

in the warp, sample 9 performed better due to the existence of Kevlar®/polyester yarn in the weft. Sample 9 reached the abrasion resistance requirement for level 1 in zones 1, 2, 3 and 4.

Sample 7, with 59 tex cotton/Cordura® in the warp and weft, met the standard requirement for level 1 only in zone 4 by resisting for 1.33 s against impact abrasion. Sample 8, with coarser 92 tex cotton/Cordura® in the warp and weft met the standard requirement for level 1 in zones 3 and 4 with 2.37 seconds, implying that coarser yarns improved the resistance against impact abrasion.

The results of the current study will also provide an insight for the selection of fabrics for protective denim clothing utilised in other application areas such as workwear and sportswear. For the extension of this study, comfort properties of the fabrics designed will be examined.

Acknowledgements

The authors would like to acknowledge Kipaş a denim manufacturer, for accommodating their industrial rapier weaving machine for the production of single layer denim fabrics.

References

1. Varnsberry P. Motorcyclists. In: Scott RA. (Ed) *Textiles for Protection*. Woodhead Publishing Series in Textiles, CRC Press, 2005, pp. 714-733.
2. Zwolińska M. Thermal subjective sensations of motorcyclists. *Accident Analysis and Prevention* 2013; 50: 1211-1220.
3. Meredith L, Brown J, Clarke E. Relationship between skin abrasion injuries and clothing material characteristics in motorcycle crashes. *Biotribology* 2015; 3: 20-26.
4. De Rome L, Ivers R, Fitzharris M, Du W, Haworth N, Heritier S, Richardson D, Motorcycle protective clothing: Protection from injury or just the weather? *Accident Analysis & Prevention* 2011; 43(6): 1893-1900.
5. EN 13595-2:2002. Part 2. Protective clothing for professional motorcycle riders. Jackets, trousers and one piece or divided suits. Test method for determination of impact abrasion resistance.
6. Mao N. High performance textiles for protective clothing. In: Lawrence, C.A., (Ed) *High Performance Textiles and Their Applications*. Woodhead Publishing, The Textile Institute, 2014; pp. 91-143.
7. Woods RI. Specification of motorcyclists' protective clothing designed to reduce road surface impact injuries. In: Johnson, J.S. and Mansdorf, S.Z. (Eds.) *Performance of Protective Clothing*. Fifth Volume, ASTM STP 1237, American Society for Testing and Materials, Philadelphia, 1996, pp. 3-22.
8. Fan W, Zhu Y, Xi G, Huang M, Liu X D. Wear-resistant cotton fabrics modified by PU coatings prepared via mist polymerization. *Journal of Applied Polymer Science* 2016; 43024: 1-7.
9. Hurren CJ, Phillips P, Zhuang Y, Wang X. Thermal comfort levels and abrasion resistance of protective denim motorcycle clothing. *Proceedings of the 2014 Australasian Road Safety Research, Policing & Education Conference* 12-14 November, 2014, Grand Hyatt Melbourne.
10. <http://www.schoeller-textiles.com/en/fabric-groups/protection/schoeller-keprotec.html>, access date: June 2016.
11. Patra AK, Pattanayak AK. Novel varieties of denim fabrics. In: Paul, R. (Ed) *Denim: Manufacture, Finishing and Applications*. Woodhead Publishing Series in Textiles, 2015, pp. 483-506.
12. <http://www.alpinestars.com/road/featured-collections/tech-denim>, access date: June 2016.
13. http://www.dainese.com/we_en/catalog/product/view/id/98598/s/strokeville-slim-reg-jeans/, access date: June 2016
14. <http://www.revitsport.com/en/jeans-philly-41952.html#6371>, access date: June 2016.
15. ISO 13934-1:2013. Textiles – Tensile properties of fabrics – Part 1: Determination of maximum force and elongation at maximum force using the strip method.
16. ISO 4674-1:2003. Rubber – or plastics-coated fabrics – Determination of tear resistance – Part 1: Constant rate of tear methods, method B.

Received 12.12.2016 Received 06.10.2017

THE 5TH EDITION OF ACI'S EUROPEAN BIOPOLYMER SUMMIT will be taking place on 14th – 15th FEBRUARY 2018 in Dusseldorf, Germany

The two day event specially designed to bring together senior executives, key industry experts, researchers and bioplastic manufacturers, to exchange and share their experiences and research results on all aspects of bioenvironmental polymer engineering, most recent innovations, trends and concern as well as solutions adopted in the sector.

It's also provides platform to meet experts from other industries such food & beverage, product & packaging and automotive to discuss the latest strategies on commercialisation, application and market access of biopolymer products and methods to overcome current market challenges and maximise the opportunities.

More information:

<http://www.wplgroup.com/aci/event/biopolymer-conference-europe/>

THE EUROPEAN
Biopolymer Summit
14 & 15 FEBRUARY 2018 DUSSELDORF, GERMANY

