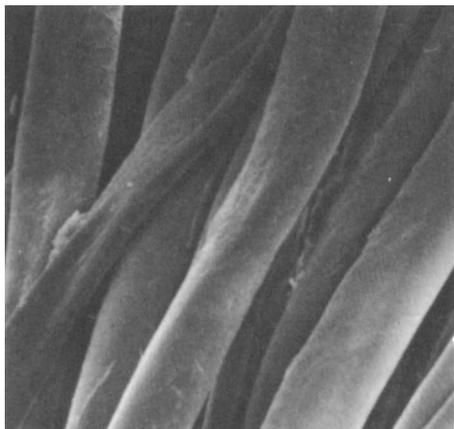
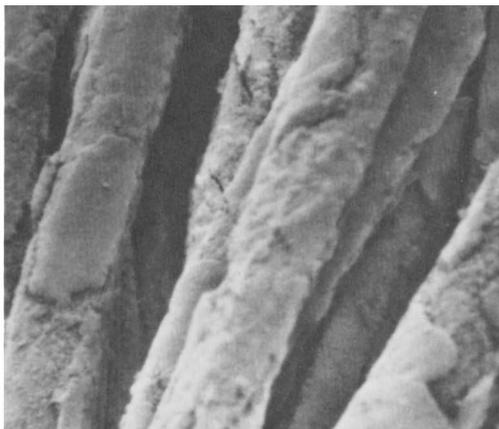


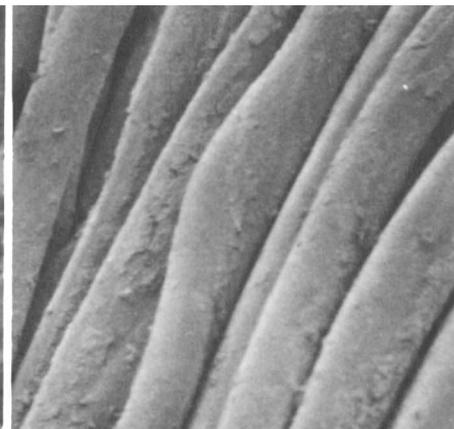
*Deposit buildup on fabrics, which is related to abrasion damage, occurred during laundering in hard water, particularly when carbonate detergent was used.*



**Fig. 1. Unwashed cotton fabric, examined by scanning electron microscope.**



**Fig. 2. Cotton laundered 40 times in hard water with carbonate detergent.**



**Fig. 3. Cotton laundered 40 times in hard water with phosphate detergent.**

## Fabric damage during laundering

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**L**aundering may cause considerable abrasion on fabrics, which can appreciably shorten the wear life. The reaction of detergent builders with hard water ions may cause a deposit to build up on fabrics during repeated launderings, and such a deposit could affect the amount of abrasive damage to fabrics.

A study was conducted to compare the effects of detergents and builders on abrasion and deposit buildup on a durable-press cotton fabric laundered repeatedly. Two detergents (one phosphate and one carbonate-built), a phosphate builder, and a carbonate builder were each used in combination with soft water and hard water. Deposit formation on a nylon fabric was also compared with that on the cotton.

Edge abrasion on the cotton samples was determined visually, and the deposit buildup was determined on both cotton and nylon fabrics by atomic absorption spectrophotometer analyses for calcium and magnesium, scanning electron microscope (SEM) examination, and weight-change determinations.

### Abrasion damage

Cotton samples laundered in hard water had significantly more edge abrasion than did those laundered in soft water with comparable detergent or builder. The greatest amount of abrasion

was on samples laundered in hard water with carbonate detergent, followed, in descending order of abrasive damage, by carbonate builder, phosphate detergent, and phosphate builder. The amount of edge abrasion was similar on all cotton samples laundered in soft water, regardless of the laundry treatments.

### Deposit buildup

A heavy buildup of calcium deposit was found on both cotton and nylon fabrics laundered in hard water with carbonate detergent or builder. Less buildup occurred on samples laundered in hard water with phosphate detergent, and no deposit was found on soft-water or phosphate-builder/hard-water samples. No significant amount of magnesium was found on any fabric.

SEM examination of the samples before laundry treatments showed the fibers to be smooth and without surface deposit (fig. 1). After 40 launderings in soft water, the samples still showed no deposit, regardless of the detergent or builder used. After 40 launderings in hard water with carbonate detergent the fabrics were heavily encrusted (fig. 2). Some incrustation was found on samples laundered with carbonate builder in hard water, but the deposit was smaller and less uniformly distributed than that seen on the carbonate detergent samples.

Fibers from samples laundered with phosphate detergent in hard water (fig. 3) showed a slight granular deposit on the surface. Deposits on nylon samples were similar to those on cotton.

The amount of abrasive damage to the cotton fabric was directly related to the amount of deposit on the fabric. Although other factors may have contributed to abrasion, the deposit appeared to be the major factor in determining the amount of abrasive damage.

### Hard vs. soft water

It may be concluded that, when soft water was used for laundering, neither carbonate nor phosphate detergent harmed the fabrics. The use of hard water in laundering accelerated the rate of abrasive damage, and significantly more abrasion occurred on samples laundered with carbonate detergent than with phosphate detergent. This increase in abrasion was directly related to the buildup of calcium deposit on the fabric.

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