

Title: Valorization of dyed brush fiber waste through production of upcycled mélange yarn: A sustainable approach

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Abstract: The utilization of recycled fibers from textile waste has greatly increased in recent times due to growing environmental consciousness, legislative sustainability mandates, and escalating raw material expenses. This study seeks to utilize dyed brush fiber waste from a textile finishing machine called sueding, which is also known as emerizing, sanding, or brush machine, in order to create environmentally-friendly mélange yarn. Due to the brush fibers' limited length, the primary obstacle was utilizing them as a raw material for yarn production. In order to surmount this obstacle, brush fibers were blended with raw cotton and subsequently introduced into the carding machine to generate [carded slivers](#). Subsequently, three variants of ring-spun mélange yarn samples were generated, namely: one derived from dyed brush fiber, one obtained from post-consumer waste fiber, and another produced from virgin viscose fiber. In order to verify the existence of the short brush fibers in the yarn, this research conducted optical microscopy on both the sliver and yarn, as well as scanning electron microscopy specifically on the yarn. Next, the quality parameters of ring-spun mélange yarn manufactured from brush fiber are contrasted with those of ring-spun mélange yarn made from viscose fiber and ring-spun mélange yarn generated from post-consumer fiber. The study revealed that ring-spun mélange yarn made from brush fiber exhibited a 6.42% and 4.52% rise in unevenness, an 8.48% and 4.53% increase in [hairiness](#), a 69.02% and 7.80% enhance in imperfection index, and a 16.51% and 13.98% decrease in [strength](#) compared to ring-spun mélange yarn made from viscose fiber and post-consumer fiber, respectively. Subsequently, Minitab 2023 was employed to conduct a statistical analysis to determine the significance of various quality criteria. The results revealed that all criteria, with the exception of elongation, were significant. The ring-spun mélange yarn made from brush fiber is of lower quality compared to both grey mélange yarn and post-consumer mélange yarn. This is due to the significantly shorter length of the brush fibers in comparison to viscose and post-consumer waste fiber. Using dyed brush fiber ensures the utilization of waste materials, decreases dyeing expenses, minimizes water and energy consumption, has a lesser environmental impact, and is cost-effective. By incorporating 1 kg of brush fiber into the fiber mixing process, it is possible to decrease water usage by 200–400L, energy consumption by 50–64 MJ, and CO₂ emissions by 2.8–6 kg. The utilization of brush fiber in the manufacturing of ring-spun mélange yarn results in a cost reduction of around 10–15 cents per kilogram, in comparison to mélange yarn produced from viscose and post-consumer waste fiber. Additionally, fabrics were manufactured to showcase the visual aspect, demonstrating the versatility of this yarn in creating various clothing such as t-shirts, underwear, and more. The findings of this study suggest that the utilization of brush fiber for the production of mélange yarn may be a feasible option.

Keywords: Recycled textile fibers Brush fiber waste Mélange yarn Sueding/emerizing process Sustainable textile production

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