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Industrial Design of Fixed Bal-Con in Bobbin Winding Machine and its effect on Yarn Indices

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ABSTRACT

In spinning processes, bobbin winding yarn guide tools are effective on the yarn quality and mostly reduce the yarn quality. This negative effective more showed in end of spinning process especial in winding machine. In new winding machine for reduce yarn hairiness in bobbin winding processes, some researchers have been conducted in Morata-Tech Company and hairiness is reduced at high speed by Bal-Con mechanism. The present study used Bal-Con system in old bobbin winding machine not similar to Morata-Tech Bal-Con system and a method was used to change the geometry structure of the bobbin winding process region. In the first step evaluated more accurate balloon region. In new bobbin winding machines, a mechanism called Bal-con is used to reduce yarn hairiness and it reduces hairiness at high speed as acceptable. Based on this issue, a new design was performed in old bobbin winding machines in which a method is used to change the geometry of yarn balloon in bobbin winding. At first, the balloon control region was measured exactly in bobbin winding machine. Then, by various types and different designs of Bal-con, the best Bal-con design was selected and used in cotton spinning system. The results of the study showed that based on evenness and hairiness tests and designed Bal-con, in spinning system, the short fibers showed acceptable yarn quality improvement. Therefore, this mechanism is proposed for spinning system of short fibers namely on Schlafhorst machines.

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INTRODUCTION

Bobbin winding is typically conducted after spinning and to rapidly perform processes such as relocation of packages and adjusting thread imperfections which in most cases increases hairiness of the thread, which this action occurs by rubbing the thread to different sections of bobbin winding machine. That’s why, two basic points should be considered with respect to bobbin winding machines. First, paying attention to the lint features that are created in the thread construction and the other is baleen construction of thread that is in the process of bobbin winding that causes hairiness by undesirable rubbery. Following to clarify the issue, the research that has been done in relation to hairiness and balloon structure is discussed. Hairiness is one of the characteristics of hairiness that increasing its numbers in the produced threads in short fiber spinning system has created many problems. Fiber is not a strange element, but is constituted from fibers that is exited from the thread body and causes length increase or looping of fiber from the thread level. Creating fiber in the thread depends on many factors such as the fiber parameters, production processes, environmental conditions (temperature, humidity) and other factors. It is important to bear in mind that although nap is desirable, increasing its numbers will be undesirable and in the meantime, determining its boundary changes according to final consumption of the product.

For the first time, "Barella" examined the direct correlation between increasing the speed of winding bobbin and the thread hairiness. Following, he study conducted by Zeltner showed that conventional bobbin winding process increases hairiness of spun thread in some cases by more than 55%.

In Figure 1, different types of fibers in hairiness environment between radius r1 and r2 can be seen. In this figure, the fiber (1) and rings fiber (2) are located in the outer radius of the thread, protruding fibers (3), the back

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end of the fiber (4), bounced back and bottom of the ring (5). The number of fibers (4) and (5) the low in the thread that can be ignored.

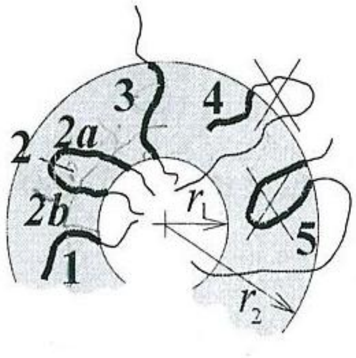

Fig. 1: different types of fibers in the thread.

According to research conducted by "Morton", "Yen" [3, 4] and "Barla" [5], hairiness theory was founded in 1956. In fact hairiness occurs because there are some free ends protruding from the core yarn. Sometimes fibers are exited from a thread in a loop method that this fiber was labeled as wild fiber by Morton and has a nature like a fuzz in the threading construction. Barla realized as the number of fibers in the cross section can be measured, the number of fuzzes can also be measured and the hairiness index can be evaluated by expressing the number of fuzzes. Generally, hairiness is the number of fibers that do not exist in the thread structure and the majority of them are created by short fibers. But in a more precise definitions, hairiness is the rings and the fibers with protruding ends, and hence, the existence of hairiness cannot be limited to short fibers, although the majority calculate hairiness based on short fibers protruding from the thread structure. While the fuzzes from fiber with protruding ends are independent of the thread warp. “Boswell "Townen "'[6]," Pillay "[7]" and Barla "[8, 9] also pointed out this issue. When twisting the thread increases, the number of ringing fuzzes also decrease, that is due to existing a higher degree if cohesion and continuity of the two types of fibers with thread structure by twisting. If the wild fiber is considered as a combination of ringed fibers and protruding ones out of thread structure, their number is reduced by twisting, because of their different position in the outer surface of the thread that their spatial location round the thread is changed only by twisting without changing their number.

In studying the thread fuzz, changing in length is a very important issue, because the thread cross-sectional area will increase relatively by reduced twisting factor, so that if thread twisting decreases, fiber cross-sectional area will be added. For this reason, if the fuzz length caused by protruding fibers increases, hairiness index will also be increased and if the length of ringing fuzzes is considered, the number of hairiness index will also be reduced. However, in low twist, recent fuzzes show more participation in the thread structure. And this means that thread hairiness is inseparably associated with the outer layer of thread, because this fiber is not adhere directly to the core thread.

Early research studies on the structure of the yarn balloon was conducted by "Padfield" using balloons dynamic theories on the opening of yarn from bobbin ends in spinning machines [10, 11]. He solved the problem of fundamental equations of thread movement path in the case of balloons formation and slipping of the threads, from ocular to the area of arising the thread and from arising the thread to its opening area from the bobbin head and the problem of low speed opening of the bobbin thread by making the opening angle small. Following his studies, Bowess physically experienced the slipping movement of the yarn from the bobbin surface and could solved the obtained equations [12]. Over time, "Kothari" and "Leaf" solved Padfield equations numerically [13]. On the other hand, "Freazer" et.al formulated fundamental equations of the motion of with boundary bound conditions for high speed of thread opening from the bobbin head and presented numerical solutions [14].

In the meantime, it is important that the mathematical models require the determination of the parameters of opening the thread from bobbin ends. For example, many of the indicators and parameters such as, yarn weight, transfer speed and angle of the yarn opening from the bobbin, friction coefficient and colon (unit of electrical charge) between the thread and bobbin with these sizes with various measurements are obtained.

Experiments and theories point to the fact that the performance thread opening is sensitive to these parameters, especially the "Freezer" [14] and "Kong" and colleagues [15] showed that an increase in friction coefficient greatly reduces the length of the slipping thread on the bobbin ends. Although many experimental measurements were done to estimate the friction between yarn and metal or ceramic materials, they cannot be used to accurately estimate μ.

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In Figure 2, a polar coordinate system is shown rotates with an Ωκ angular velocity around the axis z (bobbin curve). Eye (hole) is the source of coordinate system in which the yarn is completely flexible, non-elastic with linear density and uniform cross section, regardless the gravity impact is assumed.

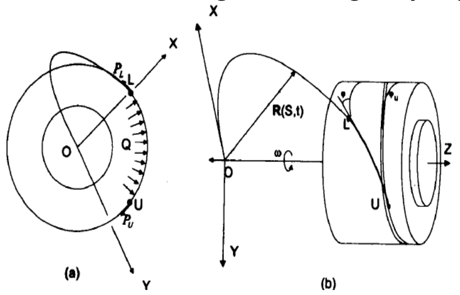

Fig. 2: View of the opening of the bobbin thread.

In the semi-permanent move thread, changing the location of $R = iX + jY + kZ$ and extension P (s) are equations of coordinate arc length (arc) S, quasi-constant equation of motion is:

$$m\left\{V_0^2\frac{d^2R}{dS^2} - 2V_0\omega\kappa\times\frac{dR}{dS} + \omega^2\kappa\times(\kappa\times R)\right\} = \frac{d}{dS}\left(P\frac{dR}{dS}\right) + F$$

Which m is linear density of yarn and 0V is the speed of yarn opening and F is the external force per unit length in the fiber [16].

The Research Process:

Designing and manufacturing a sample winding bobbin machine:

Although, initially designing the new system on the SCHLAFHORST machine (one of the well-known creators of the full history of the textile industry) was done, many trials and changes in the sector in a sample and developing machine caused the research becomes completely industrial and applied. To achieve this purpose, a machine was designed according to the size of the actual machine and built with their components to not only work with it easily, but also the winding bobbin can be created in a variety of conditions.

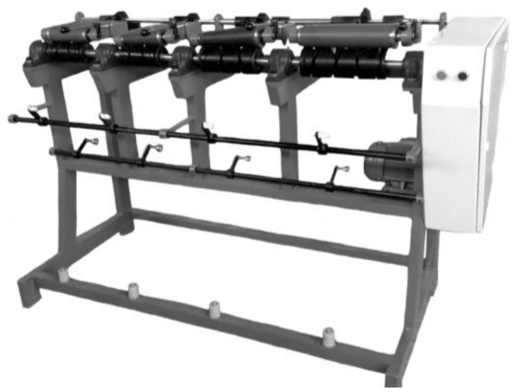

Fig. 3: The winding bobbin.

Figure (3) is a blurred bobbin winding image so that the bobbins move along the drums located on the shaft and at the end of shaft, there is a pulley that receive the force from electromotor head pulley by the belt. In this type of machine, different sizes of drums used are 28, 21 and 17 sizes, respectively, which by increasing the diameter of the thread on the bobbin, RPM speed will decreases. However, twisting speed of the thread will not change due to constant surface speed.

Designing and constructing the balloon stuck:

Figure (4), designing and constructing of a balloon stuck based on using the "Moratech Co." view as the basic design of balconyy system is shown in which simple tube mechanism with bending at the end of the tube is used. For this type of design, many preliminary experiments were conducted with its best results are used in the industry.

Using the balloon stuck designed in SCHLAFHORST bobbin winding machines:

Retention stuck were designed based on the size of the machine and designed and made in the profile making companies using systems with bending tube and tube systems with suitable silt to move yarn. To ease the guiding of thread into slotted tube, wings were attached to both sides of the gap and in the entry of balloon stuck, a ring to reduce thread friction with the body of balloon stuck is placed and finally this tube was installed in the place of machine balloons control by a different turning, an example of which is seen in the graph:

Fig. 4: initial balloon stuck used.

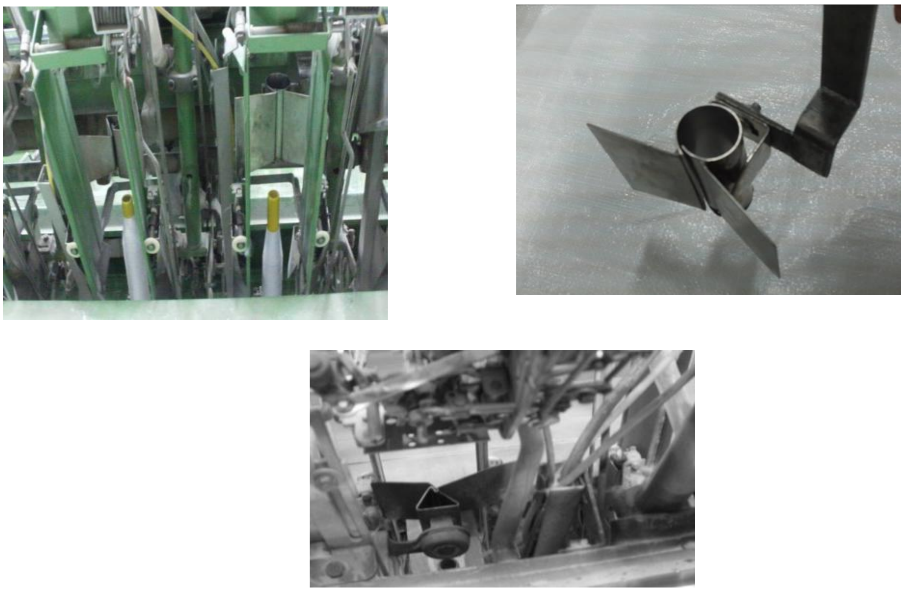

Fig. 5: Balconyy made a - b and the original one made by SCHLAFHORST Company.

Obtained Results:

In this study, the experimental conditions were tested, that is, some of them were classified to trial for two different modes of cut polyester / viscose and in utmost measurement details of fuzz, made in “Kizouki Co.” of Japan and indices of non-uniformity by the non-uniformity detector of “Kizouki Co.” of Japan were tested.

Results of Polyester-viscose yarns variance analysis with 63/35 ratio (30 cotton score):

Table 1: Production condition of polyester-viscose yarn samples with a ratio of 65/35 and 80/20.

Code	Production conditions
1	Ring thread
2	schlafhorst Autocanner thread (balloon stuck made in schlafhorst Co.)
3	Schlafhorst autocanner thread with (bal-con) with a distance of 2 cm from the spool
4	Schlafhorst autocanner thread with (bal-con) with a distance of 4 cm from the spool
5	Schlafhorst autocanner thread with (bal-con) with a distance of 6 cm from the spool

Hairiness index for cotton, polyester-viscose with a ratio of 35/65:

Hairiness index that is determined based on the sum of the indices of cotton lint are compared using One Way ANOVA and according to the conditions listed in Table 1 and by ANOVA with post hoc by Duncan test in which the results listed in Tables 2 and 3 show that conditions of ring yarn are more desirable compared to other cases and conditions of balloon stuck manufacturer (SCHLAFHORST) with the Design Guidelines have similar results show no much difference.

Table 2: Results of Duncan Test on hairiness changes for sample polyester-viscose yarns with 65/35 ratio *Hairiness ANOVA index.*

	Total square	degree of freedom	Mean squares	F index	Sig.
Inter-groups	3285.513	4	821.378	994.176	0.000
Intra-groups	57.833	70	0.826		
Total	3343.347	74			

Table 3: Duncan Test of Hairiness Index.

Conditions	Subset for alpha= 0.05			
	1	2	3	4
1	22.3000			
2		33.6000		
3		34.1667		
4			38.6000	
5				41.8000
Sig.	1.000	0.092	1.000	1.000

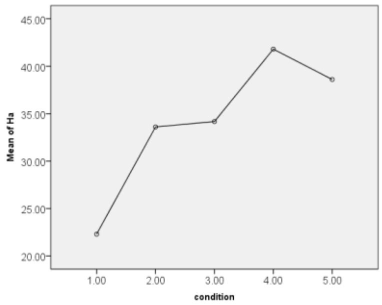

Fig. 6: Hairiness changes for the sample polyester-viscose yarns with 65/35 ratio.

This indicates that although using the balcony system regarding polyester-viscose yarns did not help to change yarn hairiness, it caused non-uniformity quality of the thread has been affected in a significant amount. The best balcn condition for the experiments is condition (4) with a distance of 4 cm from the spool. According to the experiments of the yarn index, this result obtained that in the exposure position between 2 and 6 cm of balcony from the spoon head, the best condition can be obtained.

Results of variance analysis of polyester-viscose yarns with 80/20 ratio (30 score cotton):

In this case, due to the high amount of polyester in the production yarn, it is chosen as a specific conditions of production in the study to examine the effectiveness of balcony has been analyzed which results is given below. Of course, different conditions of study is the same as Table 1 that similar to previous experiments, polyester-viscose is 65/35.

Hairiness index of polyester-viscose yarns with 80/20 ratio:

Results of experiments are shown in Tables 4, 5 and Figure 8. It can be seen in this table that the best condition relates to the ring yarn and then the state 3 with 3 cm height from the bobbin. But the worst condition is the state of manufacturer i.e. condition 11. So this result is achieved that by increasing the percentage of polyester, in addition to increasing the flexural stiffness fibers, fuzz protrusions will also be increased, and this means that, balcony system could well help control the hairiness index.

Table 4: hairiness changes for sample yarns polyester-viscose yarns with 80.2. ratio *Hairiness ANOVA index.*

	Total squares	Degree of freedom	Mean squares	F index	Sig.
Inter-groups	1820.887	4	455.222	1435.384	0.000
Intra-groups	22.200	70	0.317		
Total	1843.087	74			

Table 5: Duncan test of hairiness index.

Conditions	Subset for alpha = 0.05				
	1	2	3	4	5
1	28.4667				
3		36.2000			
4			39.2667		
5				41.3000	
2					42.0333
Sig.	1.000	1.000	1.000	1.000	1.000

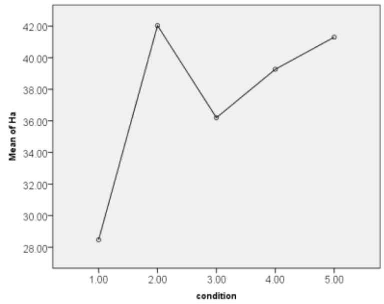

Fig. 7: Changes of hairiness index for polyester viscose yarns sample with a ratio of 80/20.

Non-uniformity index for polyester-viscose yarn with the ratio of 80.20:

Table 6: Non-uniformity index for polyester-viscose yarn with the ratio of 80.20 ANOVA analysis of non-uniformity index.

	Mean squares	Degree of freedom	Mean squares	F index	Sig.
Inter-groups	12.958	4	3.240	18.182	0.000
Intra-groups	12.472	70	0.178		
Total	12.430	74			

Table 7: Duncan test of non-uniformity index.

Conditions	Subset for alpha = 0.05			
	1	2	3	4
3.	13.0733			
2		13.4133		
5		13.4667	13.4667	
4			13.7733	
1				14.3100
Sig.	1.000	0.730	0.051	1.000

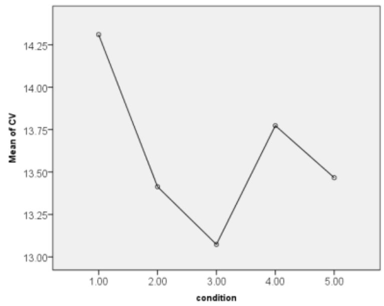

Fig. 8: Changes in non-uniformity index for viscose polyester yarns samples at a ratio of 80/20.

According to Tables 6 and 7, it is specified that the ring yarn cannot be transferred to the next stage without the bobbin windings process due to the worst conditions and lack of structural reforms. However, the best non-uniformity conditions relates to the conditions that balcony system has been used. Although the balloon stuck made in SCHLAFHORST in this circumstance is not much different from the balcony condition.

Conclusion:

Generally, the results show that the yarn with a guide similar to balcony system can modify hairiness and uniformity indices in short fiber spinning yarns. Concerning the ratio polyester viscose yarns of 65/35, less hairiness ring yarn will be achieved and balcony conditions and the original manufacturer is not much different. But the non-uniformity index (CV%) on the polyester viscose yarn ring has a 80/20 ratio of ring yarn with less hairiness and the balcony conditions is much better than the original manufacturer. But the non-uniformity index (CV%) in using the balcony of all the circumstances is less than the ring yarn conditions. This means that in the ring spinning system, with changing the fibers material, until the viscose fiber is higher than polyester fibers, hairiness improvement will be less and uniformity becomes significantly better and by increasing the polyester than the viscose amount in short fiber spinning of ring after winding bobbin, hairiness value is greatly improved and uniformity changes will be less. In general, given the lack of facilities in the renovation of some textile companies, it is hoped that this research improve the production circumstances in spinning line using balcony the system by providing the results achieved.

REFRENCES

[1] Barella, A., 1983. Yarn Hairiness, Textile Progress, 13(1): 1.
[2] Zeltner, V., 1990. Measurement of Yarn Hairiness by Means of Uster Tester-3, Zellweger Uster AG, Switzerland.
[3] Morton, W.E. and M.C. Yen, 1952. The arrangement of fibres in fibro yarns, J. Text. Inst., 43: T60.
[4] Morton, W.E., U.K.C. Yen, 1952. Fibre Arrangement in Cotton Slivers and Laps. J. Text. Inst. 43: T 463.
[5] Barella, A. and A. Sust, 1964. Cohesion Phenomena in Cotton Rovings and Yarns. Part III: Influence of Fiber Characteristics on the Cohesion of Non-twisted Slivers, Textile Research Journal, 34: P283.
[6] Boswell, H.R. and P.P. Townend, 1957. Some factors affecting the hairiness of worsted yarns. J. Text. Inst., 48: T135.
[7] Pillay, K.P.R., 1964. A Study of the Hairiness of Cotton Yarns – Part II: Effect of Processing Factors., Textile Res. J. , 34(9): P783-791.
[8] Barella, A., Ruiz Cuevas, 1958. A Application of yarn hairiness measurement techniques to the control of gassing or singeing, J. Text. Inst., P4–P8, T170–T171., 49.
[9] Barella, A., M. Ruiz Cuevas, 1957. Influence of the spinning process on the hairiness of woollen and of worsted yarns Rev., Cienc. Apl., 58: 514.
[10] Padfield, D.G., 1958. The motion and tension of an unwinding thread I, Proc. R. Soc., A245, P382-407.
[11] Padfield, D.G., 1956. Note on friction between yarn and package , J. textile Inst., 46: T71.
[12] Booth, H.V., 1957. Vibration in tension of an unwinding thread, Br. J. Appl. Phys., 8: P142-144.
[13] Kothari, V.K. and G.A. Leaf, 1979. The unwinding of yarns from packages, J. textile Inst., 70(89-105): 172-183.
[14] Fraser, W.B., T.K. Ghosh and S.K. Batra, 1992. On unwinding yarn from a Cylindrical package Proc., R. Soc. London A, 436: 479-498.
[15] Kong, X.M., C.D. Rahn and B.C. Goswami, 1999. Steady-State unwinding of yarn from Cylindrical packages, Textile Res. J., 69: P292-306.
[16] De Barr, A.E. and H. catling, 1965. The principles and theory of ring spinning, Manual of cotton spinning, vol. 5, Butterworths Press, London.