Technology of Production of Weft Knitted Fabrics Made From Modified Acrylic Yarns and Studies of Their Properties

Lawal, A. S.
Adamu, B.

Department of Textile Science and Technology
Ahmadu Bello Unversity, Zaria, Nigeria

Abstract

Different types of acrylic yarns such as twisted spun acrylic yarn 3-ply (Sample A), relaxed ring spun acrylic yarn 3-ply (Sample B), repco spun acrylic yarn 2-ply (Sample C) and relaxed repco acrylic yarn 2-ply (Sample D) were knitted into fabrics under different tension and a comparative study was made on the properties of these fabrics. The properties studied are fabric abrasion resistance, fabric wettability, fabric thickness and fabric flammability test. The results obtained suggested that the knitted fabrics produced from Sample B and Sample D were better than the knitted fabrics produced from Sample A and Sample C in terms of fabric abrasion resistance and fabric thickness. Analysis of the results also shows that all the four samples have good flammability rating.

Key words: acrylic yarns, knitted fabrics, properties, tension

Introduction

Polymerization of acrylonitrile gives polyacrylonitrile. The polymer obtained is either dry or wet spun into fibres [Femi, 2001].

Acrylic is a synthetic fibres. Fibre produced for the manufacture of man-made staple fibre is first produced as tow [Peter, 1993]. 'Tow' means a thick bundle of continuous filament [Peter, 1993]. Tow has to be cut, broken or abraided to convert it into staple fibre. The machines are mainly used as tow-to-top machines that produce sliver [Peter, 1993; James, 1995].

Knitted fabrics produced from textured acrylic yarn (same denier count) are not comfortable for apparel under certain condition due to the nature of the texture.

In this paper, different range of denier counts are employed; tow-to-top application producing the most wool-like-fibres. Less explosion hazards and less health and environmental hazards.

Methodology

Due to the differences in the elasticity and count of four different samples of acrylic yarns obtained from the Nigerian Spinner and Dyer Limited, Kano, Nigeria, the samples were knitted under different tension using weft knitting machine (Riccar No. 4206066047).

i.Twisted Ring Spun Acrylic yarn 3-ply i.e Sample A, knitted with tension 6.
ii.Relaxed Ring Spun Acrylic yarn 3-ply i.e Sample B, knitted with tension8.
iii.Repco Spun Acrylic yarn 2-ply i.e Sample C, knitted with tension 5.
iv.Relaxed Repco Acrylic yarn 2-ply i.e Sample D, knitted with tension 7. All the four samples of knitted fabrics were evaluated for those properties required for satisfactory end-use performance.

Results and Discussion of Results

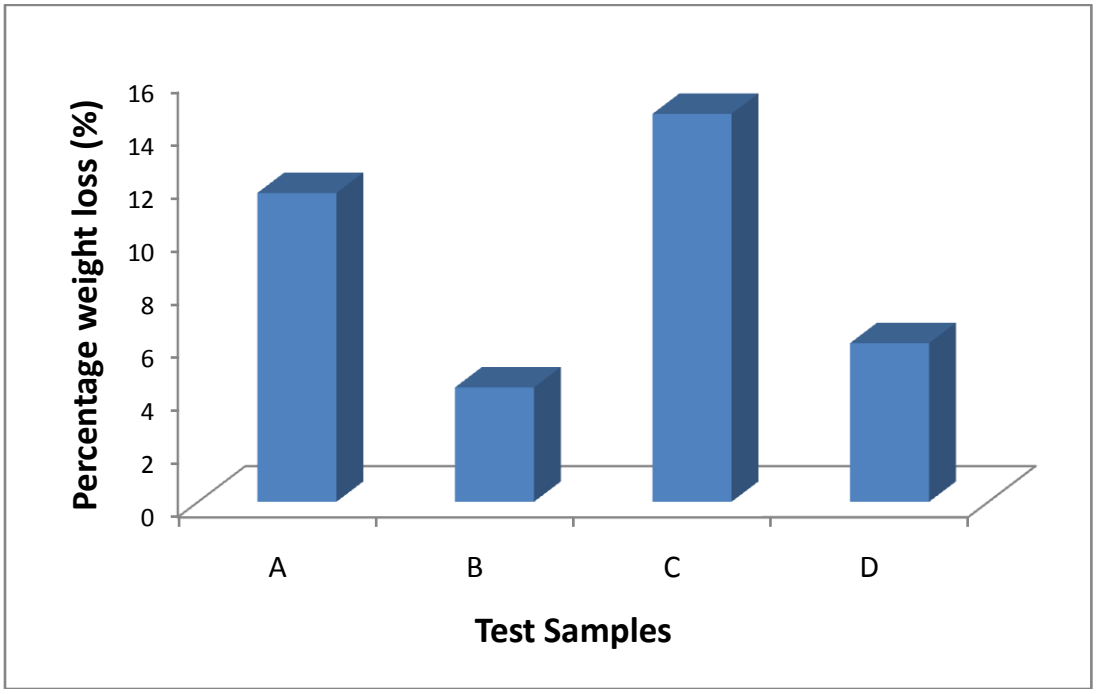

Fig. 1: A plot of percentage weight loss against test samples

Fabric Abrasion Resistance

The results obtained in Fig. 1 show that Sample B has a very good abrasion resistance since the weight loss after applying 1000 rubs is very low, followed by Sample D. Sample C has the lowest abrasion resistance followed by Sample A. This is due to the fact that relaxed or texture acrylic yarn is always stronger than twisted or untexture acrylic yarn. The order of abrasion resistance is Sample B> D> A> C.

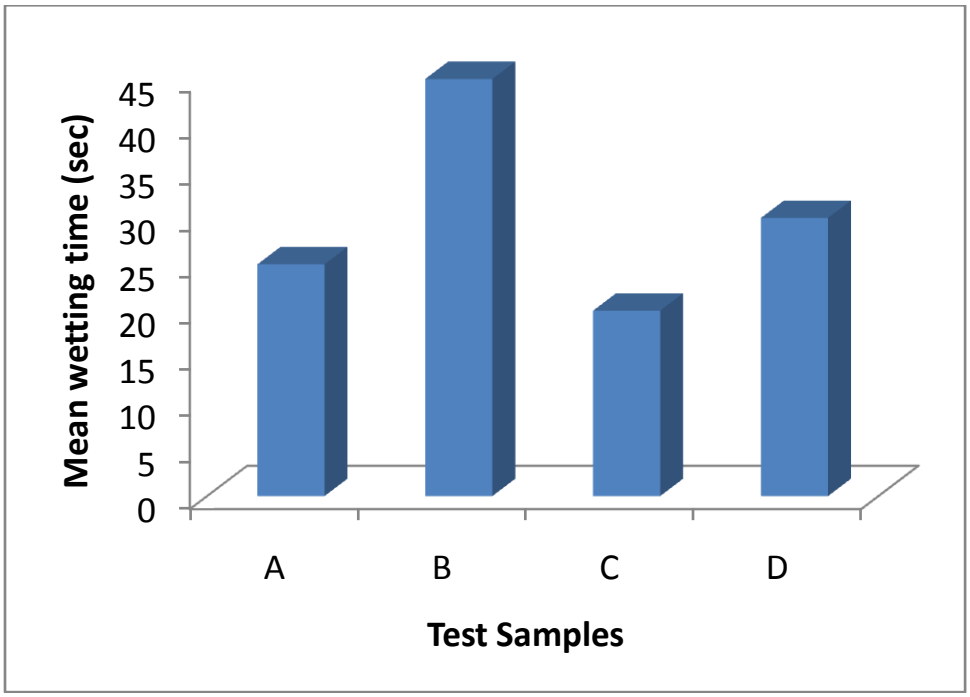

Fig. 2: A plot of mean wetting time (sec) against test samples

Fabric Wettability

Wettability is a factor which determined the movement of moisture into fibres or along the surface of fibres, yarns and fabrics [Gregor and Swarz, 2008]. The results in Fig. 2 shows that Sample C has the lowest mean wetting time, followed by Sample A while Sample B has the highest mean wetting time followed by Sample D. This couple with the fact that Sample C and A have large interstices and these permit rapid transfer of water, but Sample B and D were constructed with tiny interstices and these made them to repel water. This behaviour can be enhanced by using fibres that are hydrophobic, non-wicking and non absorbent and with a high surface tension. The order of increase in wettabiity is given as Sample C> A> D> B.

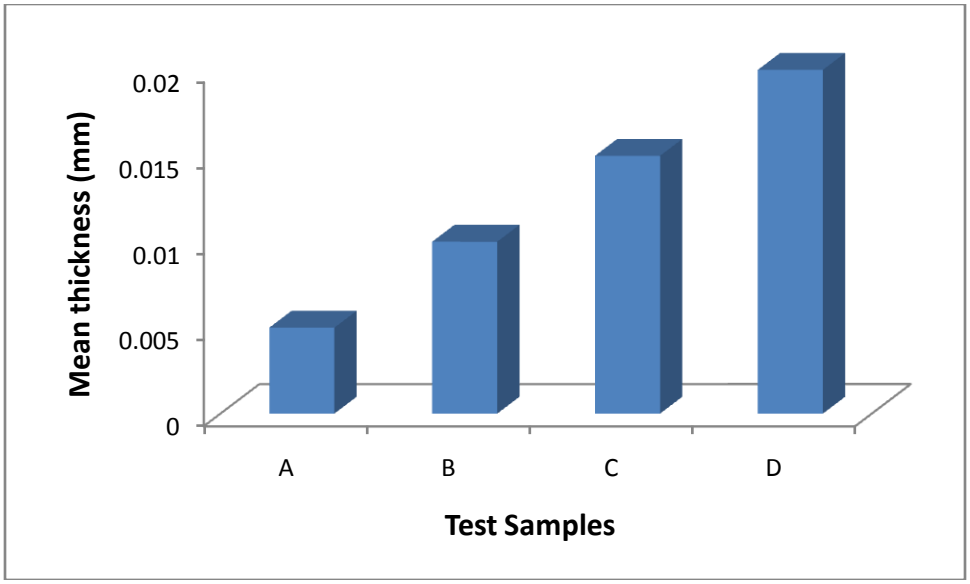

Fig. 3: A plot of mean thickness against test samples.

Fabric Thickness

The thickness of a fabric depends on its mass per unit area, the type of yarn used, the weave structure, bulkiness of fabric and density [David, 1987; Clara, 2007]. From Fig. 3, it can be observed that Sample D has the highest value of thickness while Sample C has thermal insulation, dimensional stability, stiffness and abrasion resistance. Fig. 3 shows that the fabric thickness increases in the following order, Sample D> C> B> A.

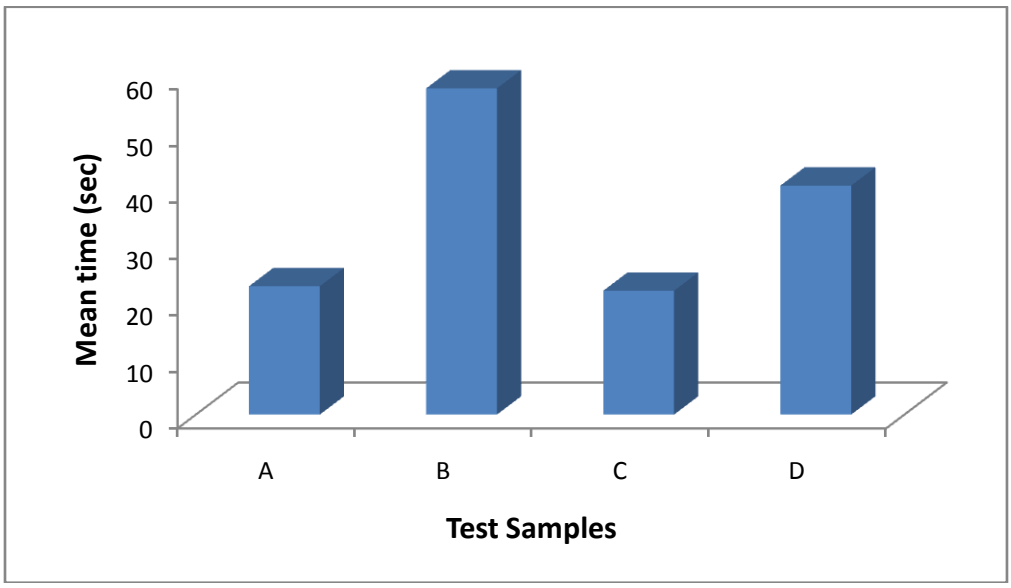

Fig. 4: A plot of flammability rating against test samples

Fabric Flammability

The results in Fig. 4 implies that sample B and D have better flammability ratings than sample C and A. The variation in flammability rating may be attributable to the type of fibre used, as well as the type and extent of the flame retardant and the finishing incorporated into the fabrics. The order of increase in flammability is given as Sample B>D>A>C.

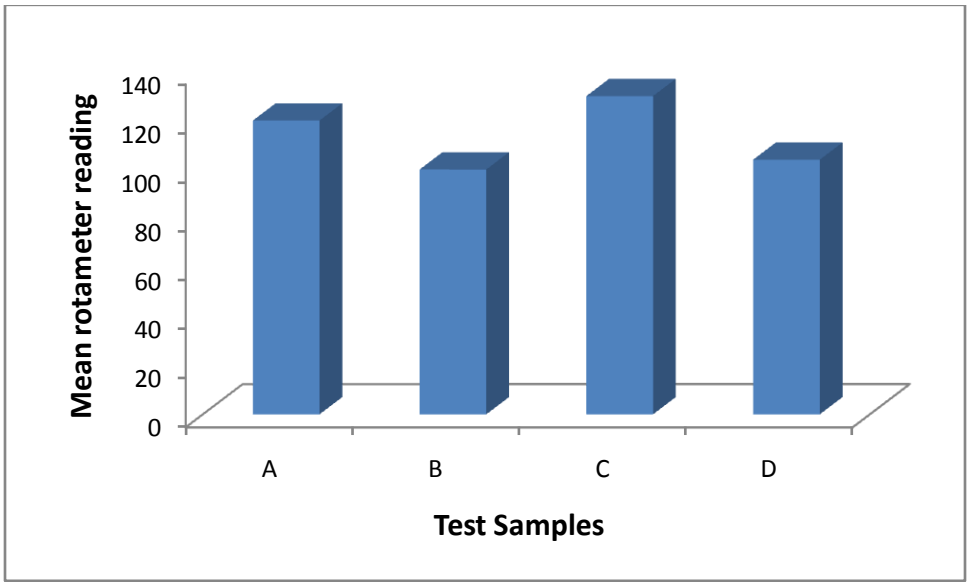

Fig. 5: A plot of mean rotameter reading against test samples

Fabric Air Permeability

Fabric air permeability is a factor which depends on the fabric sett, yarn count and the diameter of yarn used to produce the fabric [Clayton, 1935]. Figure 5 shows the average flow rate of air through the tested fabrics. From the Figure, sample C has the highest mean air permeability with the least air, followed by sample A. Sample B has the least air flow rate followed by sample D. This implied that sample B and D were constructed with less porosity and could be used or suitable in cold weather as compared to sample C and A. The order of increase in fabric air permeability is given as sample C> A> D> B.

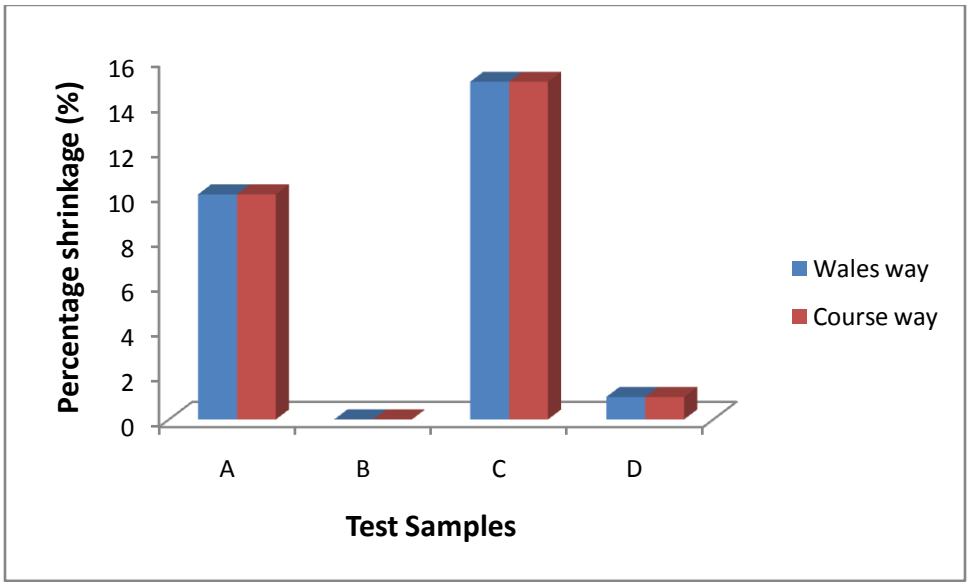

Fig. 6: A plot of percentage shrinkage against test samples

Fabric Shrinkage

Fabric shrinkage is one of the factor that affect the dimensional stability of the fabric, though the effect is less in knitted fabric as compared to other type of fabric especially woven and non-woven [Taylor and Malorie, 1981;Morton, 1975]. Figure 6 show that sample C has the highest percentage shrinkage in both wales and courses direction. While sample B has zero, that is, no shrinkage in both length and width direction, and this indicate that sample B has excellent dimensional stability and D has a very good dimensional stability

Conclusion

It is possible to knit twisted ring acrylic yarn non-texture) 3-ply and repco acrylic yarn (non-texture) 2-ply, although their knitting process is somehow tedious because the thread cannot flow well on the knitting machine compared to relaxed acrylic yarn for both 3 and 2-ply. Sample B and D have better abrasion resistance, air permeability, wetterbility, fabric shrinkage and fabric flammability.

Sample A and C have low abrasion resistance; have high air permeability as well as wettablity. They are softer in term of fabric handle and fabric thickness. They have poor shrinkage.

The results obtained for the properties, determined how functional these knitted fabrics may be disposed to various end uses.

Sample B and D will be better used in cold weather because of their tiny hole (interstices), air cannot flow rapidly and therefore keep the body warm.

Sample A and C can be used in hot weather because of their porosity, they can provide medium for good ventilation in hot seasons

Acknowledgements

The authors would like to thank the management of Nigerian Spinners and Dyers Limited, Kano, Nigeria, for their cooperation and understanding during the conduct of this research.

References

Femi, S. (2001). 'A Short Introduction to Fibre and Polymer Chemistry', First Published in Zaria, Nigeria, pp. 95.

Peter, O. (1993). 'Introductory Textiles for Home Economics', S. Asekome & Co. publishers, Nigeria, pp 23 – 39.

James, C. (1995). 'Acrylic Fibre Technology and Applications', www.mfeprogetti.com

Gregor, M. and Swarz, E. (2008). 'Mechanical properties of Cashmere Single Jersey Knitted Fabric', Textile Research Journal, 78: 9-216.

David, J. (1987). 'Knitting Technology', Lesceter Polylectine, U.K., Pergamon Press (Publisher) 1st Edition, pp. 29.

Clayton, P. (1935). 'Dynamic Air Permeability Behaviour of Nylon 66 Air bag Fabric', Journal of Textile Industries, 26: 171 – 186.

Taylor, and Majorie, A. (1981). 'Technology of Textile Properties', 2nd Edition, Forbes Publication Ltd, London, pp. 458.

Morton, W.E. (1975). 'Physical Properties of Textile Fibres', Textile Institute Heinemann, London, pp. 12 – 131.

Clara, P. (2007). 'Knitter's Book Yarn', Copyright © 1999 – 2010. Ettow. Inc.