

# Dishwasher Study Executive Summary

A study was conducted to investigate the interaction of detergent dose and water hardness levels on the performance of automatic dishwashers. Removal of difficult soils as well as the resultant appearance in terms of spotting and filming was measured by Scientific Services S/D, Inc. Laboratories located in Sparrow Bush near Middletown, NY.

Two dishwashers with the specified load as shown below were used in all of these tests. The load consisted of:

**Dinner plates, silverware, glasses**

**Standard soils for filming and spotting including oatmeal, dry milk, and grease**

**Hard-to-remove-soils such as egg yolk, pizza sauce, spinach, brownie mix, fish, bread crumbs & olive oil**

The guidelines of ASTM D 3556 were followed for the tests. Evaluations of the glasses and saucers were performed at the end of each of the two cycles after cooling and aging. At least three trained evaluators were used.

Six commercially available detergents (4 liquid and 2 tablets) were used in this study with three being used in the main part of the study in a comprehensive way.

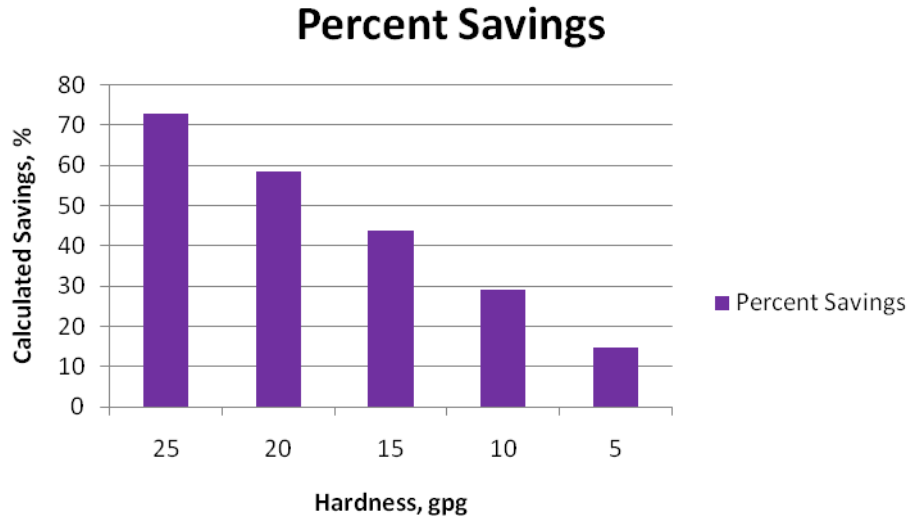
Detergent levels and hardness levels used in these tests as shown below:

**Detergent dosages used in these tests were the amounts that can be contained in small cup, large cup, and in both cups, which corresponds to 30 g, 55 g, 85 g.**

**Water hardness levels of 0 and 513 ppm (30 gpg) plus a center point level of 257 ppm (15 gpg) were employed in these experiments.**

Results were then arranged for statistical analysis by JMP Statistical Software.

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 soft 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.**