Showerex Calculator

The performance-graphs show the raw measurements taken by Vaportec of the Showerex 900mm and 1400mm products installed in vertical and horizontal positions.

The calculator uses this raw data and other variables as documented on the calculator page under the heading nominal calculation details and included below for reference.

There is also a graph of recent domestic electricity prices which forms the basis for selecting 28 cents per kWh as the electricity tariff. This can be changed in the calculator to the actual rate if known.

The calculator also allows input of the number of people in the house and the duration of an average shower. These can be adjusted to suit different households.

Nominal Calculation Details

Calculation is based on an average shower with a mixed shower temperature of 38°C, hot water cylinder temperature of 60°C, cold water temperature of 11°C for horizontal installation and 11.5°C for vertical installation, specific heat of water of 4.186 joules per °C per gram, and does not account for any change in flow caused by temperature limiting valve. Calculation also excludes any savings made in the period before a shower when shower and Showerex is warming up.

CO_2 saved is calculated based on the average CO_2 emissions per kWh of electricity generated in New Zealand (0.1287 kg per kWh) as reported by the New Zealand Government's EECA Business CO_2 Emission Calculator on 8th May 2019.

Return on investment and payback period are calculated based on a purchase price of $483.00 for Showerex 900 and $611.80 for Showerex 1400, which includes New Zealand GST but excludes freight and any installation costs.

Flow Rate and Pressure Drop

The calculator allows the selection of standard flow rates for showers ranging from 6LPM to 20LPM. As shown on the graphs there is no significant pressure drop at flow rates below 24LPM and therefore the calculator does not consider pressure drop.

As an aside, in some shower situations involving low pressure systems, the actual pressure at the shower head can increase when installing a Showerex. This is due to an increased flow rate on the cold-water side, which in some low-pressure shower systems is at mains pressure.

Energy Transfer

Showerex transfers heat from wastewater to clean water. The experiments conducted by Vaportec record the amount of such transfer under different conditions and those results are reported in the graphs.

When the Showerex increases the temperature of the incoming cold water going to a shower, that increase offsets and decreases the amount of hot water required from the hot water cylinder.

Based on that, there is an equivalence between temperature recovered, energy in joules required to heat water, power in kWh required to heat water, the cost in dollars to domestically obtain that power, the amount of hot water not used from the cylinder, and the CO_2 emissions based on average electricity generation in New Zealand. These are all the different results provided by the calculator. The return on investment and payback period relate these results to the cost of the product.

Calculation Method

The calculator solves fluid flow temperature equations for a steady state output temperature.

The biggest challenge in calculating the energy savings, is that as shown in the performance graphs, the amount of energy recovered is a function of the flow rate.

As flow rate increases, the temperature recovered decreases, but the overall energy recovered increases substantially because at higher flow rates, a lot more water is heated (just by a slightly smaller amount). The temperature recovered multiplied by the flow or volume of water heated is roughly an approximation of the energy recovered.

However, in a shower setting, the flow of water to the shower is a mixture of hot and cold water. With a fixed output temperature, if you install a Showerex, the ratio of hot to cold water will change, as the temperature of your cold water will increase.

The challenge is that the two unknown variables of the equations are inter-connected. When you install the Showerex, if you keep the same ratio of hot to cold water as before, the output water temperature at the shower head will be a lot hotter. So, the calculator must change the ratio of hot to cold water. However, when you change the ratio, you change the flow rates, and when you change the flow rates, you change the efficiency of the Showerex heat exchanger. So, this must be repeated over and over. In practice, this is an iterative method of solving the equations. If you have ever studied or used calculus, you might know this is a description of the process of taking a limit.

In practice, one simply adjusts the dial on the shower to find the optimal temperature.

Unless using a thermostatic shower mixer, this will be in a slightly lower (colder setting) than without a Showerex fitted. There is no need to go through this process when using the product (but it is required to perform the calculation correctly).

Mathematically, the equations are solved to allow direct computation of the final steady state without the iterative process and that is what the online calculator does.

To my knowledge, all the raw data, values, and assumptions are publicly available on the website and someone with knowledge of the appropriate physics equations for heat-energy conversions and the requisite background in mathematics can perform the same calculations, arrive at the same formulas, and obtain the same results.

Obviously, these are nominal calculations based on the specific assumptions outlined on the calculator page and the conditions under which the Showerex measurements were performed. The actual results will be different in every installation. As an example, if the incoming cold water were to be cooler than in Vaportec's tests, there would likely be larger energy savings, and vice-versa if the incoming cold water were hotter. All sorts of factors such as the temperature of the environment also affect the results as these can cool the water to a lesser or greater extent before it arrives at the Showerex for transfer to occur.

I hope this provides some incite into the inner workings of the Showerex calculator.

Kind Regards,

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