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Study on tension detection and acceptance of glove liners

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The glove industry plays a leading role in the Sri Lankan economy. The quality of the final product is crucial when it comes to mass production. A significant shrink or extension of a glove can cause great losses to the company by increasing the number of defective products. The dimensions of knitted liners vary due to various factors in the knitting process. In finding a solution to this problem, the Six Sigma "DMAIC" approach is being used. This research investigated how the tension of the main yarn and yarn conditioning time affect liner dimension changes in a controlled temperature and humidity level. As for finding the dimension changes, the total length, cuff length, and the cuff width of the liners were considered. Relevant data was gathered from a leading glove manufacturing company in Sri Lanka. The Randomized Complete Block Design with 9-12 replicates, considering yarn conditioning time as blocks and tension ranges as treatments, was set up. Analysis of Variance suggested that there is a significant difference among the population means in all three dimensions. Hence, a multiple comparison test (Tucky's test) is used to compare means. The results confirmed that the changes in yarn conditioning time had a significant impact on total length and cuff width. Nonetheless, factorial designs suggested that the interactions of tension and yarn conditioning time had a significant impact on the dimensions of knitted glove liners. As the tension increased, the length of the liners decreased. As tension levels increased, cuff lengths began to shorten. In contrast, the increase in tension of the main yarn caused the cuff widths to lengthen. Low-conditioned yarns contained significantly different dimensions than the rest of the liners knitted with yarns that had been conditioned for at least 24 hours. Generally, industries determine the optimal tension values of the main yarn manually using test gloves, which is time-consuming and costly. As a solution, this research used statistical modelling concepts, which aided in the development of a model to predict the level of tension required when the relevant liner length parameters and conditioning times were provided. Multiple linear regression and data mining techniques were used, and the models were compared. By having the lowest Root Mean Square Error, the Generalized Regression Neural Network (GRNN) outperformed the regression model and decision tree model. The error of the implemented GRNN model is 0.1521, and the independent variables explained more than 90% of the mean tension.

Keywords: Glove liners, Randomized Complete Block Design, Generalized Regression Neural Network, Tension, Yarn