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COMPARATIVE ANALYSIS OF YARNS SPUN FROM DIFFERENT DERIVATIVES OF SAME RAW MATERIAL

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ABSTRACT

Sattar MA, Ullah ANMA, Shamim ANM (2011) Comparatıve analysıs of yarns spun from dıfferent derıvatıves of same raw materıal**.** *J. Innov. Dev. Strategy* 5(2), 48-52.

Regenerated fibers coming from same raw material have same and different properties due to their production methods. Chemical reaction between raw material and chosen chemical leads to clearify the characteristic properties and usage areas of fibers. In this study, yarn strength and breaking elongation of viscose and lyocell fibers were analysed by Uster Tensorapid device. Yarn faults were detected by Uster Tester 3. Yarn counts and physical properties of these yarns were same with each other. Minitab statistical software was used to compare results. Variance analysis of these outputs were determined. Datas of strength and breaking elongation were also analysed in terms of yarn quality.

***Key words**: lyocell, strength, unevenness, viscose, yarn*

INTRODUCTION

Fiber is separated into various qualities according to its length, strength and fineness. Cotton raw material contains approximately 95% cellulose. The remaining 5% of a raw material consists of pectin, wax, protein and other materials. Artifical cellulosic fibers have been widely used than natural cellulosic fibers. Although artifical cellulosic fibers are not as strength as natural cellulosic fibers, these fibers have wide usage due to their luster, softness and smoothness.

The first regenerated cellulosic fiber, viscose, is produced in filament form by being extruded from spinnerets after being soluted of wood pulp in suitable solvents. Viscose can be naturally spun therefore it is updately getting important. Lyocell fiber is also a regenerated cellulosic fiber which is result of an innovative fiber investigation. This investigation is trigerred by some reasons such as; ecological problems, being consumed of natural sources, having high breaking strength of viscose as wet. Lyocell fiber, which is the third generation of regenerated cellulosic fibers, is soluted in organic solvents. A fiber having economical and ecological advantages was produced by synthesizing 100% natural cellulosic fiber with non-toxic solvents (Gruber and Weigel, 1997).

Lyocell fibers can be spun in conventional ring and open-end systems. Finer yarns and lighter fabrics can be produced by lyocell fibers than that's by viscose fibers. Lyocell fiber is used in production of lingerie, shirts and lighter clothes with or without blending with cotton, acrylic, wool and polyester (Bischofberger 1997).

STRUCTURAL PROPERTIES OF VISCOSE FIBER AND ITS PRODUCTION

Production of Viscose Fiber

Cellulose is alkalified with sodium hydroxide and then it is xanthanized with carbon disulphide. A viscous liquid is obtained by adding diluted alkaline. This liquid making extrusion easier, is called as viscose (Harmancıoğlu 1981).

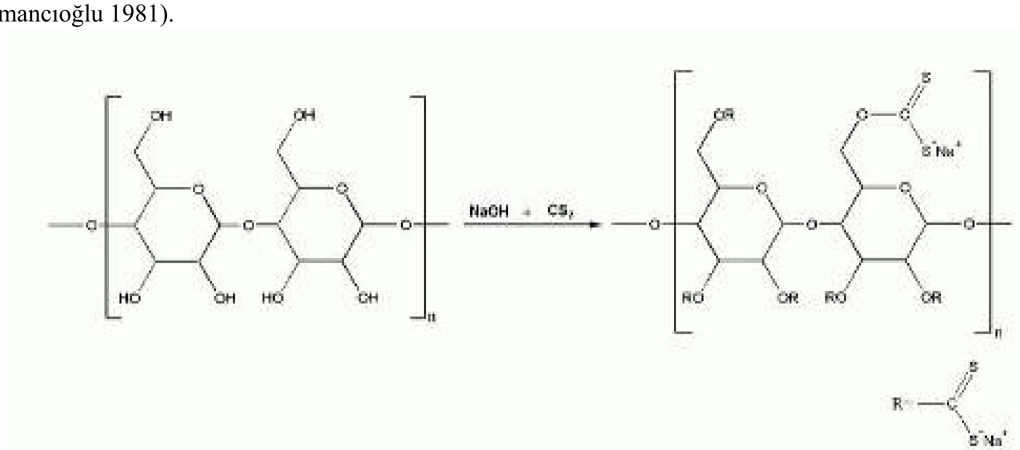

Fig. 1.Chemical structure of viscose

Properties of Viscose Fibers

Cellulosic material obtained from linter, wood pulp or straw is treated with several chemical processes. This type of fiber is classified as regenerated cellulosic fiber and called as viscose rayon. If output is filament fiber, the fiber is called as rayon. If it is produced as staple form as like wool and cotton then it is called as viscose (Bozkurt 1995).

Although it has same properties with cotton, production of fiber, attraction of various reactants, reaction to dyeing, printing and finishing processes are different. Faster reaction of viscose with some chemicals is the main difference between viscose and cotton. Viscose reacts easily with alkaline and acides. Its affinity to dyestuffs is higher because of having more amorphous area than crystalline. Striations are available in longitudinal view and the fiber has cross-sectionally irregular shape.

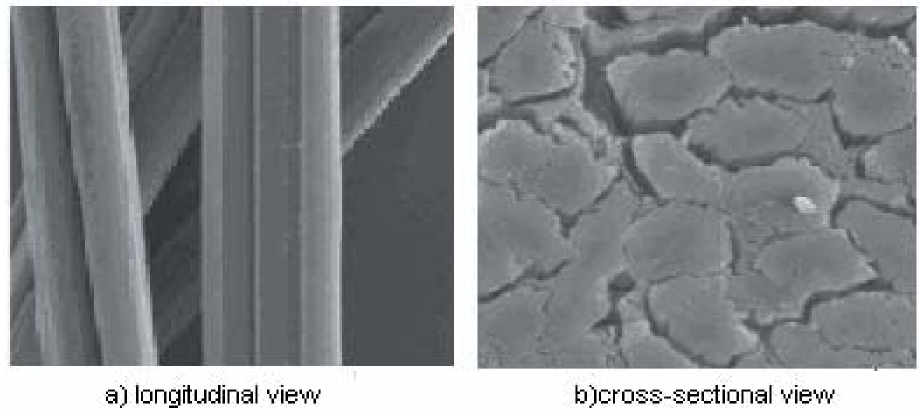

Fig. 2. Viscose fiber

Advantages of viscose fiber are:

- non-allergic;
- a good absorbent;
- resistant to usage;
- more luster than many of other fibers.

Disadvantages of viscose fiber are:

- Fiber strength decreases when it is wetted;
- It dries later;
- Extremely high shrinkage can be observed if drying is performed with drums at high temperature. Shrinkage is also higher in fabric production if stretching is not enough;
- There is a probability of dyestuff migration. That makes other fabrics to be soiled. Therefore it is necessary not to use inexpensive dyestuff. Dyestuffs having high washing fastness must be used (Vischvinger 1996).

Production of Lyocell Fiber

The most important point of lyocell production technique is reuseability of organic solvents. These solvents can be recycled with a probability of 99% or more. Main principle of this technique is to solve cellulose in an organic solvent and to draw filaments with a special drawing system. Lenzing firm prefers to use N-Methylmorpholin N-Oxide (NMNO) and water as an organic solvent (Çoban 1998).

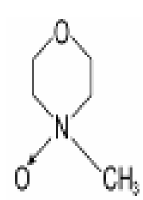

Fig. 3. N-Methylmorpholin N-Oxide

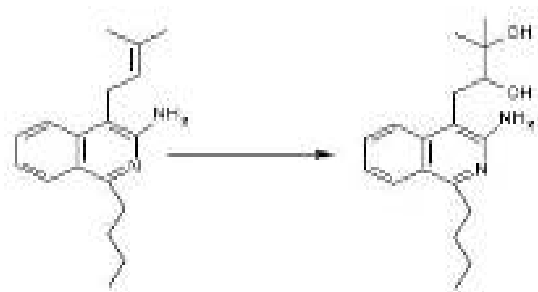

Fig. 4. Chemical structure of lyocell

Structural Properties of Lyocell Fibers

Lyocell is a regenerated cellulose fiber. Lyocell is the general name of fibers produced by solving cellulose in N-Methyl-Morpholine-N-Oxide as an organic solvent.

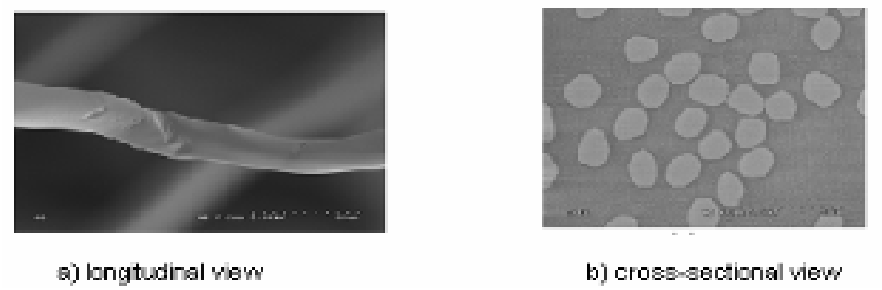

Fig. 5. Lyocell fiber

Advantages of lyocell fiber are:

- non-allergic;
- a very good absorbent;
- more resistant than viscose fiber;
- has a cotton-like handling and a silky lustrous;
- darker colors are obtained as it is dyed with all dyestuffs using for cotton dyeing;
- more stable than viscose fiber during washing.

Disadvantages of lyocell fiber are:

- Extremely high shrinkage can be observed if drying is performed with drums at high temperature. Shrinkage is also higher in fabric production if stretching is not enough;
- There is a probability of dyestuff migration. Color of product becomes lighter. That makes other products to be soiled;
- Fibrillation, which refers to longitunal division of strongly crystalized fiber, causes some problems in finishing treatments. On the other hand different effcets can be occured by this property (Bredereck 1998).

MATERIALS AND METHOD

Material

100% viscose fiber and 100% lyocell fiber marketted by Lenzing AG firm were separately investigated after being spun with carded yarn production. Devices used for examining the characteristic properties of each yarn are:

- Uster Tester 3
- Uster Tensorapid

Method

Slivers coming from Zinser 660 roving frame were spun into yarn in Zinser 350 ring machine. Unevenness, thin places, thick places neps and hairness of yarns were detected in Uster Tester 3. Strength and breaking elongation of yarns were tested by Uster Tensorapid device. Minitab statistical software was used to compare yarn qualities. Variance analysis was basically determined with 95% confidence bounds. Working conditions were arranged in the manner that relative humidity was 50% and temperature was 26ºC.

RESULTS

The specimens were tested in Uster Tester devices. Tension and conveying speed are kept constant while yarns are tested. The results were statically evaluated. Results are analysed according to experimental plan of factorial coincidence. Variety and type refers to fiber and yarn count, respectively.

Unevenness: Variety is unimportant($p>0.05$). Effect of type is very important($p<0.01$) and interaction effect of variety and type is important($p<0.05$). Different variences have different unevenness averages on different types. In terms of type, the lowest average group is 16 Ne however the highest average groups are 20 Ne, 30 Ne, 36 Ne and 40 Ne (according to Tukey).

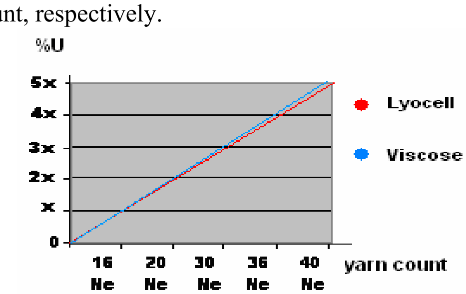

Fig. 6. Shematic illustration of unevenness difference

Coefficient of Variation: Effects of variety and type are very important ($p<0.01$). Interaction effect of variety and type is unimportant ($p>0.05$). In terms of variety, the lowest average group is viscose however the highest average group is Lyocell (according to Tukey). In terms of type, the lowest average group is 16 Ne however the highest average groups are 20 Ne, 30 Ne, 36 Ne and 40 Ne.

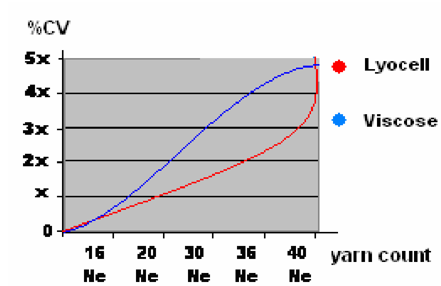

Fig. 7. Shematic illustration of CV% difference

Thin Places: Effect of variety is unimportant ($p>0.05$), effect of type is very important ($p<0.01$) and interaction effect of variety and type is important ($p<0.05$). In terms of type, the lowest average groups are 16 Ne, 20 Ne, 30 Ne however the highest average groups are 36 Ne and 40 Ne.

Thick Places: Effect of variety is unimportant ($p>0.05$), effect of type and interaction effect of variety and type are very important ($p<0.01$). In terms of type, the lowest average groups are 16 Ne, 20 Ne, 30 Ne however the highest average groups are 36 Ne and 40 Ne.

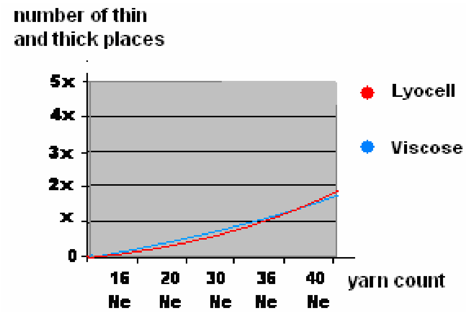

Fig. 8. Numbers of thin and thick places

Neps: Effect of variety, effect of type and interaction effect of variety and type are very important ($p<0.01$). In terms of variety, the lowest average group is viscose however the highest average group is lyocell. In terms of type, the lowest average groups are 16 Ne, 20 Ne however the highest average groups are 36 Ne yarns.

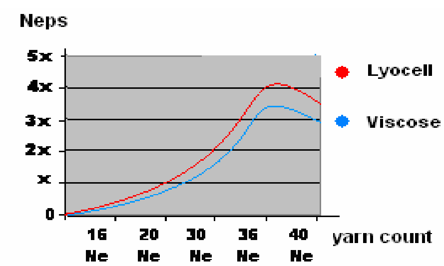

Fig. 9. Difference between numbers of neps

Hairiness: Effect of variety, effect of type and interaction effect of variety and type are very important ($p<0.01$). In terms of variety, the lowest average group is viscose however the highest average group is lyocell. In terms of type, the lowest average groups are 16 Ne, 20 Ne, 40 Ne however the highest average group is 36 Ne.

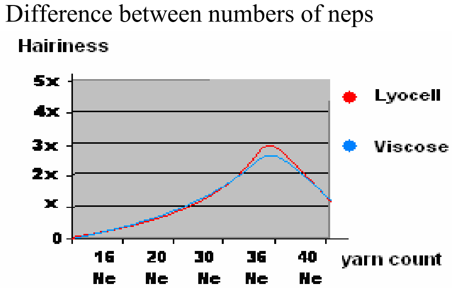

Fig. 10. Shematic illustration of hairiness difference

Yarn Strength: It is tested by Uster Tensorapid device. Effect of type and interaction effect of variety and type are unimportant ($p>0.05$). Variety is more effective on yarn strength.

Breaking Elongation: Effect of variety, effect of type, interaction effect of variety and type are very important ($p<0.01$). In terms of variety, the lowest average group is lyocell however the highest average group is viscose. In terms of type, the lowest average groups are 16 Ne, 20 Ne however the highest average groups are 36 Ne.

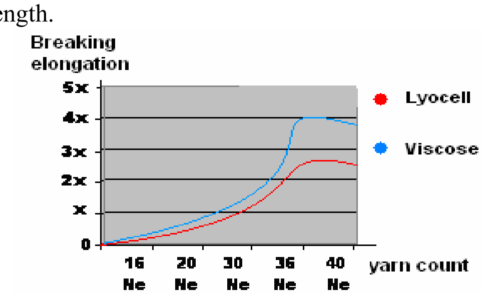

Fig. 11. Shematic illustration of breaking elongation difference

DISCUSSION

Fibers produced from same raw material have different properties due to different production processes. Chemical construction of a fiber determines the physical and mechanical properties of end product. In this experiment, all yarns are spun under same conditions. If two yarns have different yarn qualities under same spinning conditions, this is result of different fiber structures. Viscose and lyocell fibers, which are regenerated from wood pulp, are used to investigate this hypothesis. Coarser and thinner yarns are individually spun from these fiber types.

It is noted that yarn count determines the properties of end product. If yarn count increases, yarn becomes thinner in English yarn counting system. Viscose and lyocell yarns have nearly the same test results for 16 Ne yarns. It means that thick yarns hide some yarn faults succesfully and finer yarns show yarn faults clearly because degree of twist changes. But coarser yarns are more volumes thereby imperfections are not seen obviously. Thereby there is no clear variance difference among 16 Ne yarns whatever they are spun from. Coarse and fine yarns, which are spun from same material, have different yarn qualities.

CONCLUSION

Fiber type has a significant effect on some parameters such as; coefficient of variation, thick places, neps, hairiness and breaking elongation. It is observed that lyocell yarns have low breaking strength. Coarse lyocell yarns breaks easily. Viscose yarns are more hairy and coefficient of variation is obtained high. Neps and thick places of viscose yarns are more than that of lyocell. Yarn strength is related with fiber type. If yarns are stretched until they are broken, elongation of coarse yarns is less than that of fine yarns. Fine viscose yarns have high breaking elongation than fine lyocell yarns.

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