EXAMINATION OF FACTORS AFFECTING POST-SCOURED FIBER METAL CONTENT

Gary R. Gamble
USDA-ARS-Cotton Quality Research Station
Clemson, SC

Abstract

Previous work at the Cotton Quality Research Station indicates that, subsequent to scouring with 1% NaOH solution at 90°C, different cotton samples exhibit varying levels of calcium and magnesium content. Further work indicates that these varying metal contents may be related to issues of fabric dyeability. The goal of the present work is to determine what fiber physical or chemical properties may explain the observed variations in metal content, with the overall aim of mitigating dyeability differences between otherwise identical cottons as determined by HVI. Initially, two cotton varieties grown in Arkansas were subjected to combing. The resultant rovings and noils obtained were analyzed for maturity by AFIS, and subsequently scoured and analyzed for calcium content by ICP-OES. Results show that a comparison of Maturity Ratio (MR) with calcium content leads to a linear fit with high (0.99) correlation coefficient. Additional samples of finisher drawing from different varieties grown in Texas, Arkansas, Georgia, and Mississippi were treated similarly, with the result that the correlation deteriorated dramatically between MR and calcium. The reason for this behavior is due to the presence of many outliers exhibiting high calcium content. In order to follow up on this, two lots of a single variety of cotton grown in the same field in Arkansas but harvested in different modules were analyzed. The two samples exhibit identical HVI properties, but the post-scoured calcium contents were substantially different (500 vs. 1300 ppm). The presence of calcium after scouring may be due to incomplete removal of pectin, which incorporates calcium as a cross-linking agent. Therefore, an additional treatment involving soaking the scoured cottons in an alkaline solution of EDTA, a metal sequestering agent, can potentially be used in order to remove the intransigent pectin. In order to explore this, knit fabrics were processed from the two cotton samples. each of these knits were then scoured by three different methods: (1) ethanol extraction to remove waxes only, (2) NaOH scouring (1%, 90°C, 1 hour), and (3) NaOH scouring plus an additional soaking in pH 10 EDTA solution (50°C, 1 hour). Following the scouring treatments, the fabrics were bleached and subsequently dyed using Reactive Blue 4. The L* value was then determined on each fabric using a Jasco, Inc. spectrophotometer. Results of this experiment show that the wax extracted samples of the two cottons are not significantly different, though there is a large difference in L* between these samples and the NaOH scoured samples. L* for the ethanol extracted samples was lower, indicating that the pectin component is a more efficient binder of the dye. Additionally, the L* of the NaOH scoured sample exhibiting higher calcium content showed a lower L* value than the sample with lower calcium content. This leads to the conclusion that the sample with higher calcium content also has a higher post-scouring pectin content, which affects the dyeability of the fabric. Finally, when the NaOH scoured fabrics were treated with EDTA, L* increased for the sample exhibiting higher calcium to the same level as the low calcium sample, the L* of which did not change. It is concluded from this work that post-NaOH scoured cotton shows some correlation between the calcium-pectin content of the fiber and the Maturity Ratio. Other factors, as yet not understood, lead to wide variations in the calcium-pectin content. Furthermore, the calcium-pectin remaining subsequent to NaOH scouring presumably differs in structure from that which is solubilized. Finally, the pectin component of the fiber appears to have higher reactivity with Reactive Blue 4 than cellulose, leading to dyeing differences between cottons exhibiting different calcium-pectin contents but that are otherwise identical.