CASE STUDY 2

SHOWERHEAD WITH PAUSE VALVE

ATLANTIC ECOWORKS, AUGUST 2010

SUMMARY

"Low-flow" is a term commonly used to describe a showerhead's flow rate. Technically, it means the flow rate is no more than 9.46 litres (2.5 U.S. gallons) of water per minute at 80 p.s.i. of water pressure. Unfortunately, just because your showerhead may comply with this definition does not necessarily mean it's efficient.

The showerhead featured in this case study (see Photo 1) delivers 3.76 litres of water per minute. It also saves 43,571 litres of hot water each year (enough to fill the 20,000 litre pool pictured in Photo 2 more than twice) and its annual avoided carbon dioxide emissions of 435 kilograms are equivalent to taking a 2010 Toyota Corolla off the road for seven weeks. Additionally, it costs less than $15 and has been saving the homeowner an estimated $129 each year since 2007.

A summary of its economics (based on the hot water being provided by an oil-fired boiler) is provided in Table 1, below.

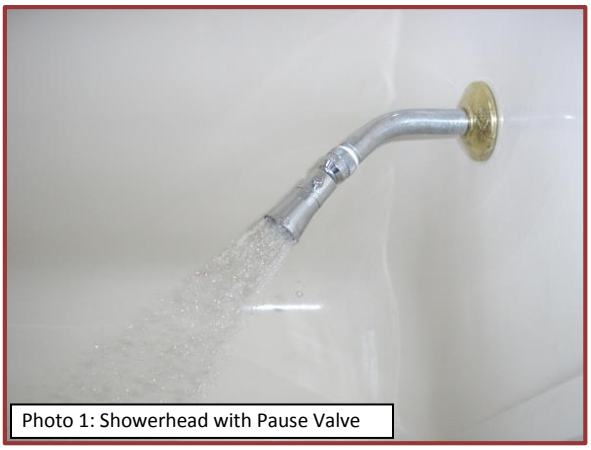

Photo 1: Showerhead with Pause Valve

Photo 2: 20,000 Litre Pool

Table 1: Estimated Annual Showerhead Economics

Description	Result
Estimated Annual Cost Savings	$129
Simple Payback ($15/($129/year))	0.12 yrs
Return on Investment ($129/$15) x 100	860%

DETAILS

1. Item: Showerhead with Pause (Soap-Up) Valve

2. Cost: $15 or less (taxes included)

3. Product Identification:
At Home Depot: "The Incredible Head Power Showerhead," Product No. 157624/Alsons ES141 Showerhead (See Photo 3 on following page.)
At Home Hardware: SKU No. 3266913
At Canadian Tire: "Plumb Shop Fixed Chrome Showerhead," No. 63-0157-8

4. Purpose: The term "low-flow" defines a showerhead that delivers no more than 9.46 litres (2.5 U.S. gallons) of water per minute at 80 p.s.i. of water pressure. While this is an improvement over showerheads with higher flow rates, it still leaves considerable room to reduce flow rates further while maintaining an acceptable level of showerhead performance. Hence, having a "low-flow" showerhead does not necessarily mean having an efficient showerhead for your particular household. The purpose of this case study is to provide data and savings relating to the use of an efficient showerhead as compared to a hypothetical 9.46 litre per minute showerhead.

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5. Rationale: There are three reasons why it is important to use an efficient showerhead.

1. According to Environment Canada, more water is used in households for showers and baths than for any other use.[1] Our growing demand for water is placing increasing stress on the environment and our water supply and sewage treatment infrastructure.
2. Hot water is expensive water in that energy is required to increase its temperature from approximately 10^0 C (50^0 F) when it enters your house to 37^0 C (99^0 F) when it leaves your showerhead.
3. If the water is heated using any method other than a solar domestic hot water system, then fossil fuels or biomass are being consumed and carbon dioxide and pollutants are being released into the atmosphere for every litre of water used.

6. Method and Results: The showerhead flow rate was determined by timing how long it took to fill a 7.4 litre container. A series of ten measurements were taken (see Appendix A) from which the average showerhead flow rate was 3.76 litres per minute. Because the home in which the showerhead was installed has its own well, some variation in flow rate occurred in accordance with variances in water tank pressure.

The two adults and two children in the household cumulatively take about three showers each day for a total of 21 showers per week and 1,092 showers per year. With an average duration of 7 minutes per shower, the showerhead is in use for 127 hours and 24 minutes per year.

Table 2, in the next column, summarizes the savings that have been realized by using the 3.76 litre per minute showerhead compared to a 9.46 litre per minute showerhead (see Appendix A for the calculations).

Photo 3: Showerhead with Pause Valve

Table 2: Showerhead Comparison Over 1 Year			
Description	**Flow of 9.46 L/min**	**Flow of 3.76 L/min**	**Savings**
Water Consumed (L)	72,312	28,741	43,571
Oil Consumed (L)	267	106	161
Total Cost of Oil ($)	241	85	129
CO_2 Emissions (kg)	721	286	435

7. Comments:

- The showerhead provides a solid flow of water and a nice spray pattern. However, because it delivers only 3.76 litres of water per minute, the temperature of the water decreases more rapidly with increased distance away from the showerhead than would be the case with a showerhead with greater flow. This had been a minor issue in the household because the showerhead had been mounted high in the tub enclosure and the three shorter members of the household were accustomed to letting the water run hotter so that it would still be sufficiently warm when it reached them.

- This issue was resolved when an adjustable shower arm extender was installed.

  As per Photos 4 and 5 below, the shower arm extender allows the showerhead to be positioned close to everyone regardless of their height. (Having the showerhead positioned nearer your head also makes it much easier to rinse the shampoo out of your hair.)

Photo 4: Shower Arm Extender in High Position

Photo 5: Shower Arm Extender in Low Position

- For the last two years, one member of the household has been taking navy showers, that is, using the pause valve to turn the water off at the showerhead while lathering his hair or soaping his body (apparently this is common practice on Canadian naval vessels). The advantage of using a pause valve located at the showerhead rather than adjusting the main shower controls, is that when the pause valve is turned back on, the water will resume flowing at the same temperature (subject to the discharge of any water that may have cooled off in the supply pipe when the showerhead was turned off). In recent months, the other members of the household have also started taking navy showers or modified navy showers. (A modified navy shower is one in which the pause valve is closed part way to reduce the flow of water while lathering up. This still allows for a pleasant stream of warm water to flow over your body.) The consensus within the household on taking navy or modified navy showers is that it really isn't a big deal. It's simple to do and it's nice knowing that hot water isn't flowing down the drain unnecessarily.

- There is no way of knowing the flow rate of your existing showerhead without measuring it. This is easily accomplished by holding a bucket under the showerhead for one minute (see Photo 6, below) and then using a kitchen measuring cup or container to measure the volume of water in the bucket in litres. Knowing the flow rate of your existing showerhead is important because, based on taking showers of 7 minutes duration, even a 1 litre per minute reduction will save 2,555 litres of hot water per person per year.

Photo 6: Measuring Showerhead Flow Rate

- In areas where water pressure is high and measurements have confirmed that even an efficient showerhead is providing too much water, the pause valve can be used as a regulating valve. That is, it can be partially closed to reduce the volume of water coming from the showerhead and then left in that position permanently. However, it will not be possible to take navy showers or modified navy showers unless a second pause valve (available at many hardware stores) is inserted above the showerhead.
- The process of determining your level of satisfaction with a particular showerhead is subjective. People are accustomed to the characteristics of their existing showerheads and the substitution of a showerhead with a lower flow rate and different spray pattern will be noticed. In this case study, it had been agreed that a decision on whether or not to keep the new showerhead would be made after it had been in use for one week. That was in 2007! Although it does not deliver as much water as the previous showerhead, it does allow everyone to have a satisfactory shower and the household members feel better knowing that it has allowed them to reduce their environmental impact.

8. Conclusion

With a flow rate of 3.76 litres per minute (as compared to a showerhead with a flow rate of 9.46 litres per minute), the showerhead featured in this case study will annually

- save 43,561 litres of hot water,
- displace the consumption of 161 litres of oil,
- avoid the emissions of 435 kilograms of carbon dioxide,
- save $129, and
- provide a 0.1 year simple payback with an 860% return on investment.

A CHALLENGE TO THE READER

Using an efficient showerhead is an easy way to reduce your carbon footprint and water consumption. It's incredibly cost-effective and won't have any appreciable effect on the quality of your life. If you live in an area with a municipal sewer system, then consuming less water has the added benefit of reducing the amount of waste water that has to be treated, thus resulting in even greater carbon dioxide savings.

To determine if you have an efficient showerhead, you must measure its flow rate. This is easily accomplished by following the explanation on the previous page and should be within the capability of most people. If the flow rate of your existing showerhead is greater than 5 litres per minute, consider replacing it. The showerhead featured in this case study would be an excellent choice but is certainly not the only efficient showerhead available.

Once you have installed your new showerhead, you must measure its flow rate. If the flow rate is higher than desired (likely due to having high water pressure), then you must reduce it by either closing the pause valve part way and leaving it there (assuming you're not interested in taking navy showers) or by installing a separate pause valve above the showerhead which can be adjusted to regulate the flow of water and thereby leaving the pause valve on the showerhead available for navy showers.

If, after having gone through the above exercise (which is not as complicated as it may sound), you are still not able to bring your flow rate down to a desired level, consider trying a different showerhead. Hardware stores are generally quite good about allowing for the return of a product that did not meet the customer's expectations.

Appendix A: Data, Calculations and Reference

Average Showerhead Flow

Ten measurements of showerhead flow rate were taken in July and August of 2010 as summarized in Table 3, to the right. The average flow rate was 3.76 litres per minute. It must be noted that showerhead flow rate will vary from house to house although, as per the comment section on the previous page, even in a house with high water pressure, it is possible to reduce the showerhead flow rate to an efficient level.

Table 3: Showerhead Flow Rates (2010)

Date	Time to Fill 7.4 Litre Container (Min:Sec)	Flow Rate (Litres/Min)
July 28	1:52	3.96
July 29	2:07	3.50
July 30	1:56	3.83
July 31	2:02	3.64
August 1	2:08	3.47
August 2	1:44	4.27
August 3	1:54	3.89
August 4	1:53	3.93
August 5	2:05	3.55
August 6	2:04	3.58
Average Flow Rate		**3.76**

Calculations for Table 2

Table 2 on Page 2 has been copied to the right. The calculations for the featured showerhead (with a flow rate of 3.76 litres per minute) are shown below as an example.

Table 2: Showerhead Comparison Over 1 Year

Description	Flow of 9.46 L/min	Flow of 3.76 L/min	Savings
Water Consumed (L)	72,312	28,741	43,571
Oil Consumed (L)	267	106	161
Total Cost of Oil at $0.80/L ($)	214	85	129
CO_2 Emissions (kg)	721	286	435

Water Consumed

21 showers per week x 52 weeks x 7 minutes per shower x 3.76 litres per minute = 28,741 litres

Litres of Water that can be Heated with One Litre of Oil

- 1 litre of oil contains 38.2 MJ of energy
- At 80% efficiency, a boiler will produce 30.6 MJ of heat per litre of oil (38.2 MJ x 0.8 = 30.6 MJ)
- 30.6 MJ = 30,600,000 Joules
- Water will be heated from 10 to 37 ^{0}C. (50 to 99 ^{0}F.) therefore ΔT = 27 ^{0}C
- 1 litre of water = 1000 grams = 1000 calories x ΔT of 27 ^{0}C = 112,968 Joules
- 30,600,000 Joules per litre of oil/112,968 Joules required to raise temperature of 1 litre of water = 271 litres of water that can be heated from 10 to 37 ^{0}C. (50 to 99 ^{0}F.) for every litre of oil consumed

Oil Consumed to Heat Water

28,741 litres of water/271 litres of water per litre of oil = 106 litres of oil

Total Cost of Oil

106 litres of oil x $0.80 per litre = $85

Carbon Dioxide Emissions

106 litres of oil x 2.7 kilograms of carbon dioxide per litre = 286 kilograms

Equivalent Emissions for a 2010 Toyota Corolla

A 2010 Toyota Corolla (1.8 litre engine, manual transmission) produces 3,082 kilograms of carbon dioxide per year. Therefore, saving 435 kilograms of carbon dioxide per year by using a 3.76 litre per minute showerhead (compared to a 9.46 litre per minute showerhead) is equivalent to taking the Corolla off the road for seven weeks.

Visualization of Annual Water Savings

The above ground pool shown below in Photo 7 is 4.88 meters (16 ft) in diameter. At the current depth of 1.07 meters (42 inches), it contains 20,000 litres of water. In this case study, the 3.76 litre per minute showerhead will save 43,571 litres of hot water compared to a 9.46 litre per minute showerhead. This is enough water to fill the pool 2.18 times.

Photo 7: 16-Foot Diameter Pool

Calculations

Diameter = 16 ft = 4.88 m
Radius = 4.88 m/2 = 2.44 m
Depth = 42 in = 1.07 m

Area = $\Pi R^2 = \Pi (2.44)^2 = 18.7\ m^2$
Volume = Area x Depth = 18.7 m^2 x 1.07 m = 20 m^3

1 m^3 = 1,000 litres therefore 20 m^3 = 20,000 litres

43,571 litres/20,000 litres = 2.18 “pool fulls” of hot water

Reference

1. Environment Canada. (2010). *Wise water use: Water use in the home*. Retrieved July 30, 2010 from http://www.ec.gc.ca/eau-water/default.asp?lang=En&n=F25C70EC-1#i2