

INVESTIGATION OF ABRASIVE PRE-TREATMENT TO MITIGATE LENGTH LOSS DURING MECHANICAL TEXTILE RECYCLING

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Abstract:

The environmental burden of the textile industry can be decreased with an increased use of mechanically recycled fibers. However, it is well known that the recycling process is harsh and shortens the fibers substantially. Still, little has been investigated about the influencing factors of the fiber length loss.

Previous research has shown that the parts of a garment that is more worn, lose less fiber length in the mechanical recycling process.¹ One explanation could be that a loss of fibers during wearing create a more open structure of the textile. By removing fibers from the yarns in a textile, the yarn structure is partly broken down, and the yarn linear density is decreased. The strength of spun staple fiber yarns is dependent on the friction and contact surfaces between fibers. In addition, fiber migration, the variation of radial position of a fiber in the yarn, causes the fibers to lock between different helical layers and thus creates a self-locking mechanism giving strength to the yarn.² Removal of any fiber in such a yarn affect all fibers in contact with that fiber. This in turn makes both the textile and yarns weaker and consequently more easily disentangles in a mechanical recycling process – keeping more of the fiber length.

The work at hand investigated this theory by subjecting woven cotton textiles with abrasion treatment prior to mechanical recycling. We compared two different methods of abrasion with unabraded textile. The two pre-treatment abrasion methods used were rubbing with sandpaper and raising with steel pins. By measuring the fiber length post mechanical recycling, we could estimate the efficiency of the recycling process in respect to preservation of the fiber.

Results showed that only the raising process had a positive impact in mitigating fiber length loss through the recycling process. During the rubbing with sandpaper, the fabric was pressed and thus became denser. On the contrary, the raising process pulled out the fibers and created a fuzzy surface. As the removal of any fiber affect all fibers in direct contact, even fibers in the center of the yarn are affected when surface fibers are pulled out or weakened. The raising process extracted fibers which opened up the fabric and affected the yarn structure. Hence, the yarns were more easily disentangled in the recycling process. The result gives great insight into the mechanisms of mechanical recycling and can be used for future development of the same.

Key words:

Mechanical textile recycling, abrasion pre-treatment, fiber length loss, recycling efficiency.

References

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