How a simple change in the washroom can significantly reduce water consumption and associated costs.

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Abstract

Sustainability and resource efficiency are a growing environmental concern across the world. Many organisations are striving to reduce their environmental impact and in the process save money by using less energy and natural resources. Water is one such natural resource, which is becoming increasingly scarce as the global population grows.

Independent research studies conducted in the UK in 2009 have shown that water consumption during hand washing can be reduced by between 16% and 45% by simply using foam soaps rather than traditional liquid/lotion soaps. For every 100 people employed, this equates to a potential annual reduction in water usage of as much as 56,000 litres.

Importantly, the research shows that hand washing with foam soaps rather than lotion soaps can be achieved with no loss of cleansing efficacy or inconvenience to the user. Overall users expressed a marginal preference for foam soaps.

In addition to reducing water consumption, this article will also identify further environmental and associated financial benefits with using foam soap for hand washing. These can be summarised as follows:

- *Reduction in energy required to heat washroom water*
- *Reduction in packaging waste*
- *Reduction in product consumption and chemical waste*
- *Reduction Chemical Oxygen Demand per hand wash*

Background

Water consumption and the potential savings is an important issue that is set to increase in focus in the future. Water reduction targets are being set by governments and businesses alike. Taking two examples from G20 countries, the UK Government, in an attempt to lead by example, has set a target to reduce water use by 25% on their office and non-office estate by 2020 compared to 2004/2005 levels.[i] Whilst China has set itself a target to reduce water consumption per unit GDP by 60% by the year 2020.[ii]

Water scarcity is a real and growing issue. Only 2% of the world's water is fresh water and most of that is frozen in glaciers or deep underground. This leaves only a very small percentage available for human use and consumption.[iii] Increasing population, consumption and changes in climate are all putting pressure on these stocks. By 2025 the UN expects that 1.8 billion people will be living in water scarce countries or regions.[iv]

This is not just an issue that affects the developing world. Nine European countries can be considered water-stressed - Cyprus, Bulgaria, Belgium, Spain, Malta, Macedonia, Italy, UK, and Germany as well as parts of the US and Australia.[v] Basically, water is a finite resource that we need to conserve.

While organisations may be using recycled paper and energy efficient light bulbs, they may over-look how the washroom contributes to their environmental impact. But for many office based businesses, the washroom can be where a large proportion of their water is used. Washrooms account for around 65% of water use in the average office,[vi] which, without a canteen, uses 25 litres per full time employee per day.[vii]

There are many ways to save water in washrooms – hippos in toilet cisterns, fixing leaking taps, fitting spray nozzles. These small changes ca n save a lot of water and money. For example, a dripping tap can waste 5000 litres[viii] of water a year and cost around £400[ix].

One other opportunity which needs to be considered is the choice of soap.

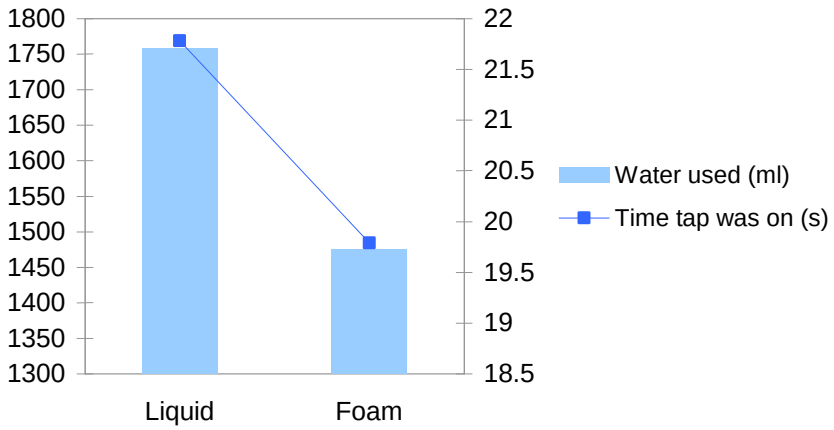
Water Savings

Deb Group commissioned independent research[x] to understand whether using foam soap for hand washing affected people's hand wash behaviour and water use. Wall-mounted, non-aerosol foam hand wash systems were invented by Deb in the mid-1990's. In simple terms, the integrated pump in the cartridge takes a special formula liquid soap and mixes it with air to increase its volume by 10 times and provide an instant lather for hand washing.

Researchers asked 150 people to place their hands in compost to simulate a moderate level of dirt and then wash their hands, once with a traditional liquid/lotion soap and once with foam soap. Participants were free to use their hand washing method of choice and to control the tap, and hence water flow rate, as necessary. The product tested first was rotated to avoid order effects and all the participants used liquid/lotion or foam soaps on a day–to-day basis.

When testing the lotion soap, participants used an average of 1758ml water with the tap on for 21.8 seconds. For foam soap, this reduced to 1475ml water with the tap on for 19.7 seconds. This amounted to a 16% water saving (see fig 1). If we presume people wash their hands three times a day at work, an office of 100 people currently using lotion soap would save nearly 20,000 litres of water per year[xi] by changing to foam soap.

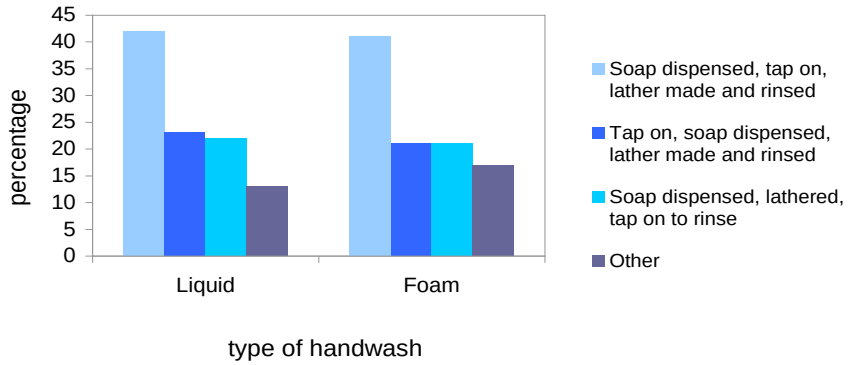
Fig 1: Water use for different soaps and handwash methods



The research also looked at the different methods people used to wash their hands. There were three main methods used during the test, adopted by around 85% of respondents (see fig 2). The remaining 15% used another four alternative methods, which included pre-wetting hands, and filling the sink with water. Most people, completely spontaneously, used the same hand washing method with both products. This shows that the reduction in water use is directly related to the product format rather than the hand washing method used.

In addition to measuring water usage, participants were asked to describe their experience. Foam and lotion soap were both rated highly, with a marginal preference for foam - 86% said that the foam soap was about right based on the amount of lather and the length of time it took to rinse off compared to 84% for lotion soap.

Fig 2: Hand washing methods

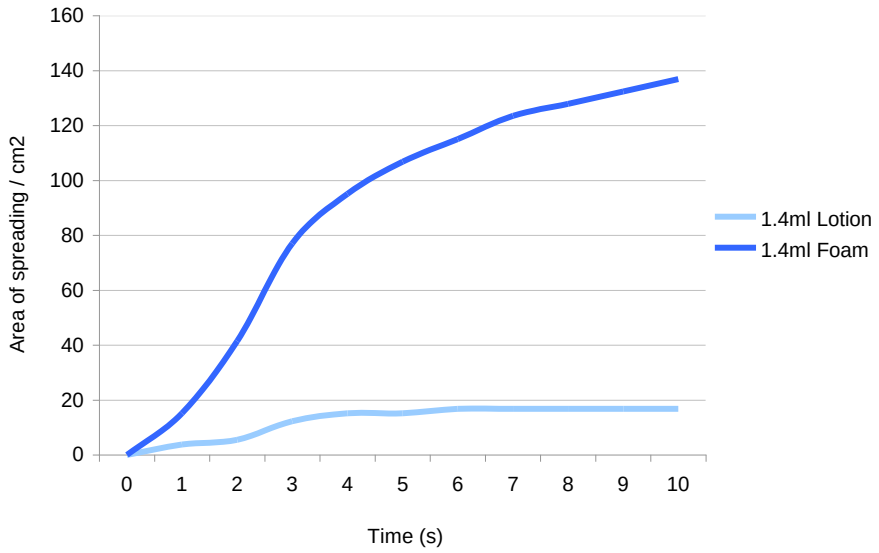


Spreadability

It is believed that less water is required for rinsing because foam soap spreads more easily on the hands than lotion soap. While structurants are needed to thicken lotion soaps, the hand-feel of foam is given by bubbles of air which could influence spreadability.

To confirm and quantify this effect, Deb conducted a simple experiment to compare the spreadability of foam soap with lotion soap. 1.4ml of each product was placed at the centre of a glass plate marked with a series of concentric rings. A second glass plate was then placed on top of the first to exert consistent pressure and cause the products to spread. The area covered was calculated as a function of time. The foam soap was shown to be eight times more spreadable than the lotion soap and to spread much more rapidly (see fig 3).

Fig 3: Spreadability of Lotion vs Foam



Energy Savings

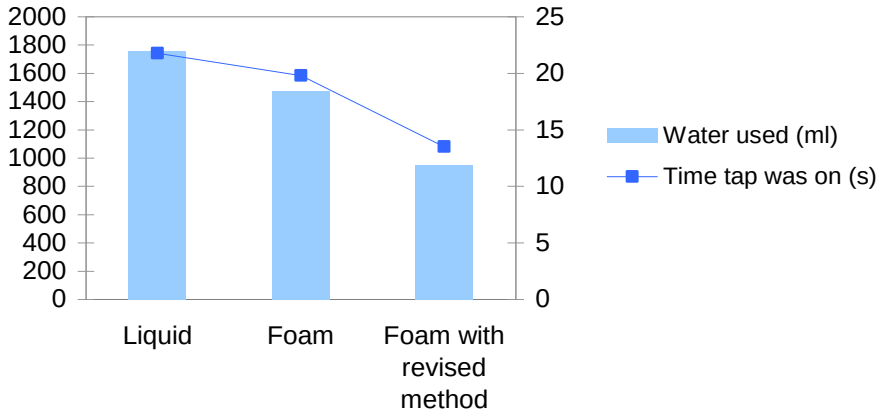
The reduction in water use provided by hand washing with foam soap will also inevitably lead to energy savings. People do not tend to wash their hands in cold water, and heating water consumes energy. So, reducing the amount of water used will reduce the amount of water that needs to be heated. In fact, saving one litre of hot water saves approximately 13g of CO_2. For our model office of 100 people washing their hands three times a day, using foam soap compared to lotion soap could save 254 kg CO_2 a year[xii] or 1,027kWh[xiii].

Behavioural change

The water savings reported above were produced spontaneously driven by product format. Further research was conducted[xiv] to determine if greater reductions could be made through changing the hand washing method. Participants were asked to use Deb's recommended hand wash method for foam soaps: dispense the foam lather direct on to dry hands and turning the tap on only when they wished to rinse the lather off. This method is enabled by the fact that foam soap is dispensed as an instant lather, without the need for additional water, and exploits the greater spreadability of the foam soap lather on dry hands.

This revised method reduced water usage to 951ml with the tap on for 13.5 seconds – 45% less than participants' chosen hand washing method with lotion soap (see fig 4). It is worth noting that just over 20% of participants were already using this recommended method and 69% said it was as, or more, effective than their usual method.

Fig 4: Water use for different soaps and handwash methods



If we once again assume people wash their hands three times a day at work, our model office of 100 people using this alternative hand washing method would save 56,000 litres of water a year compared to liquid handwash, or 36,000 litres each year compared to foam handwash using their usual method.[xv] In terms of heating the water this would save 724 kg CO_2[xvi] or 2929kWh[xvii] a year compared with lotion handwash.

Additional benefits of foam

Less product is needed

Deb's foam pump dispenses soap in 0.7ml measures compared with 1.0-1.2ml usually associated with lotion hand wash pumps. The significant reduction in the amount of foam soap dispensed is because the product volume is increased with air. It is Deb's belief that 0.7ml of foam soap at a ratio of 1:10 with air is the optimum combination to be effective when compared to using traditional lotion soap. However, Deb wished to scientifically prove if this was the case.

Independent research carried out on behalf of Deb Group[xviii], compared the effectiveness of Deb Gentle Wash Lotion Soap – a leading lotion soap used in UK NHS hospitals – with Deb Rose Foam Wash – a typical example of Deb's range of foam wash products – using the test method and requirement (phase 2/step 2) set out in BS EN1499:1997 Chemical disinfectants and antiseptics – Hygienic handwash.

Researchers asked participants to put their clean hands in a broth contaminated with E. coli K12, wash their hands with one of the soaps for 30 seconds and then rinse for 15 seconds. The number of test organisms was assessed before and after the hand wash products were used. The conclusion was that no significant difference was recorded between 0.7ml of the

foam hand wash and 1.1ml of the lotion hand wash – confirming that equivalent efficacy from foam is delivered using 36% less product per hand wash.

Less packaging

Using less product per hand wash translates to more washes in the same amount of packaging. In fact, you get a third more washes in a cartridge of the same size. Our model office of 100 people would have roughly 69,000 hand washing events each year - with the lotion soap they would use 76 one litre cartridges per year, but with the foam soap this would drop to just 46 cartridges.

Even accounting for the small amount of additional packaging in the pump unit required to form the lather, foam soap uses 26% less packaging than lotion soaps; just 11mg of packaging per wash compared to 15mg with lotion hand wash.

Fewer chemicals

Finally, because the product structure and hand-feel is provided by the lather, foam soaps do not need to contain the polymeric structurants used to thicken lotion soaps. This enables foam soaps to be more easily environmentally degraded, as determined by the Chemical Oxygen Demand (COD) of the product. On a per hand wash basis, foam soap has less than half the COD (150mg per hand wash) of lotion soap (332mg per wash), which means that foam soap will biodegrade more easily.

Conclusion

Hand washing using foam soap offers a number of benefits compared to lotion soaps. People spontaneously use significantly less water when washing their hands with foam soap compared to lotion soap. This is achieved because foam soap is dispensed as an instant lather and is immediately more spreadable than lotion soaps which need water adding to create lather.

Water savings can be increased further by using Deb's recommended foam soap hand washing technique – dispense, lather, tap on, rinse. The big question arising from this is how the behaviour change can be achieved and, in particular, how can the hand washing industry foster this change. This challenge is heightened by the fact that the hand washing method used by an individual is very much a sub-conscious activity.

The water savings in turn lead to a reduction in the energy consumed to heat the water. In addition, less product is needed, which leads to less packaging and the foam soap biodegrades more easily than lotion soap.

Because of these demonstrated environmental benefits, Deb has achieved a number of environmental accreditations for their foam hand washing products. These include the EcoLabel in the European Union - which is based on the impact of the product throughout its life-cycle – EcoLogo in North America and Environmental Choice in Australia.

References:

[i] http://www.defra.gov.uk/sustainable/government/gov/estates/targets-guidance.htm#waterconsumption

[ii] http://greenleapforward.com/2009/02/17/chinas-new-water-efficiency-targets-and-implications-for-food-and-energy/

[iii] http://thewaterproject.org/water_stats.asp

[iv] http://www.un.org/waterforlifedecade/scarcity.html

[v] http://www.eea.europa.eu/themes/water/featured-articles/water-scarcity

[vi] http://businesslink.gov.uk/bdotg/action/detail?itemId=1082914518&type=RESOURCES

[vii] http://envirowise.wrap.org.uk/uk/Topics-and-Issues/Water/Useful-Facts-and-Figures.html

[viii] http://www.waterwise.org.uk/reducing_water_wastage_in_the_uk/the_facts/the_facts_about_saving_water.html

[ix] http://www.businesslink.gov.uk/bdotg/action/detail?itemId=1083609730&type=CAMPAIGN

[x] Study conducted by McCallum Layton

[xi] (260 work days per year – 8 bank holidays – 22 holidays = 230) * (3 hand washing events per day * 100 employee = 300) * (1758 – 1475 = 283ml) /1000 = 19,527 litres

[xii] '1 litre of water needs about 1.16 watts to raise it through 1°C in an hour' and 'in the UK, mains cold water is generally assumed to be 4°C'. http://www.diydata.com/planning/ch_design/hot_water.php Washing hands at 38°C requires a temperature change of 34°C so uses 1.16*3600*34 J = 142kJ or 0.142MJ. Natural Gas produces approximately 68 g(CO2e)/MJ http://en.wikipedia.org/wiki/Carbon_footprint#cite_note-strategic-7 and the average boiler is approximately 75% efficient http://www.energysavingtrust.org.uk/Home-improvements-and-products/Heating-and-hot-water. Therefore 0.142MJ would produce 0.142*68/0.75 = 12.9g of CO2. So heating one litre of water from 4°C to 38°C produces ~13g of CO2

[xiii] 142kj (to raise water temperate 34°C) * 19,527 litres (used in a year / 0.75 (as average boiler is 75% efficient) = 3,697,112kj * 0.00027777777777778 (conversion factor) = 1027kWh

[xiv] Study conducted by McCallum Layton

[xv] (260 work days per year – 8 bank holidays – 22 holidays = 230) * (3 hand washing events per day * 100 employee = 300) * (1758 – 951 = 807ml) /1000 = 55,683 litres revised vs liquid soap or …(1475 – 951 = 807ml) /1000 = 36,156 litres revised vs foam soap

[xvi] 13g (CO_2 emission to raise water temp by 34°C) * 55,683 litres / 1000 = 723.879kg CO_2

[xvii] 142kj (to raise water temperate 34°C) * (used in a year / 0.75 (as average boiler is 75% efficient) = 10,542,648kj * 0.00027777777777778 (conversion factor) = 1027kWh

[xviii] Study conducted by Campden BRI