Laundry Study Executive Summary

A series of designed experiments were carried out to compare the effects of detergent dose, water hardness and wash temperature on the stain removal performance of five household laundry detergents by Scientific Services Laboratories located near Middletown, NY.

- **Detergent usage was 50, 75 and 100% of the manufacturers recommended level.**
- **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.**
- **Wash temperatures tested were 60, 80 and 100°F.**

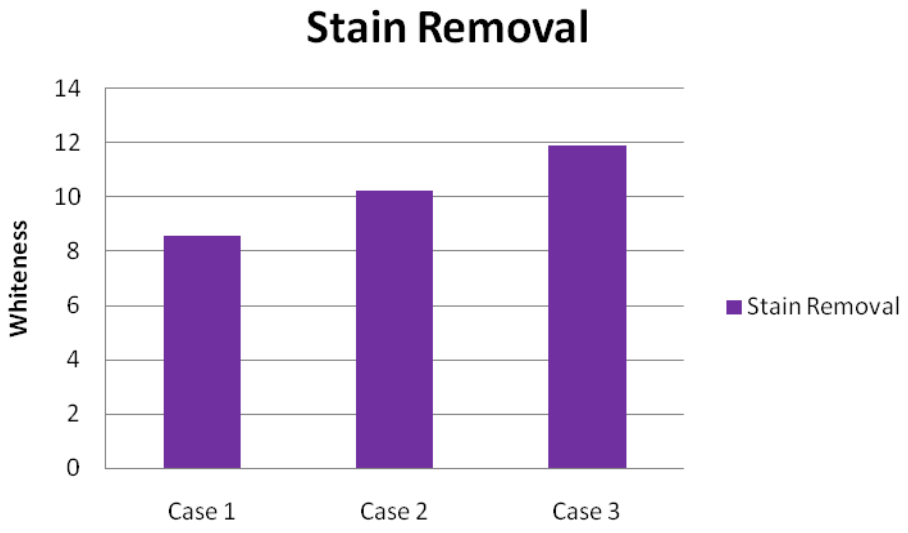
Stain removal effect of the following nine stains were studied:

Blood, coffee, dust sebum, grass, red wine, chocolate pudding, chocolate ice cream, barbecue sauce, ground in clay

Six liquid and 3 powder detergents were used in this study with five of them being used more completely in these experiments.

The guidelines of ASTM D 4265 were followed for the tests. Standard soiled and stained cotton swatches were used. The reflectance readings before and after the wash were measured and used for the analysis. JMP statistical software program was used to interpret the implications of the results obtained in this study.

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.



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

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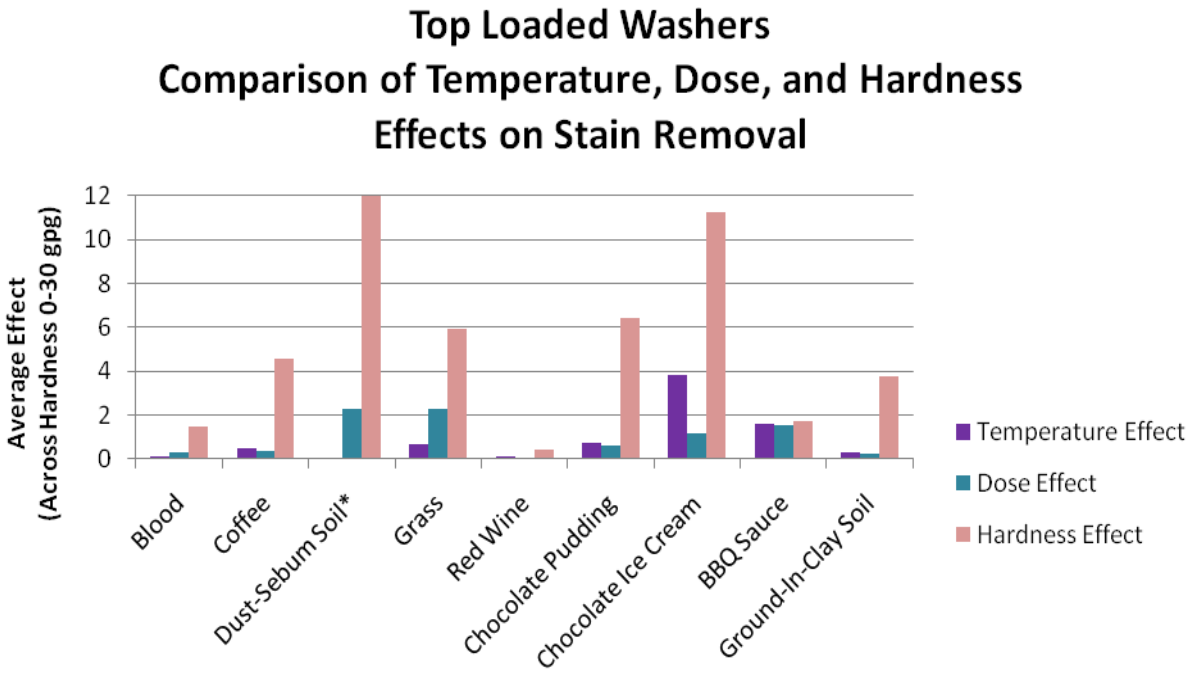
Reduction of hardness is significantly more effective on stain removal than either increase in temperature or detergent dose. This is demonstrated in the graph below for top loading washers, but it was also confirmed for side loading washers.



*Note that the hardness effect of dust-sebum actually continues to 62.6 and is the most significant effect.

The results also showed the following conclusions:

- **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.**