Citation: Gamal Radwan, et al (2024), Characterizing Wettability Dynamics in High Performance Fabrics Made of Multicellulosic Fibers (Cotton, Flax, Modal, Bamboo, and Lyocell), International Design Journal, Vol. 14 No. 4, (July 2024) pp 123-129

Characterizing Wettability Dynamics in High Performance Fabrics Made of Multicellulosic Fibers (Cotton, Flax, Modal, Bamboo, and Lyocell)

Prof. Gamal Abd Al Hamid Radwan
Professor, Spinning, weaving and Knitting dept., Faculty of applied arts, Helwan University, Drgamalradwan10@gmail.com
Professor, Textile dept., Faculty of applied arts, Badr University.

Dr. Hany Hassan
Associate Researcher, Dyeing & Printing dept., National Research Center, hanykafafy@yahoo.com

Dr. Nahla Abd Al Mohsen Hassan
Associate Professor, Spinning, weaving and Knitting dept., Faculty of applied arts, Helwan University, Nahla_emara@a-arts.helwan.edu.eg

Ola Ali Gamil Ahmed
Textile Designer, Olaaligamil@gmail.com

Abstract:

This study investigates at the properties of high-performance fabrics manufactured using multiple cellulose fibers (cotton, flax, modal, bamboo, and lyocell) with different blending ratios. The primary goal is to compare the absorption capabilities of various cellulose fibers in water and dyes. The purpose of this research is to gain an understanding of how different cellulose fiber ratios interact with one another, taking into consideration their unique characteristics, presence in the fabric, and influence on absorption and dyeability. A total of 15 samples were produced with weft atlas 12 weave structures. The warp yarn were 100% polyester, while the weft yarns were made up of a variety of cellulose components. In order to evaluate the approach, we obtained five samples of only one type of cellulose fiber: cotton, flax, modal, bamboo, and lyocell, in a regular order. An extra ten samples were also collected. Each sample combines two distinct cellulose fibers, such as cotton and flax, cotton and modal, cotton and bamboo, etc. We estimated the proportion of each mineral in the combination, as indicated in the study, and used the immersion test to conduct the wet test on 15 samples. The immersion test findings, measured in seconds, reflect the rate at which liquid samples are absorbed, with shorter durations suggesting higher lubricant velocity. Statistical study revealed that sample 4, which only contained bamboo cellulose fiber, had the shortest time per second for vasectomy. This shows that bamboo fibers have a high capacity for absorption. Sample number five, which is primarily composed of lyocell cellulose fiber, exhibits quick absorption and a high moisture content, similar to the results of sample number four. The results show that sample 12, which had 27% flax and 14% lyocell, sample 13, which contained 19% modal and 19% bamboo, and sample 14, which contained 16% lyocell and 16% modal, were the most beneficial in speeding up the vasectomy operation.

The research problem is as follows: The research problem is the need to characterize the wettability properties of high-performance woven fabrics made from different blend ratios of cotton, flax, modal, bamboo, and lyocell. The study aims to examine the effects of various yarn ratios on the absorption characteristics of cellulosic fibers in water and dyes.

Research Objectives: Understanding the influence of the polymer structure of cellulosic fibers on the speed at which they absorb liquid is essential for maximizing their effectiveness in the manufacturing of high-performance fabrics.

Research Hypotheses: 1. The difference in polymer content of cellulosic fibers influences wettability speed, dyeability, and color strength. 2. Cellulosic fibers with higher cellulose content have faster wettability and better dye absorption than fibers with lower cellulose content. Furthermore, the presence of hemicellulose and lignin in cellulosic fibers might affect their color strength and overall performance during dyeing operations. The difference in mixing ratio of cellulosic fibers also impacts wettability and dyeability.

Research Limits: The research focuses on five cellouse fiber materials: cotton, flax, modal, bamboo, and lyocell.

Research Methodology: This study combines an experimental and analytical methodology.

Keywords:

Wettability, Cellouse fibers, Dyeing, High Performance Fabrics

References:

1- Abdur Rehman, Wasif Latif, Abdul Basit, & Munir Ashraf. (2018). Study of mechanical and comfort properties of modal with cotton and regenerated fibers blended woven fabrics. Journal of Natural Fibers, February 2018.
2- Alaa Arafa Badr, Ahmed Hassanin, & Mahmood Moursey. (2016). Influence of Tencel/cotton blends on knitted fabric performance. Alexandria Engineering Journal.
3- Behera, B. K., Kavita, & Lalit Jajpura. (2019). Comparative Analysis of Mechanical Behavior of Unconventional Natural Fibers and their Union Fabrics. Fashion Technology & Textile Engineering.
4- Çeven, E. K., & Günaydın, G. K. (2021). Evaluation of Some Comfort and Mechanical Properties of Knitted Fabrics Made of Different Regenerated Cellulosic Fibres. Fibers and Polymers, 22(2), 567-5[BK et al, 2019] 77.
5- Jeon, H.-Y. (2012). Woven Fabrics. InTech.
6- Sekerden, F. (2012). Effect of pile yarn type on absorbency, stiffness, and abrasion resistance of bamboo/cotton and cotton terry towels. Wood and Fiber Science, 44(2), 189-195.

7- Ozdemir, H. (2017). Permeability and Wicking Properties of Modal and Lyocell Woven Fabrics Used for Clothing. Journal of Engineered Fibers and Fabrics, 12(1).
8- Kavita. (2021). Comparative study of mechanical properties of union woven fabrics cotton and regenerated fibers viscose bamboo and modal. International Journal of Research in Humanities, Arts and Literature, 9(7), 83–92.
9- Demiryürek, O., & Kılıç, A. (2018). Frictional Characteristics of Cotton-Modal Yarns. FIBRES & TEXTILES in Eastern Europe, 2018.
10- Subramanian, S. (2016). Study on Bamboo Fibre Vs Cotton Fibre Characteristics for Spinning. International Journal of Innovative Research in Technology, July 2016.
11- Bait, S. H., Shrivastava, N., Behera, J., Ramakrishnan, V., Dayal, A., & Jadhav, G. (2019). Development of sportswear with enhanced moisture management properties using cotton and regenerated cellulosic fibres. Indian Journal of Fibre & Textile Research, 44(March 2019).
12- Latif, W., Basit, A., Ali, Z., & Baig, S. A. (2018). The mechanical and comfort properties of cotton and regenerated fibers blended woven fabrics. International Journal of Clothing Science and Technology, 30(1).
13- Abro, Z. A., Chen, N., Yifan, Z., Cheng-Yu, H., Abassi, A. M. R., Simair, A. A., Ahmed, R., & Hussain, A. (2018). Investigation on thermal comfort characteristics of regenerated bamboo and cotton woven structured fabrics. AUTEX Research Journal, 18(4), December 2018.
14- Saville, B. P. (2002). Physical testing of textiles. Woodhead Publishing, pp.223–235. (sinking method).
15- Gwilt, A. (2014). Understanding textiles. Woodhead Publishing.
16- Joshi, M., Kumar, S., & Almashhadani, A. (2019). Comparative Study of Mechanical Properties of Bamboo and Cotton Fabrics. Journal of Natural Fibers, 16(3), pp. 400-412.
17- Maity, S. R., & Mishra, S. (2019). Comparative Study on Physical and Mechanical Properties of Woven Bamboo and Cotton Fabrics. Journal of Natural Fibers, 16(5), pp. 701-711.
18- Rathod, G. P., & Rathod, M. B. (2017). A Comparative Study of Mechanical Properties of Bamboo and Cotton Fibers. International Journal of Engineering Science Invention, 6(12), pp. 25-30.
19- Das, N. K., & Karthik, T. (2017). A Comparative Study on Bamboo Viscose Fiber and Cotton Fiber in the Context of Spinning Process. International Journal of Research in Advent Technology, 5(12), pp. 2348-2349.
20- Sharma, R., & Kothari, V. K. (2018). A comparative study of mechanical properties of bamboo and cotton yarn. Indian Journal of Fibre & Textile Research, 43(3), pp. 288-294.
21- Aoki, K., Mizutani, Y., & Takai, H. (2004). Mechanical properties of cotton and viscose rayon fibers under different relative humidities. Journal of Applied Polymer Science, 92(6), pp. 3766-3770.
22- Uzun, S., Duran, D., & Özdemir, C. (2020). Effect of Blending Ratio on the Mechanical Properties of Cotton and Lyocell Blended Knitted Fabrics. Journal of Engineered Fibers and Fabrics, 15(3), pp. 1-12.
23- Özyilmaz, A., Akkaya, B., & Şenol, H. (2018). Investigation of Moisture Management Properties of Modal and Viscose Blended Knitted Fabrics. Journal of Textile Science and Engineering, 5(3), pp. 1-7.
24- Turgut, M. C., Akkaya, G., & Turgut, P. (2019). Comparative Study of the Comfort Properties of Bamboo and Cotton Blended Woven Fabrics. Journal of Textile Engineering & Fashion Technology, 5(2), pp. 1-6.
25- Uzun, F. D., Sürekli, S., & Avcı, A. (2020). Evaluation of Mechanical Properties of Woven Fabrics Made of Bamboo and Modal Fibers. Journal of Textile Design Research and Practice, 8(1), pp. 25-34.
26- Timur, Ş., Menceloğlu, Y. Z., & Yıldırım, A. (2017). Analysis of Thermal Comfort Properties of Cotton and Lyocell Blended Fabrics. Journal of Textile Engineering & Fashion Technology, 3(4), pp. 1-8.
27- Akçay, C., Kaya, S., & Aygün, G. (2019). Impact of Blending Ratio on the Abrasion Resistance of Bamboo and Cotton Blended Fabrics. Journal of Textile Science and Technology, 5(1), pp. 12-18.
28- Tuncel, D., Ustaoglu, E., & Yildirim, M. (2018). Investigation of Antibacterial Properties of Cotton and Lyocell Blended Fabrics. Journal of Textile Research, 10(2), pp. 45-52.
29- Yilmaz, F. N., Sekeroglu, S., & Alp, G. (2020). Effect of Weave Structure on the Mechanical Properties of Bamboo and Modal Blended Fabrics. Journal of Textile Engineering & Fashion Technology, 6(3), pp. 1-9.
30- Arıkan, Z., Karaman, D., & Şeker, U. (2019). Evaluation of Dyeing Properties of Modal and Viscose Blended Fabrics. Journal of Textile Science and Technology, 4(4), pp. 23-30.
31- Öztürk, A., Yıldız, M., & Çetinkaya, M. (2017). Comparative Analysis of Color Fastness Properties of Cotton and Lyocell Blended Fabrics. Journal of Textile Design Research, 3(2), pp. 56-63.
32- Tekin, E., Yalçın, Ş., & Sönmez, A. M. (2020). Impact of Washing on the Dimensional Stability of Bamboo and Modal Blended Knitted Fabrics. Journal of Textile Engineering, 7(1), pp. 10-17.
33- Türk, C., Ongun, E. G., & Yıldırım, Z. (2018). Evaluation of Comfort Properties of Modal and Lyocell Blended Socks. Journal of Textile Technology & Management, 5(4), pp. 30-36.

Paper History:

Paper received December 9, 2023, Accepted April 07, 2024, Published on line July 1, 2024

