ANALYSIS OF YARN PARAMETERS INFLUENCING THE KNITTABILITY OF THERMOPLASTIC POLYURETHANE YARNS

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July 2021

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Acknowledgements

Firstly, I would like to express my sincere gratitude to my advisors Senior Lecturer Dr. Inoka Manthilake and Senior Lecturer Dr. Himan Punchihewa for the continuous support given amidst all the hardships. Thanks for all the directions given on required resources and study materials related to the research. Highly appreciate all the patience, motivation, and immense knowledge and guidance given by you.

I am extremely grateful to my parents and my sister for their support and sacrifices for educating and preparing me for my future. Without this support and understanding, this really would have been an unrealistic goal to achieve.

Dinidu Madusanka Atapattu

07th July 2021

Abstract

Knittability specially in synthetic yarns such as polyester and nylon is an essential index of the performance in ensuring the proper conversion of yarn to a knitted fabric. This can be affected by various conditions of the yarn manufacturing, yarn storage, knitting machine, knitting pattern and the environment. In footwear knitting industry, Thermoplastic Polyurethane synthetic yarn is being used due to its higher heat resistance and colour fastness properties compared to normal melt spun yarns. One of the major concerns in the process of knitting is the continuous yarn burst, which occurred significantly in thermoplastic polyurethane yarn. Occurrence of this burst appeared to be random and emerged in every yarn knitted areas. This research aimed to identify the critical factors affecting the yarn burst. After identifying the most critical factors through literature review, temporary and permanent countermeasures were developed. Initially, Prisma approach was applied to extract the relevant information from literature. Then, parameters were categorized into three based on factors related to: yarn compound, storage environment, and machine and knitting pattern. Under each category the critical parameters relevant to each factor was identified after analyzing the significance of each quantitatively and qualitatively. In terms of yarn aging, previous literature explains three types of tests namely natural exposure, field aging and artificial acceleration. According to literature, the strength of Thermoplastic Polyurethane yarn deteriorates once it is subjected to extreme conditions. In this study, the relationship between the Thermoplastic Polyurethane polymer manufactured date, the yarn lot manufactured date and the yarn burst was experimentally tested. The correlation with knittability and the yarn manufacturing dates were found to be not significant. In terms of yarn compound related factors, yarn unevenness was identified as the most critical parameter. An experimental set up was developed to measure the unevenness of black and white colourway samples. These colourways were selected as the defect rate of white colour was the highest while the black colour was the lowest. Through the statistical analysis of “t” distribution, it was identified that the statistical variance of the data set was high between the two colourways. This proves that the factor of yarn unevenness is directly correlated with

defect rates. Related to machine and method related factors, the programming structures were less researched in the literature. According to the relevant footwear application, initial all needle knit structure is changed to 1*1, 1*2, and 2*2 structures. All 1*1, 1*2 and 2*2 structures prove better knittability compared to initial all needle structure. Depending on the aesthetic factors, 1*1 structure is considered as the optimum one for the relevant application. This study was limited to few parameters and the dependence of other parameters such as temperature, time and moisture absorption has to be further investigated in future works. Further, the needle knit structure is also an interesting avenue for further research.

Keywords: Knittability, Thermoplastic Polyurethane

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