and assumed design flow rates.

State Sizing Comparison and Performance

As shown in **Table 4**, the minimum number of linear feet of chamber required for a 4-bedroom chamber system ranges between 234 feet (Maine) and 464 feet (Illinois). By comparison, statistical analysis shows that the hydraulic performance of a 300-foot-long Equalizer 24 chamber system in Oregon provided performance reliability in line with a natural aggregate trench system. Hydraulic failure rates for both system types in Oregon were less than 2 percent, even though chamber trenches had 50 percent less basal area than natural aggregate systems.

The Oregon field performance study data demonstrate that chamber systems installed at reduced sizing compared to traditional natural aggregate systems provide a level of reliability that is consistent with traditional aggregate. Further, chamber systems in Oregon are generally sized with smaller basal areas than other states, such as Idaho, Kentucky, New York, and Illinois. If using Oregon sizing as a baseline, where performance is shown to be acceptable, additional basal area translates to added factor of safety against system hydraulic failure.

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