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Figure out the weight loss percentage of three thread fleece fabric composed of different fibres for abrasion on the technical back side

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Abstract- Abrasion resistance is used to quantify the service life of the textile material in normal use. The aim of this study is to measure the deterioration of three thread fleece knit fabric due to abrasion. To conduct these work three different types of three thread fleece (all cotton, cvc/poly/cotton, all PC) fabrics were selected. The test was carried out in the technical back side of the fabric because of the presence of loose and course fleecy yarn where the possibility of fibre loss is higher than technical face side. The weight loss percentage of the fabric both in grey and finished state were measured at every 500 cycles interval on Martindale instrument according to ISO 12947-3:1998. The result showed that the rate of weight loss percentage was raised with increment of the cycle, and a measurable effect found in the weight loss percentage of polyester based three thread fleece fabric yarn after 500 cycles than the others. It was also observed that for all cotton based fleece fabric variation in loss of weight in grey to finished state was not so remarkable, but the weight loss percentage was found higher in all CVC, polyester, cotton based fleece fabric.

Index Terms- Abrasion resistance, Three thread fleece, Weight loss percentages (%), Technical back side, Grey state, Finish state.

I. INTRODUCTION

Knit fabrics will find wider use in time since they can be produced more easily for a lower cost, and they are more flexible. However, knit fabrics are less stable than woven fabrics since they are produced with low twist yarn and have a slack construction, as a result of which they have a low abrasion resistance.

Invisible fleecy is a plain plated structure composed of a face and binding yarn with a fleecy backing yarn tucked into the technical back at every fourth wale to mesh only with the binding yarn. The face yarn prevents the arms of the fleecy tucks being visible between the wales on the face, which would spoil its clean appearance. The fleecy inlay is spread across the technical back by centering the fleecy tucks of the next three-feed sequence on the middle of the three needles that missed the fleecy yarn in the previous sequence.In fleecy fabrics, the fleece yarn fibres (usually in the form of inlaid yarn) become entangled and indistinguishable from the base yarn on the effect side, despite having been separately supplied during knitting.[1]

Abrasion resistance is the ability of a fabric to resist surface wear caused by flat rubbing contact with another fabric. Abrasion resistance of the textile materials is very complex phenomenon and affected by many factors, mainly classified as follows: Fiber, yarn, fabric properties and finishing processes. Some of these parameters affect fabric surface whereas some of them has an influence on internal structure of the fabrics. [2]

Abrasion occurs during wearing, using, cleaning or washing process and this may distort the fabric, cause fibers or yarns to be pulled out or remove fiber ends from the surface. The first stage of abrasion is small balls entanglement because of the loose fibers unravels from the fabric surface during usage and washing. Eventually the fibers which bind the balls to the surface breakdown and a hole occur. If the sock consists of synthetic fibers with natural fibers, during rubbing action natural fibers, which give the desirable properties of the sock, move away, only synthetic fibers remain. This gives the sock undesirable appearance and decrease the overall fabric thickness. [3]

There are many factors, such as the yarn spinning system, fabric construction and finishing operation, which affect the abrasion resistance and pilling performance. With certain precautions taken in fabric production, the abrasion resistance and pilling performance of knit fabrics can be developed positively.

The initial effect of abrasion on the surface of a fabric is the formation of fuzz as the result of two processes, the brushing up of free fiber ends not enclosed within the yarn structure and the conversion of fiber loops into free fiber ends by the pulling out of one of the two ends of the loop. Gintis and Mead consider that the fuzz formation must reach a critical height, which is dependent on fiber characteristics, before pill formation can occur. [4]

Dessouki H. A. E. found that the abrasion resistance value of socks can be increased by a number of measures; use of thicker yarns, adding PA to the structure, adding elastic yarns to the structure. [5]

Jerkovic I. et al. compared four abrasion testers, which are used for the automobile sector. [6]

Abrasion is generally only one of several factors contributing to wear performance or durability as experienced in the actual use of the material [7], but abrasion behavior is an important property of textile materials that governs the quality and efficiency of processing

and the performance of products [8]. Abrasion is the mechanical deterioration of fabric components by rubbing them against another surface [9]. Therefore it is affected by many factors in a very complex, and as yet little understood manner [10].
The Martindale tester is used for both the abrasion, pilling resistance of fabrics, and straight line test by adjusting three moving parts, each one has three setting levels; making twenty seven paths possibilities. According to the standards there are only three types of motion to perform different tests. Therefore the aim of Kotb N. A. et al [11] study is to evaluate the effect of other setting possibilities on abrasion behavior.
Akaydin M. et al. [12] determined the effects of dyeing, knit construction and the thread yarn production type on the abrasion resistance and pilling performance of jersey and interlock fabrics were produced from 100% cotton ring and compact yarns.
Rashid M.R. et al. [13] investigated the abrasion resistance and seam stretchabilty of knitted fabrics using ring and compact spun yarn on three different knitting structures single jersey, rib and interlock were produced from these yarns.
Jerkovic I.et al. [14] compared three abrasion tests with different abrasive elements using car seat upholstery structures.

II. EXPERIMENTAL DATA

100% Cotton, Cotton/polyester/cotton, 100% Polyester, CVC/polyester/cotton, CVC/polyester/CVC and Cotton/Polyester/CVC fibers are mostly used in fleece. So in this research, the effect of commonly used fibers to abrasion resistance was investigated. For this purpose the specifications of selected specimens shows in Table (1)

Table 1: Selected yarn for experiment

Material	Yarn count
100% Cotton	$30^s/30^s/12^s$
100% PC	$34^s/34^s/22^s$ (52% 48%)
CVC/polyester/cotton	30^s (60% 40%)/75D/20^s

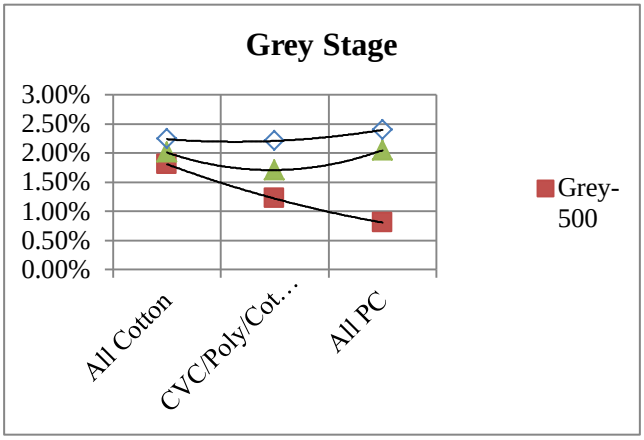
Samples were prepared on a 34”X20G JIUNN LONG, Taiwan fleece circular knitted machine in Micro Fiber Group Ltd. Each sample was made 5kg.Specimen for grey abrasion test was separated and rest of the samples was sent for dyeing and finishing. Standard dyeing and finishing process was followed for average color and finished specimen was ready for abrasion resistance test.
In this study, abrasion resistance values were measured on the basis of weight loss percentage by using Martindale instrument according to ISO 12947-3:1998 with the standard load 9kpa. [15]

After performing all the testing the following table was generated and tabulated:

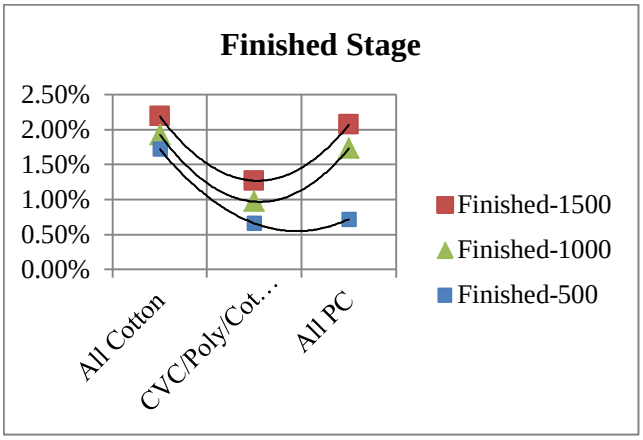
Table 2: Weight loss percentages (%) of three thread fleece fabric (without brush)

Yarn type	Wt loss % after 500 cycle		Wt loss % after 1000 cycle		Rate of increase of wt loss % (Grey 500-grey 1000)	Rate of increase of wt loss % (finish 500-finish 1000)	Wt loss % after 1500 cycle		Rate of increase of wt loss % (Grey 1000-grey 1500)	Rate of increase of wt loss % (finish 500-finish 1000)
	Grey-500	Finished-500	Grey-1000	Finished-1000			Grey-1500	Finished-1500		
All Cotton	1.81	1.72	2.01	1.93	0.11	0.12	2.24	2.19	0.11	0.13
CVC/Poly/Cotton	1.22	0.66	1.71	0.97	0.40	0.47	2.21	1.27	0.29	0.31
All PC	0.81	0.72	2.05	1.73	1.53	1.40	2.40	2.07	0.17	0.20

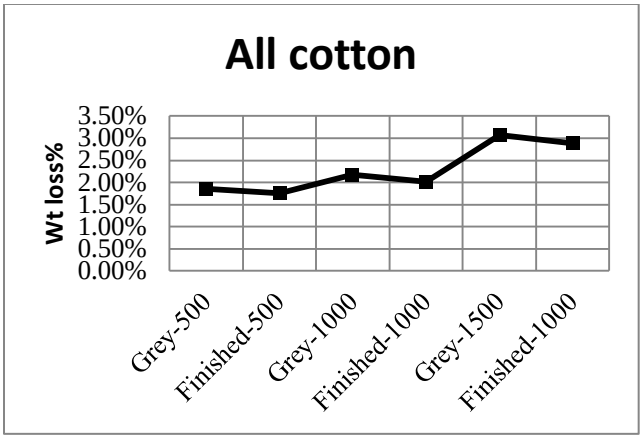
III. RESULTS AND DISCUSSIONS



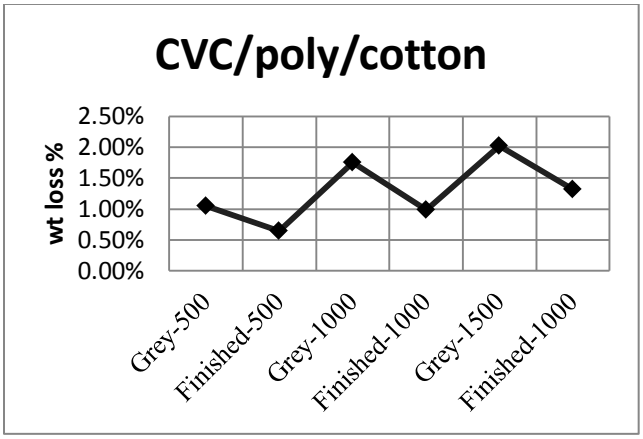
Graph 1: Weight loss percentages (%) of three thread fleece fabric (without brush) in grey state.



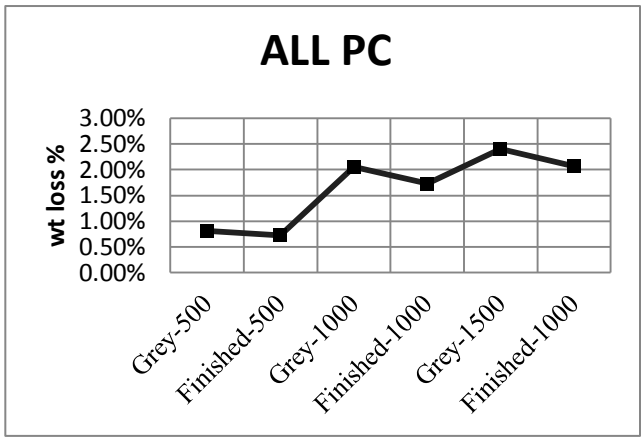
Graph 2: Weight loss percentages (%) of three thread fleece fabric (without brush) after finishing



Graph 3: Weight loss percentages (%) of three thread fleece fabric (without brush) in case of all cotton yarn



Graph 4: Weight loss percentages (%) of three thread fleece fabric (without brush) in case of CVC yarn



Graph 5: Weight loss percentages (%) of three thread fleece fabric (without brush) in case of all PC yarn

Above illustrated table 2 and Graph 1 and 2 it clearly indicate that the weight loss percentage of fleece fabric is increased with the increase of cycle number for all fabric in both grey and finished state. And it is maximum at 1500 cycle. Very interesting fact was found for all polyester based three thread fleece fabric that is weight loss percentage after 500 cycles is very low in compare with all cotton based fleece fabric. But after 1000 cycles and 1500 cycles it shows very similar values like all cotton based fleece fabrics. A remarkable change in the rate of weight loss percentage increase is found in between 500 to 1000 cycle for PC fleece fabric as compared with others. The reason behind it may be the higher strength in polyester fibre, higher cycle is required for its deterioration.
From the illustrated table 1, it is also shown that in 500 cycles with the increase of polyester in fabric the rate of weight loss percentage is not raised. For all cotton it is 1.81%,for cvc/poly/cotton 1.22%, and for 0.81%.But after 500 cycle, the rate of weight loss percentage is raised with the increase of polyester percentage in the fabric. And this percentages reach at 2.40% after 1500 cycles for polyester based fleece fabric which is very much higher than cotton(2.24% after 1500 cycles) and cvc (2.21% after 1500 cycles) and it is shown on table 1,chart 1.
From the table 2 and graph 3,4and 5, it is also observed that after finishing of the fabric weight loss percentages of every sample is lower than its grey stage. But in case of CVC /polyester/cotton threaded fleece fabric; grey to finish weight loss percentage is very much measurable. 100% Cotton based three thread fleece fabric maintains very uniform weight loss percentages after every 500 cycles for both grey and finish state. In case of polyester based fleece fabric, weight loss percentage is approximately same for both grey and finished state at 500 cycles. But after that it shows higher weight loss percentage in grey state than finished state.

IV. CONCLUSION

In this study, the results of abrasion resistance on the basis of weight loss percentage of three thread fleece fabric varied with the number of cycle, fibre composition and different state were analyzed. The summary of this observation was that higher number of cycle raise the deterioration effect on the fabric surface and enfeebles the yarn. Polyester based three thread fleece showed lower abrasion resistance after 500 cycles and a remarkable change in the rate of weight loss percentage is observed in between 500 to 1000 cycles. Also the results showed that the weight loss percentage in grey state was higher than the finished state for all fabric. The presence of high polyester fibre in the fabric show higher abrasion resistance than cotton based fleece fabric because of its higher strength.

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