Rainwater Harvesting:
Reduced use of electricity by the HydroForce® pump and smart header tank

"Save half your water bill for 1p a day" *

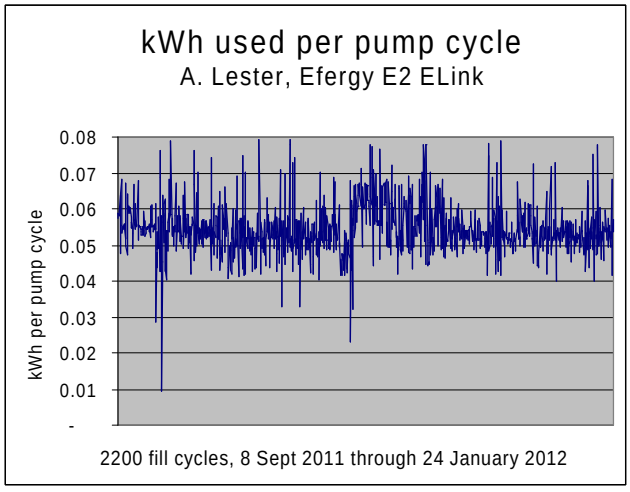
The green credentials of rainwater harvesting have been greatly improved by the results of recent pump electricity consumption tests. These tests were carried out on the specially designed Rain Director® gravity feed system in combination with the new HydroForce® pump and showed that electricity costs were less than one penny per person per day or £2.90 a year. Both products were conceived with power consumption reduction in mind. The Rain Director® greatly reduces pump activity with its smart header tank and the HydroForce pump with its lower 800 wattage is quite adequate for rainwater harvesting needs.

These test bench measurements were carried out by the manufacturers between September 2011 and January 2012 and confirmed measurements of pump electricity use by students at Portsmouth University.

The conclusions are based on instantaneous measurements of electricity used by the HydroForce® series 3 pump conducted by Chief Engineer, Adrian Lester using the Efergy E2 ELink measuring device and software (http://www.efergy.com). The 800 watt submersible HydroForce pump filled the header tank, which was 8 metres above the pump and more than 10 metres away in the lateral plane with a net volume of 80 litres, which was left to drain back into the underground rainwater tank. The pump would then fill it again and so on.

The equipment measured over 1,264 such fill cycles and over 1,250 hours of activity between September 2011 and January 2012 (graph below). The result is that the average fill, and the water used by one person in a day, required 0.0546 kWh (kilowatt-hours) of electrical energy. At a UK average of 14.56 pence per kWh of electricity, this makes less than **one penny** (0.795 pence).

As for the amount of rainwater used by a person during a day, figures from the UK Government's Code for Sustainable Homes establishes that the average person uses 150 litres of water per day. Use of rainwater for the washing machine (15% of each person's total) and toilets (35%) reduces this 150 litres to 75 litres per person per day, half the normal figure.



The Rain Director® header tank used in the test has a net volume between its float sensors of 80 litres, so it holds slightly more than the amount used by one person in one day. If the home is on the water meter then the bill is proportionately reduced… "Save half your water bill for 1p a day".

* "Use of a smart header tank which is refilled only when it's nearly empty reduces use of the pump such that the average cost of electricity for the pump is less than 1 penny per person per day"

This translates into £2.90 per person per year. When there is more than one person living in the house the pump electricity cost is proportional, for example £8.70 for a family of three.

Conclusion

The Rain Director® contributes not only to a reduction in the use of expensive purified and chemically-treated drinking water for toilet flushing, clothes washing and use outdoors, but also greatly reduces the amount of electricity used by the pump in the system. Innovations in rainwater harvesting systems designed to reduce mains electricity use (at best, to zero) make rainwater harvesting one of the most productive and attractive eco-options for new build homes in Britain and anywhere in the world.

Notes for editors and notes of clarification

1) Notes on reduced electrical use of gravity feed rainwater systems

Rainwater harvesting systems are designed principally to reduce the stresses on mains water supplies which are already severe across the densely populated areas of the UK, and forecast to worsen further as the population grows in the coming years. For the householder, rainwater harvesting reduces the water bill, makes rainwater available for the garden and other outdoor use even during a hosepipe ban and attenuates storm water flow to the main drain.

Carbon footprint issues, however, are also important and our aim at RainWaterHarvesting.co.uk is to provide our customers with systems that tackle both water shortage and climate change issues at the same time. Rainwater harvesting systems use electric pumps to deliver the harvested rainwater to the point of use which means generally, in a direct feed system, that the pump needs to switch on and off every time water is needed. If the pressure in the system falls between uses, then the pump additionally needs to switch on and off to restore pressure in the line. This "hunting" can be persistent and frequent. This pattern of use is relatively inefficient, uses more energy than necessary, and leads to additional wear and tear on components.

The Rain Director®, tackles this waste of energy with a gravity feed system which pumps rainwater from the main storage tank to a rainwater header tank which then gravity feeds to where the water is needed. A sensor in the smart header tank orders the tank to be filled only when the water in the header tank has been completely used. There is no cycling of the pump in the underground tank every time a loo is flushed. A 91 litre (80 litres net) header tank will last for more than 10 full toilet flushes, or about two clothes washing machine cycles. In a typical home the pump would only cycle once or twice a day. There's much less wear on the pump. In the case of the Rain Director® up to 6 times less electricity is used than in a direct feed system.

Some suppliers in the UK provide a plain header tank for rainwater, i.e. using one float cock for rain water and another, lower, for mains water as backup. However, such a tank is not conform to the British Standard 8515-2009 "Rainwater Harvesting Systems Code of Practice" notably 4.4.1 "All tanks and cisterns … should avoid stagnation" and 4.7.2. A plain header tank would contain rainwater for any period the occupants are away; the heat of the roof space risks triggering bacterial action in the header. A smart header tank like the Rain Director flushes rainwater from the header after 3 days' lack of use and refills it with chlorinated mains water.

2) Notes on measurements using the Efergy E2 ELink

The raw figures of the September 2011 to January 2012 measurements are available on our web site for perusal. The results were coherent and regular; the standard deviation on the average figure of 0.0546 kWh per cycle was only 0.0063 kWh per cycle. Most studies in this field assess the electrical use in kWh per cubic metre of water moved. In this case, 0.0546 kWh per 80 litre cycle translates into 0.682 kWh per cubic metre of water moved.

3) Notes on comparative studies

These figures measured using the Efergy E2 ELink (0.7 kWh/m^3 with the Rain Director® and the new 800 watt HydroForce® pump) are lower than the theoretical calculations made for Rainwater Harvesting Ltd back in March 2010 (2.13 kWh/m^3 using a 1100 watt pump) and higher than University of Portsmouth 2011 study figures (0.42 kWh/m^3). The Portsmouth University study (copy on request) was made by final year degree students in 2011 under the guidance of Dr D. Brett Martinson, Senior Lecturer, Environmental Engineering and Sustainable Development, School of Civil Engineering and Surveying, University of Portsmouth. It covers CO_2 emissions associated with the Rain Director® and pump, i.e. embodied emissions of all the components, and electrical use of the 1100watt Enviro pump. Although the Portsmouth test rig is similar in many respects to the one used by Adrian Lester, variations in electrical use can be due to pipe bore, angles and constrictions like stop cocks, float valves and solenoid valves. A copy of the Portsmouth report is available on our web site.

A white Paper from RainWaterHarvesting Ltd.

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