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STUDY ON THE DETERMINATION OF SUITABLE TWIST FOR KNITTED SWEATER

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ABSTRACT

Twist is an important factor for the strength of yarn as well as the end product. Generally, higher the twist of the yarn higher the strength of the yarn. But twist has to be an optimum value. If the twist increases up to the optimum value, after this point the strength of yarn will reduce although the twist is increased. A study was performed on the physico- mechanical and physico-chemical properties of jute: acrylic blended sweater and 100% acrylic sweater made from different (3 to 6 TPI) twisted yarn. It is observed that blended sweater made from the twist 3 TPI, 5 TPI and 6 TPI shows dissimilar properties to the 100% acrylic sweater prepared from similar type of yarn. But sweater made from the yarn of 4 TPI shows very acceptable results which are nearer to the properties of 100% acrylic sweater. Hence, 4 TPI is a suitable twist to produce standard sweater.

Key words: Physical properties, twist, detergent, flexural rigidity, count, sweater, knitting.

INTRODUCTION

Twist plays a vital role for determining the strength of yarn, generally, higher the twist of yarn, higher the strength of the yarn. But this concept is not true for all the cases. There is a certain limit when the twist is increased but the strength is not increased. So twist has to be optimum to get the maximum strength of the yarn (Anonymous, 1974; 1994). On the other hand all types of fabric (woven and knitted) are produced from the yarn. So the properties of the fabrics are also important influence of the properties of yarn (Sminfitt, 1975; Jabber and Rahman, 1990). It should be kept in mind that yarns which are used for woven fabric may or may not the same for the knitted fabric. Particularly, twist of the yarn is not same for woven and knitted fabric (Anonymous, 1974). The yarns used for knitted fabric are lower twisted than the yarn of woven fabric. Because weaving is performed by the loom through the interlacing of yarns whereas knitting is performed by the needle through the intermeshing of yarn. In this case frequent needle broken may be the cause of higher twisted yarn (Kamal Uddin *et. al*., 1989; Ali *et.al*., 1995). So this work has been taken to find out an optimum twist of yarn which is suitable for the knitted sweater.

MATERIALS AND METHODS

The materials used for producing the yarn are jute and acrylic. Two types of plied yarn viz. jute acrylic blended yarn (80 : 20) and 100% acrylic yarn of 7.5 lb / spy. are used in this experiment. The yarns are of different twist viz 3 TPI, 4 TPI, 5 TPI and 6 TPI. All types of yarns are collected from the mechanical processing division of Bangladesh Jute Research Institute in February, 2007. These two types of yarns (Blended and 100% Acrylic) are woolenished (wool like appearance) with chemical treatment in the pilot plant and processing division of Bangladesh Jute Research Institute. Then the required sweaters of blended and 100% acrylic yarns of different TPI are produced with the 5 guage knitting machine from a commercial knitting factory in Savar, Bangladesh. The tests were performed at the testing laboratory of this factory, at testing laboratory of Bangladesh Jute Research Institute (BJRI) and testing laboratory of Bangladesh Council of Scientific and Industrial Research (BCSIR). All the tests and experiments were performed under standard atmospheric condition i.e, 20 ± 2^{o}C and 65±2% RH.

** Twist per Inch (TPI) : The number of turns per unit length in the yarn expressed as TPI. The TPI is measured by twist tester using 10 inch gauge length.

** **Moisture Regain:** It is defined as the weight of water in a material expressed as a percentage of the oven dry weight.

$$\text{Moisture Regain \%} = \frac{\text{Weight of water}}{\text{Oven dry weight}} \times 100\%$$

The M.R% is determined by moisture testing ovens.

** Flexural rigidity, G. This is a measure of stiffness associated with handle. The calculation is as follows : $G= W^2C^3 \times 10^3$ mg/cm
Where, W2 = cloth weight in gram per sq. centimeter C= Bending length.
Where,

Bending Length C, is the length of fabric that will bend under its own weight to a definite extent. It is a measure of the stiffness that determines draping quality. Bending length is measured by fabric stiffness tester.

** Thermal Conductivity: From wikipedia, the free encyclopedia. In physics, thermal conductivity, k, is the intensive property of a material that indicates its ability to conduct heat. It is defined as the quantity of hear, Q, transmitted in time t through a thickness L, in a director normal to a surface of area A, due to a temperature differences δT, under steady state conditions and when the heat transfer is dependent only on the temperature gradient. thermal conductivity = heat flow rate x distance / (area x temperature difference).
So, $K = Q/t \times L/A \times \delta T$.

Thermal resistance:

It is measure of a body's ability to prevent heat from flowing through it, equal to the difference between the temperatures of opposite faces of the body divided by the rate of heat flow.
Thermal conductivity and Thermal resistance are determined by thermal resistance tester (Shirley Togmeter).

RESULTS AND DISCUSSION

It is seen that the Table–I, that the physico-mechanical and physico-chemical properties of blended (80 : 20 / jute : acrylic) sweater are varied due to the variation of the twist of the yarns. It is also seen from Table -2, that the physico-mechanical properties of 100% acrylic sweater various with the variation of twist on the yarn. From both the Tables it is observed that when the TPI is 5 & 6 then physical feeling during knitting is harder than the physical feeling during knitting of 3 TPI yarn. Again yarn breakage is also higher for 6, 5 and 3 TPI yarn than the 4 TPI yarn. The other properties like thermal conductivity, thermal resistance and flexural rigidity of 4 TPI blended sweater are much more acceptable than the 5, 6 and 3 TPI blended sweater. Here, sweater made from the blended (80 : 20 / jute : acrylic) 4 TPI shows very nearer values with comparison to standard sweater made from the 100% acrylic yarn of TPI-4.

Table 1. Physico-mechanical and physico-chemical properties of blended sweater (80 : 20 / Jute : Acrylic).

S. No.	Test Parameters	Sweater using yarn of			
		Twist / inch (TPI) 6	Twist/ inch (TPI) 5	Twist/ inch (TPI) 4	Twist/ inch (TPI) 3
1.	Machine setting length	35"	35"	35"	35"
2.	Length after knitting	31"	31.5"	34"	34"
3.	Feeling during knitting period	More hard	More hard	Soft	Soft
4.	Yarn breakage	10/hr	8/hr	2/hr	5/hr
5.	Physical feeling	Soft	Soft	More soft	More soft
6.	1st wash with detergent	32"	32.5"	33.5"	34.5"
7.	2nd wash with detergent	32.5"	32.9"	33.7"	34.2"
8.	Length after one month hanging	35.5"	35.7"	34.2"	35"
9.	Thermal conductivity	280 mw/mC^0	284 mw/mC^0	295 mw/mC^0	290 mw/mC^0
10.	Thermal resistance	8.47 cm^2/m w×10^{-2}	8.5 cm^2/m w×10^{-2}	8.9 cm^2/m w×10^{-2}	8.6 cm^2/m w×10^{-2}
11.	M.R %	11.2%	11.6%	10.8%	11.7%
12.	Flexural rigidity	830 mg.cm	810 mg.cm	740 mg.cm	780 mg.cm
13.	Hydrocarbon	Free	Free	Free	Free
14.	Health hazard	Free	Free	Free	Free

TPI plays a vital role for producing sweater. Machine parameter, processing parameters are highly related to the softened of the yarn. Highly twisted yarn is harder then soft low twisted yarn. Again low twisted yarn is less stronger than highly twisted yarn (Zurek *et. al*.,1979; Tippett, 1974). Hence extremely high twisted yarn also shows less strength. So it is a very difficult task to suggest a suitable twist for the sweater. However, we have tried to fine

out a suitable twist for different types of yarns (3 TPI, 4 TPI, 5 TPI & 6 TPI). We have tested the properties of blended sweater and 100% acrylic sweater. Both are made from different types of twisted yarn. Here the properties of 100% acrylic sweater are considered as standard properties. From the above two tables, it is observed that sweaters made from the blended yarn of TPI 4 shows very nearer and comparable properties to the sweater made from the yarn of TPI 4 of 100% acrylic sweater.

Table 2. Physico-mechanical and physico-chemical properties of 100% acrylic sweater.

Sl. No.	**Test Parameters**	**Sweater using yarn of**			
		Twist / inch (TPI) 6	**Twist/ inch (TPI) 5**	**Twist/ inch (TPI) 4**	**Twist/ inch (TPI) 3**
1.	Machine setting length	35"	35"	35"	35"
2.	Length after knitting	32"	33"	34.5"	34.5"
3.	During knitting period	Hard	Hard	Soft	Soft
4.	Yarn breakage	4/hr	3/hr	2/hr	2/hr
5.	Physical feeling	Soft	Soft	Softer	Softer
6.	Length after 1st wash with detergent	33"	33.5"	34.5"	34.5"
7.	Length after 2nd wash with detergent	33.5"	33.7"	33.8"	34.8"
8.	Length after one month hanging	35.5"	35.7"	34.2"	35"
9.	Thermal conductivity	287 mw/mC^0	288 mw/mC^0	290 mw/mC^0	291 mw/mC^0
10.	Thermal resistance	8.61 cm^2/m w×10^{-2}	8.58 cm^2/m w×10^{-2}	9.46 cm^2/m w×10^{-2}	8.17 cm^2/m w×10^{-2}
11.	M.R %	8.1%	8.2%	8.86%	9.4%
12.	Flexural rigidity	795 mg.cm	760 mg.cm	695 mg.cm	705 mg.cm
13.	Hydrocarbon	Free	Free	Free	Free
14.	Health hazard	Free	Free	Free	Free

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