Influence of Laundering on NIR Spectroscopy Fiber Identification Accuracy

Karen K. Leonas[1], Connie Wong,[1] Laxmi Silwal Panta[1] and Constanza Gomez[2]

[1] *North Carolina State University, 1020 Main Research Drive, Raleigh, NC, USA 27606-8301 Kleonas@ncsu.edu*
[2]*SORTILE, INC. 1 Uxbridge Road Scarsdale, NY 10583:* cgomezl@sortile.co

Abstract: With the increase in textile production and consumption, textile waste has increased. Most post-consumer textile waste is landfilled although these discarded products contain valuable resources [1,2]. As the Global Textiles Complex (GTC) is more actively evaluating its environmental impact throughout the supply chain, research focused on moving towards a circular economy is of critical importance. There are numerous challenges in the collection, sorting, and extracting the raw materials from post-consumer textile waste including the use of mixed materials. and accurately identifying the raw material. The sorting process requires experienced workers, is complex and time-consuming. To adopt a circular economy model, the sorting and raw material identification process must be efficient, automated, and accurate. Many methods can be used to identify the raw materials (fibers) commonly used in textiles including density, microscopy, Fourier- Transform infrared spectroscopy (FTIR), and near-infrared spectroscopy (NIRS) [4, 5, 6, 7]…... NIRS has been adopted by numerous companies working to automate the sorting and recycling process due to its quick and accurate fiber identification due to the quickness in which it can identify the fiber [8].

Most research in this area has evaluated fabrics and textiles products that are 'new'; in reality, post-consumer products have been used and laundered before being discarded. No research was found by the authors where the current NIRS technology was used to evaluate the fiber content for products that had been laundered numerous times. This study aimed to determine if repeated laundering influenced the ability of the NIRS technology to accurately measure the fiber content after repeated laundering. Ten different garments were obtained from a mass merchandiser and laundered. following AATCC LP1-2021.. The product fiber content and color (Lab) were measured using the Sortie Sorting Sensing Device. Upon receipt (before laundering), at then 10 additional times up to 50 times laundered (at intervals of five launderings). In addition to NIRS and color measurement, the products were weighed following ASTM.D3776 [10] Weight was important to determine if fiber loss was present that might contribute to a shift in fiber content identification throughout laundering.

Results showed that although the color measurements changed over the laundering, no significant changes in fiber content identification were found between the initial readings (before laundering) and the final readings (after 10 launderings). The spectral curves did change some, but this was attributed to the change in color as this did not impact the fiber identification. Findings from this study provide support for using the NIRS in fiber identification of post-consumer textile products. This accurate identification is critical so products can be appropriately recycled to reclaim the raw materials.

Keywords: textiles, circular economy, recycling, post-consumer waste, NIRS

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