



## A MICROMECHANICAL MODEL FOR BLENDED YARNS WITH FRAGMENTED LOW-ELONGATION FIBERS

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### ABSTRACT

*Often, fibers with significantly different elongations-to-break are combined in blended yarns. During yarn extension, the low elongation-to-break (LE) fibers undergo a fragmentation process, whereby the LE fibers develop multiple breaks along their length. The interaction between the LE fragments and the high elongation-to-break (HE) fibers is key to the load-extension behavior of such blended yarns. In this work, a micro-mechanical model for the interactions in a mixed array of elastic fibers representing the microstructure of a blended yarn undergoing axial extension is adopted and modified for the assumption of hexagonal fiber packing. The present results, which represent essentially an upper bound on the mechanical behavior that can be attained by increasing packing density, are compared to previous results for the assumption of square packing. It is shown that increased packing density provides for better reinforcement of the yarn by the LE fragments.*

**KEY WORDS:** fragmentation process, hybrid yarn, fiber friction, shear lag model, hybrid effect, yarn mechanics, rope, hexagonal packing.

### 1. INTRODUCTION

There is renewed interest in modeling the mechanical behavior of blended yarns, as reflected in recent papers by Realff et al. (2000), Godfrey and Rossettos (2001), and Rossettos and Godfrey (2002). While the works by principal authors Godfrey and Rossettos consider blended yarn behavior at

the microstructural level, Realff et al. develop a stochastic model that treats the entire yarn. In general, these works aim to investigate how blended yarn load-extension behavior is affected by the interactions occurring between the constituent LE and HE fibers. A key issue is the possible exploitation of beneficial "hybrid effects" whereby the LE fibers may be used to carry