ecodrain™

Summary of Independent Test Report completed by the Engineering Department at Concordia University. The test report is available upon written request.

The ecodrain B1000 is a heat exchanger that enables the recapturing of heat from waste water in large drainage systems such as the 8" – 12" drain pipes found in the garages of large apartment and commercial buildings. These drains are often accessible, and represent an untapped source of clean renewable energy.

Image 1 – Ideal location for heat recovery using Ecodrain B1000

Image 2 – B1000 testing at Concordia University Energy and Heat Transfer Laboratory

Although the water in these drains mixes hot water from showers with cold water from toilets, two factors make recapturing heat from this water practical: Even cold water in drainage systems is typically warmer than incoming cold water because it has been heated by the building. Heat transfer is driven not only by temperature difference but also by mass of the fluid being transferred. The basic equation for calculating the power required to heat water in kilowatts (kW) is

$$Q = \dot{m} C_p dT$$

Where $\dot{m}$ is the mass flow rate, normally in kg/s
Cp is the specific heat capacity of water (kJ/kgK)
dT is the temperature rise of water (^{o}C)

Since Cp is constant, the only way to increase Q, is to either increase ṁ or dT. What this means is that a large volume of moderately warm water can have as much if not more energy to transfer than a smaller volume of higher temperature water.

The Energy and Heat Transfer Laboratory in the Department of Mechanical and Industrial Engineering at Concordia University was hired to independently test the 8" Ecodrain B1000. The heat exchanger is made up of tubes clamped to the bottom of a drain pipe. The reason that the tubes are at the bottom of the pipe only is that drain pipes are oversized, and typically only filled at the bottom. The tests were conducted at relatively low flow rates as the only standard available at the time for testing this type of heat exchanger was designed for smaller heat exchangers targeted at a single shower, rather than for recapturing heat from the main drains of an entire building. In conducting these tests, it became evident that at this low flow rate, only a small portion of at the bottom of the 8" pipe was filled with water. Most of the heat transfer tubes beneath the 8" pipe were not being warmed by the drain water. It was decided to measure the temperature rise in each tube individually. A large variance was observed between the temperature rise of the tube at the bottom center, and the others. The further on the periphery the tubes were located, the lower the efficiency. This test demonstrated that efficient heat transfer was possible and also concluded that with a higher flow rate of drain water, the temperature rise of water in the tubes on the periphery would go up, and the overall efficiency would increase. The study also concluded that the heat loss from the warm drain water to the environment is minimal.

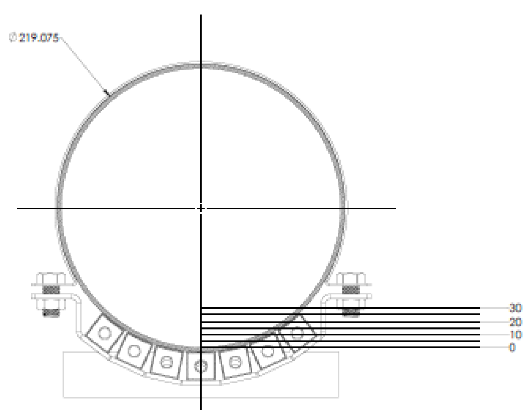


Fig 1. Water level in mm inside the 8" pipe.

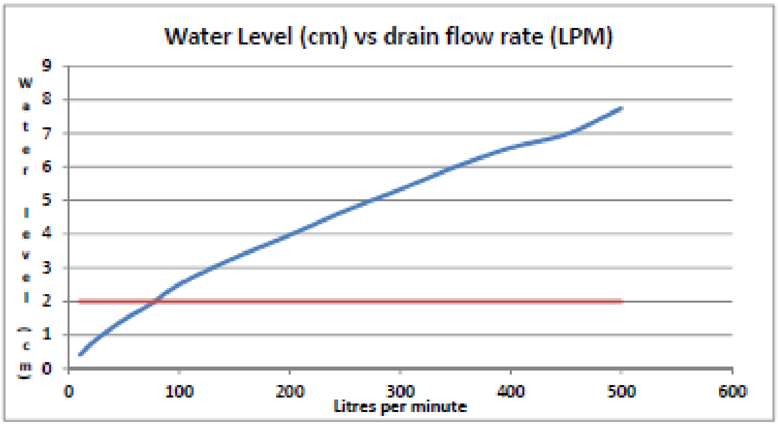
Figure 1 shows the water level in mm inside the 8" pipe. Using basic trigonometry, and knowing experimentally the velocity of gravity draining water, it is possible to calculate the flow rate corresponding to the water level. This is shown in the table on the next page. The calculations show that for an 8" pipe, with a slope of 3.5^{o}, the minimum water level for efficient heat transfer is 20 mm which corresponds to a flow rate of 80 litres per minute.

Water level in drain pipe (in cm) vs flow rate of drain water (litres per minute)
8.625" OD drain pipe

Flow (LPM)	Area	Radius	R2	X	Angle	Theta	Sin Theta	Y	h (cm)
10	0.00023	0.1095	0.01199	0.038365	31	0.541052	0.502943	0.038109	0.4
25	0.00057	0.1095	0.01199	0.095077	45.5	0.794125	0.698644	0.095481	0.86
50	0.00115	0.1095	0.01199	0.191823	59.5	1.038471	0.847629	0.190842	1.45
75	0.0017	0.1095	0.01199	0.283564	69	1.204277	0.921917	0.28236	1.93
100	0.0023	0.1095	0.01199	0.383645	77.5	1.35263	0.968092	0.384539	2.5
150	0.0035	0.1095	0.01199	0.583808	91	1.58825	0.999717	0.588533	3.29
200	0.0046	0.1095	0.01199	0.76729	100.5	1.754056	0.990534	0.763522	3.97
250	0.0058	0.1095	0.01199	0.967453	110	1.919862	0.955572	0.964291	4.69
300	0.0069	0.1095	0.01199	1.150935	118	2.059489	0.906784	1.152704	5.33
350	0.0081	0.1095	0.01199	1.351098	126	2.199115	0.841251	1.357864	6
400	0.0092	0.1095	0.01199	1.53458	132.5	2.312561	0.7765	1.536061	6.57
450	0.01	0.1095	0.01199	1.668022	137	2.391101	0.726072	1.665029	6.97
500	0.0115	0.1095	0.01199	1.918225	145.5	2.539454	0.61949	1.919964	7.74

Flow (LPM)	Height (cm)	Critical Height*
10	0.4	2
25	0.86	2
50	1.45	2
75	1.93	2
100	2.5	2
150	3.29	2
200	3.97	2
250	4.69	2
300	5.33	2
350	6	2
400	6.57	2
450	6.97	2
500	7.74	2

*Water level at which all tubes are covered.



Conclusions:

The 8” B1000 was independently tested by the Engineering Department at Concordia University. The test report is available upon written request. The tests demonstrated that the heat transfer from the drain water to the heat exchanger beneath it varied based on the position of each tube in the heat exchanger. The tests further revealed that a new test standard would be ideal for testing this type of equipment a significantly larger drain water flow rate as would be expected in an 8” pipe.