



Study Findings

Softened Water Benefits Study:

- Energy Savings
- Detergent Savings

Independent studies demonstrate the link

Softened Water Benefits Study

Introduction



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The Energy Savings Study (aka The Battelle Study)

Study on Benefits of Removal of Water Hardness (Calcium and Magnesium Ions) From a Water Supply

This study tested devices fed with softened and unsoftened water under controlled laboratory conditions designed to accelerate the waterside scaling in the device and quantify the performance efficiency. The project specifically focused on efficiency improvements in household water heaters from use of softened water, and the subsequent effect on performance of fixtures, such as low-flow showerheads and faucets, and appliances, such as laundry washers and dishwashers. For this study, Battelle tested 30 water heaters supplied by WQA over a 90-day period using a Battelle-developed and WQA-approved test protocol. Battelle simultaneously studied the effect of water hardness on performance of faucets, low-flow showerheads, dishwashers, and laundry washers. Using the empirical data generated from the water heater testing and the effect on performance of fixtures and appliances, Battelle developed a differential carbon footprint assessment for homes using unsoftened water vs. softened water.

The Detergent Savings Study

Evaluation of Relative Effects of Hardness, Detergent Dose and Temperature to Evaluate Stain Removal Efficacy, and/or Use of Less Laundry Detergent at Lower Water Temperatures

The laundry study investigated stain removal with varying levels of hardness, detergent dose, and temperature. Detergent usage was 50, 75 and 100% of the manufacturers recommended level. Water hardness ranged from 0 to 513 ppm (30 grains/gallon). Wash temperature was 60, 80 and 100°F. Statistical analysis was conducted to compare the ability of softening water to mitigate the adverse effects of lower detergent dosage and lower wash temperature in turn decreasing costs and energy usage.

Evaluation of the Effect of Water Hardness on Performance of Automatic Dishwasher Detergents and Savings Possible by Softening Water

Detergent savings was also evaluated for dishwashers. The detergent savings study included tests for removing difficult soils in addition to the spot and film evaluation. The relationship between detergent dose and hardness was investigated with three non-phosphate automatic dishwashing detergents with two consecutive wash-dry cycles for spot and film. One detergent was evaluated for five cycles to ensure that effects do not change with increased number of cycles.

Softened Water Benefits Study

Energy Savings



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Study Findings

Gas Storage Tank Water Heaters:

- **With softened water** – Gas storage tank household water heaters operated on softened water **maintained the original factory efficiency rating** over a 15-year lifetime.
- **With hard water** – Hard water **can lead to as much as a 24% loss of efficiency** in water heaters.
 - Each 5 grains per gallon of water hardness causes a 4% loss in efficiency and 4% increase in cost for gas storage tank water heaters when using 50 gallons of hot water per day. (On 30 gpg hard water, that's 24% less efficient than with softened water.)

Tankless Heaters:

- **The economic savings of softened water with instantaneous tankless water heaters can lead to recovery of the cost of a water softener and operating supplies in a period as short as a year**, if the incoming water is sufficiently hard.
- **With softened water** – Indoor instantaneous gas water heaters (tankless heaters) operated on softened water maintained the original factory efficiency rating over a 15-year lifetime.
- **With hard water**
 - The study found that **tankless water heaters completely failed to function** because of scale plugging in the downstream plumbing **after only 1.6 years of equivalent hot water use** on 26 gpg hard water.
 - Softened water saves 40% of costs compared to operating on 20 gpg and saves 57% compared to operation on 30 gpg hard water.

Electric Water Heaters:

- **Up to 30 pounds calcium carbonate rocklike scale deposits** can accumulate in electric water heaters.
- **Each 5 gpg of water hardness caused 0.4 pounds of scale** accumulation each year in electric storage tank household water heaters.
- ***“the life of the heating element can be expected to shorten due to scale buildup increasing the operating temperature of the element”*** in the electric storage water heaters operating on unsoftened water, says Battelle Memorial Institute.

Carbon Footprint:

- **The carbon footprint increases 18%** for gas storage tank water heaters when operated on 26 gpg hard water for 15 years as compared to the same operation on 0 gpg softened water.
- **For instantaneous-type natural gas water heaters, this same carbon footprint increases 4%** when operated on 26 gpg hard water versus 0 gpg softened water over 15 years.

Showerheads and Fixtures:

- **With softened water** – **Showerheads on soft water maintained** a brilliant luster and **full flow**. Faucets on softened water performed well throughout the study; nearly as well as the day they were installed.
- **With hard water** – **Showerheads on hard water lost 75% of the flow rate in less than 18 months**.
 - Faucets on hard water could not maintain the specified 1.25 gallons per minute flow rate because of scale collection of the strainers. The strainers on the faucets using unsoftened water were almost completely plugged after 19 equivalent days of testing.

Softened Water Benefits Study

Detergent Savings – Laundry Study

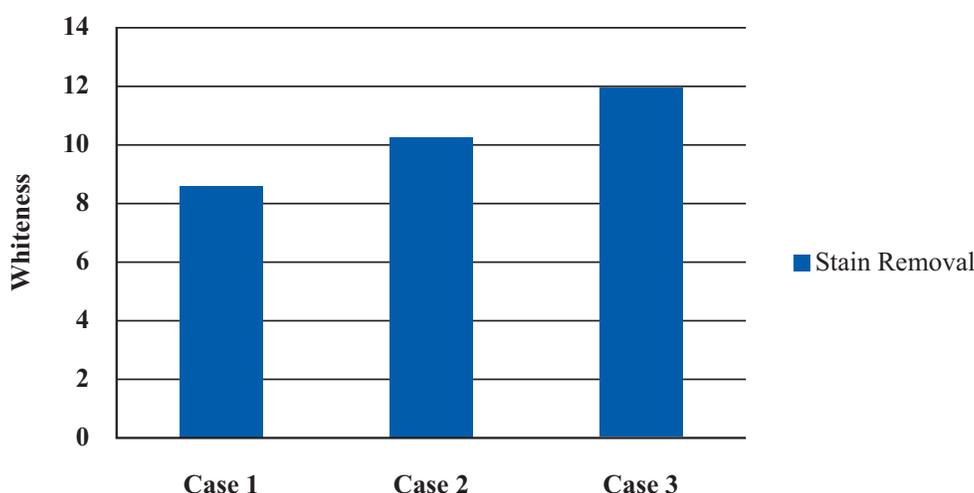


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Laundry Study Findings

The savings in detergent use and the energy required to heat the water is very high for each of the stains tested. Even when 50% of the detergent is used at a lower temperature of 60°F instead of 100°F, the washing yielded improved results when the softened water was used as compared to when hard water was used. The graph below shows that one can use cold water and half the detergents for washing clothes stained with any or all of these stains and still achieve the soil removal desired, if the very hard water is softened prior to such use. This is the most significant conclusion of this study.

Stain Removal



Pattern	Hardness, ppm	Dose, %	Temperature, F
Case 1	513	100	100
Case 2	256.5	75	80
Case 3	0	50	60

- Stain removal performance increases dramatically when hardness is removed even when dose and temperature are also lowered. Depending on the stain, hardness reduction was up to 100 times more effective at stain removal than increasing temperature or increasing detergent dose.
- Softening water will allow use of less detergent and save energy by lowering water temperatures while still maintaining or improving performance.
- When water of any hardness is softened prior to its use in washing, the detergent use can be reduced by 50% and the washing can be carried out in 60°F cold water instead of 100°F hot water and achieve the same or better stain removal yielding whiter clothes.
- This was true for all stains and all detergents tested.
- This was verified for top-loaded and high-efficiency front-loaded washers.

Softened Water Benefits Study

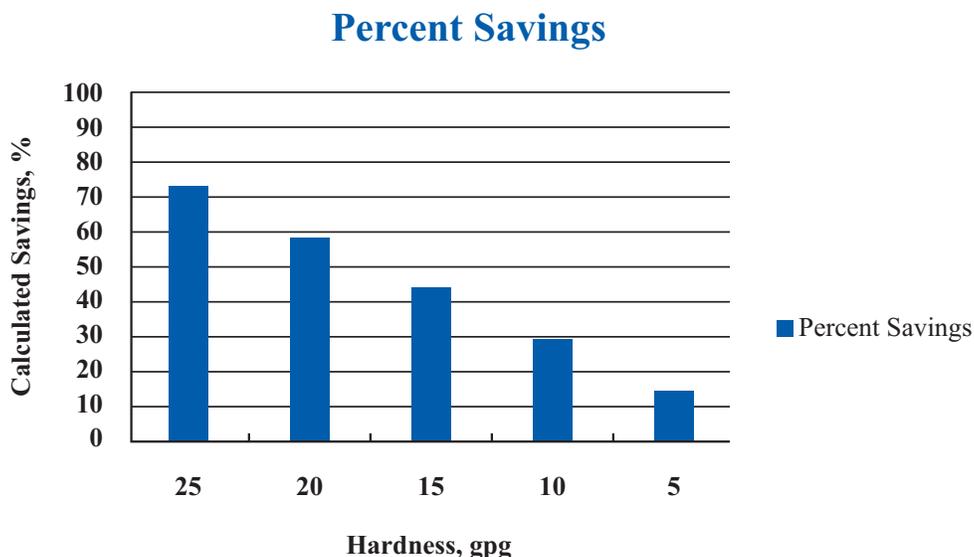
Detergent Savings – Dishwasher Study



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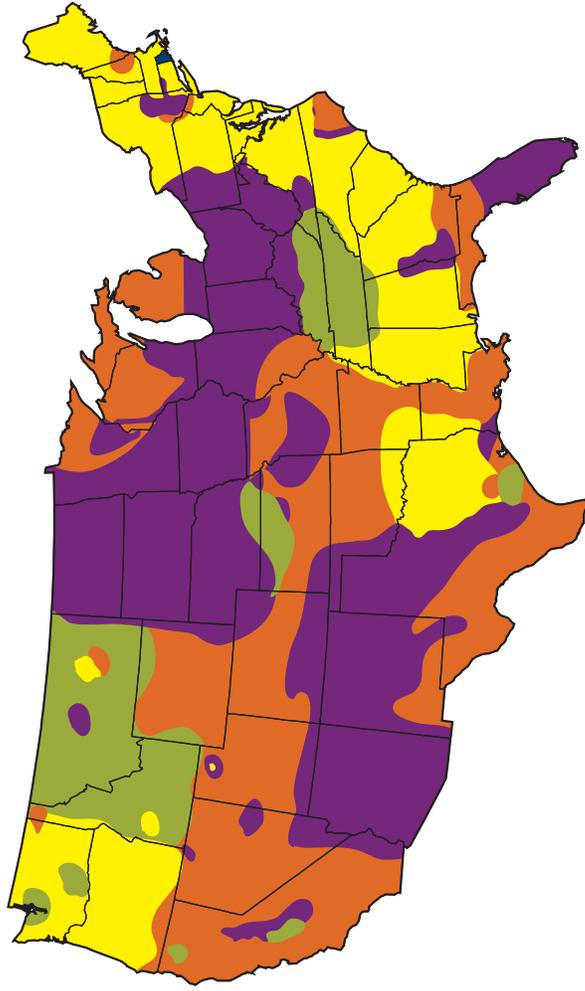
Dishwasher Study Findings

Statistically significant improvements by softening water with hardness were observed in spotting and filming performance as well as in better soil removal in automatic dishwashing. A graph showing the savings in detergent possible has been generated.



- Detergent savings up to 70% was observed for dishwashing when softened water was used compared to hard water. Depending on the soil, hardness reduction was found to be up to 12 times more effective at soil removal than increasing detergent dose.
- Hardness reduction was ~6 times more effective at reducing spotting and twice as effective at reducing filming as increasing detergent usage.
- One detergent was run for an additional three cycles to show that the hardness/dose performance relationship would persist.
- Air drying as a way to save electrical energy was evaluated and is promising to provide better results when softened water is used rather than hard water.
- With both tablet detergents, the beneficial effect of softening the wash water is much greater than the use of two tablets rather than one.

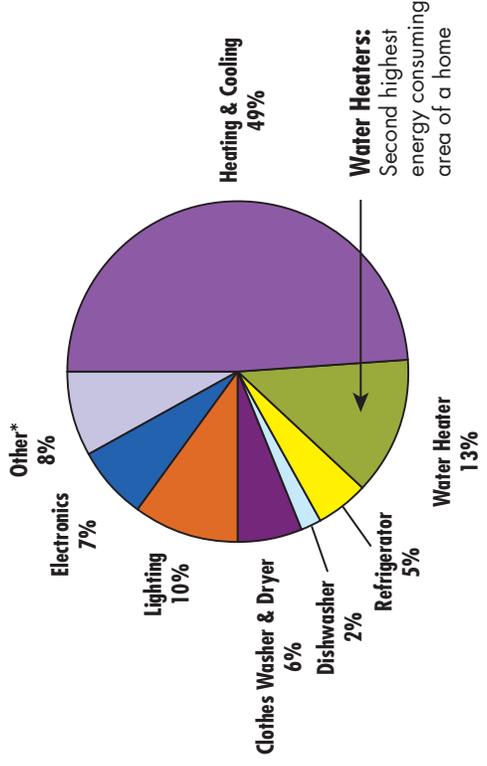
CONCENTRATION OF WATER HARDNESS ACROSS THE UNITED STATES



- Very Hard (10+ gpg)
 - Hard (7-10.5 gpg)
 - Moderately Hard (3.5-7 gpg)
 - Slightly Hard (1-3.5 gpg)
- gpg = grains per gallon

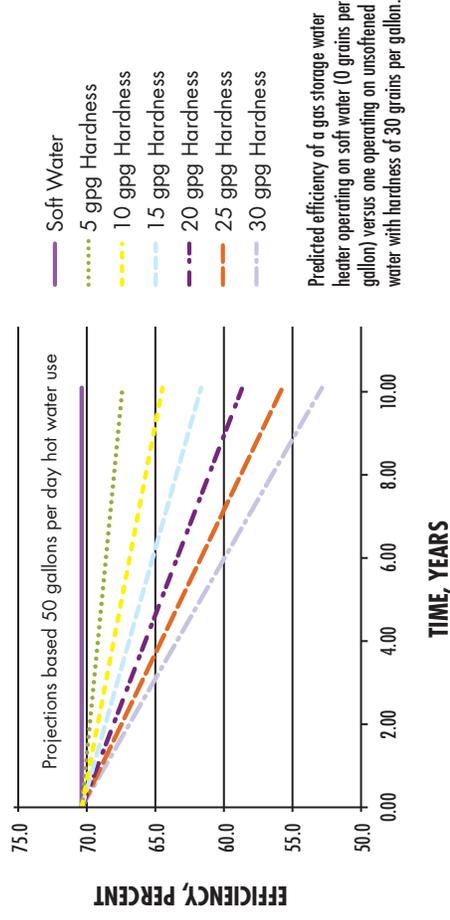
Source: Water Quality Association

US HOUSEHOLD ENERGY USAGE



Water Heaters:
Second highest energy consuming area of a home

PREDICTED EFFICIENCY



Benefits of Removal of Water Hardness From a Water Supply research study conducted in 2009 in conjunction with the Battelle Memorial Institute and funded by the Water Quality Research Foundation.