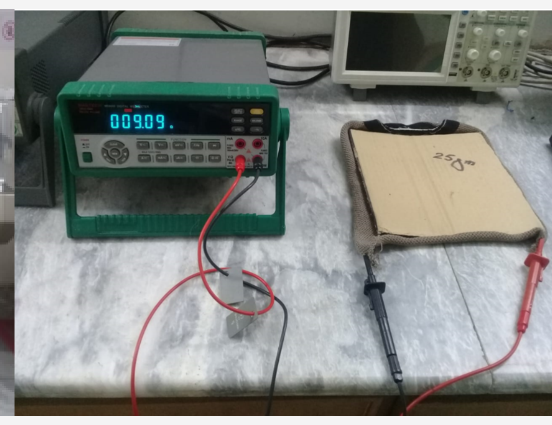
E-Textiles Network

Optimization of Knitted Structures for E-Textiles Applications

THE DEVELOPMENT OF A **KNITTED STRUCTURE PRESSURE SENSOR** HAS RECEIVED CONSIDERABLE ATTENTION DUE TO ITS BROAD APPLICATION IN THE HEALTH MONITORING SYSTEM. HERE, WE REPORT THE **ELECTRICAL AND COMPRESSION PROPERTIES** OF THE KNITTED STRUCTURES SENSING SYSTEM FOCUSING ON THE IMPROVED COMPRESSIVE BEHAVIOR. BASED ON THE RESULTS SHOWN IN FAIGURE 1(A), CONDUCTIVE YARN OF **280D-FDY AND SPFX25070-FX** WAS CHOSEN. ELECTRICAL PROPERTIES OF CONDUCTIVE YARNS IS SHOWN IN FIGURE 1(B). THE OPTIMIZED KNITTED STRUCTURES SUCH AS **DOUBLE LACOSTE, POPCORN, AND MILANO RIB** HAVE DISCOVERED THE APPROPRIATE COMPRESSION RESISTANCE DUE TO KNIT-TUCK STITCHES ASSEMBLY AND ALL THE KNITTED STRUCTURES WERE TESTED BY USING THE KAWABATA EVALUATION SYSTEM (KES FB-03). FURTHERMORE, THE **OPTIMIZED SENSOR** EXHIBITS **CONSTANT ELECTRICAL PROPERTIES** AFTER APPLYING LOADS AS SHOWN IN FIGURE 2. THE PROPOSED KNITTED STRUCTURES SENSING SYSTEM CAN BE READILY EXTENDED TO A SCALABLE AND COST-EFFECTIVE PRODUCT DUE TO THE USE OF A COMMERCIALIZED MANUFACTURING SYSTEM FOR E-TEXTILES APPLICATIONS.

Sheima Seiki flat knitting machine



2-Probe multimeter

Static charge meter

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AFFILIATIONS

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INTELLITEX

INTRODUCTION

These are those categories of textiles having the ability to sense a change in environment and respond to them in a designed manner. Smart textiles have extensive applications in the field of clothing. Smart clothing conveys, transmits, and drives the signals from one part of a structure into the other.

OBJECTIVES

- **To select the optimized conductive yarn for compression application in the course of electrical properties and knittability**
- **To choose the optimized knitted structures for socks applications with excellent compression and sensing properties**

METHODOLOGY

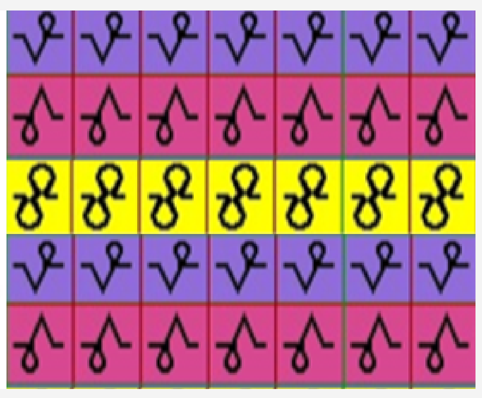
Seven different types of electrically silver coated conductive yarns (ECY) were procured from Kazhtex, the China company including 70D-DTY, 70D-FDY, 150D-DTY, 40D-DTY, SP25070FX-250, 280D-FDY, and 78D-FDY. Based on tensile strength of ECY an ASTM D2256 was used and for electrical properties an ASTM D257 utilized for the selection of yarns. Knitted structures made on flat knitting machine, tested on Kawabata evaluation system KES-FB03 and selected based on compression behavior. Furthermore, a static charge of selected knitted structures i.e. double lacoste, popcorn and milano rib having an optimized conductive yarns of SP25070FX-250 was measured using BSEN-1149-1 standard on static charge meter as shown in Figure 2.

RESULTS

Based on tensile strength and electrical properties a SP70250-FX-250 and 280D-FDY have been selected as shown in Figure 1. Knitted structures such as double lacoste, popcorn, and milano rib have been optimized on the basis of suitable compressional behavior from both single jersey and double jersey knitted structures. All of the optimized knitted structures have a lower electrical resistance upon the application of loads. This decrease in electrical resistance reflects well for the incorporation of such structures into socks.

CONCLUSION

This research project aimed to select/optimize the best possible knitted structures from both single and double jersey knitted structures based on their compressional properties. A conductive yarn of 280D-FDY and SP25070FX-250 was selected/optimized in terms of its tensile strength and electrical properties. In the case of single jersey knitted structures, double lacoste and popcorn were found to have better compressional behavior. Double jersey has only one structure called milano rib having better resilience of compression value due to structure architecture along with the best pressure sensing properties. Surface resistivity for the selected knitted structures shown a vertical resistance value of 3.1k.Ω and 2.1k.Ω horizontal resistance which means our samples have good electrical properties. Optimized conductive knitted structures with better compression properties were found suitable subsequently for smart socks applications.



(a) Kawabata compression instrument (b)Milano Rib design diagram

FIGURES

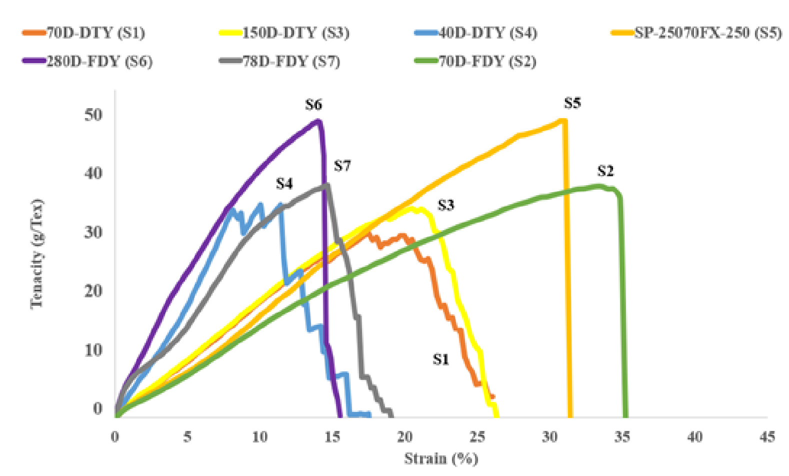


FIGURE 1 (A)

Tenacity (g/tex) vs strain (%) for conductive yarns of different counts.

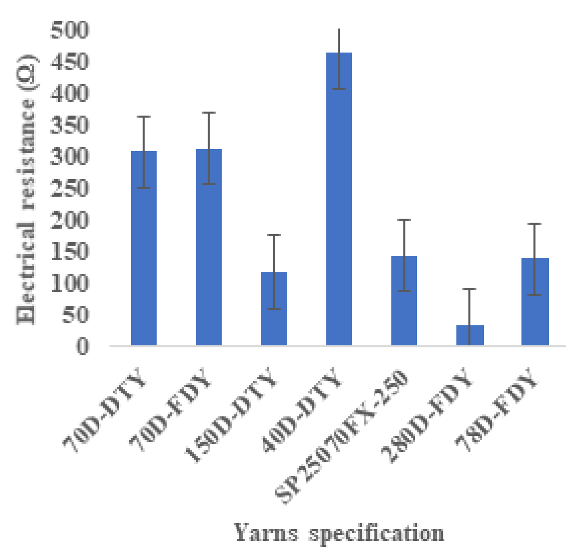


FIGURE 1 (B)

Electrical resistance (Ω) for conductive yarns of different counts.

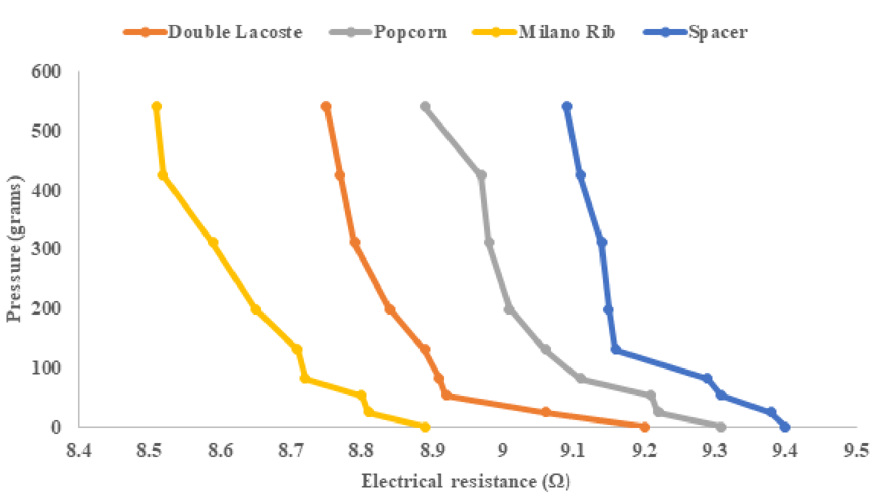


FIGURE 2

Pressure-electrical resistance curve for an optimized knitted structure.