# ENHANCING PROFITABILITY OF A SPINNING

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***Abstract***: *Systematic control of the rheological behavior of the rovings in an installation facility dynamometer constant elongation gradient is proposed in this paper. It is an application for all types of spinning both short fibers as long fibers. Industrial experiments conducted show that this control drawing of the spinning frame is optimized, getting more regular yarns mass with greater industrial profitability. This work is applied to a spinning worsted manufactures fine yarns with high quality requirement The fundamental thesis of our work is that the rheological control of the roving, output from roving frame, either torsional or friction, helps to increase the profitability of the spinning frame and get higher quality yarns. Rheology is the science of movement of the fibers within a fibrous vein, ie a sliver or roving from the graph tribocharging-elongation another fundamental concept appears in our analysis: the isocarric elongation. Empirically, we defined this elongation as the difference between the elongation percentage corresponding to half the determined maximum tribocharge on the ascending and descending branches of the tribo-charging-elongation curve. The application of these techniques to former machines to roving frame in conventional wool process also allows us to adjust the machines with more speed, reducing the time and product (waste) required a change in manufacturing. To increase, for example, the feed of a gill, increase the difficulty for drafting in the following step. These difficulties are directly related to the value of the doubling and drafting that applies: the more doubling and drafting, the greater the difficulty in later steps.*

***Key words:*** *Wool, tribocharging excision, isocharging elongation, roving*

## 1. INTRODUCTION

In the current market environment, it is very common in all types of spinning, produce very small lots, requiring machines and very flexible and versatile to be competitive processes. A few years ago, this feature was characteristic only of long fiber spinning, by imperatives of a highly selective fashion in small batches which were treated.

The current global situation of the cotton market also means working short series, with continued manufacturing changes. As is well known, although the trend in mechanical engineering is starting facilitate changes, these changes always represent wastage in the profitability of spinning.

Assessing the amount of fat that contains a wool content of spinning oils and antistatic additives in washing and carding, among other parameters, you could get an idea of the difficulty presented a wool fiber for processing into yarn.

The fundamental thesis of our work is that the rheological control of the roving, output from roving frame, either torsional or friction, helps to increase the profitability of the spinning frame and get higher quality yarns. Rheology is the science of movement of the fibers within a fibrous vein, ie a sliver or roving [1] [2] [3] [4] [5] [6].

Subjecting a roving to traction, in a constant gradient dynamometer working at a low speed elongation (mm/min), we obtain a load-elongation curve. Being a frictional load (from the Greek "tribo") interfibrillar, tribocharging denominate the traction force and tribocity the specific tribocharging, that is, the ratio of dividing tribocharging by its Kilotex mass (grams/meter).

Consequently, we will refer as excision tribocharging the charge necessary to produce the excision in the roving.

From the graph tribocharging-elongation another fundamental concept appears in our analysis: the isocarric elongation. Empirically, we defined this elongation as the difference between the elongation percentage corresponding to half the determined maximum tribocharge on the ascending and descending branches of the tribocharging-elongation curve (Figure 1) [1].

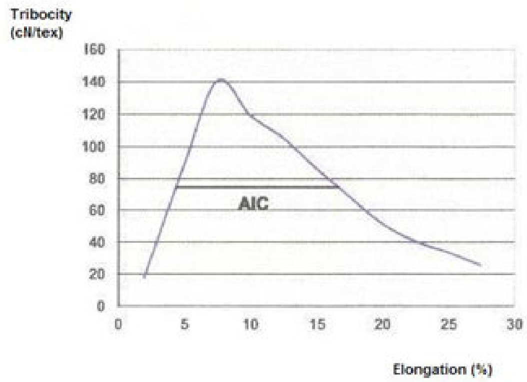


***Fig. 1.*** *Determining isocarric elongation (AIC)*

## 2. EXPERIMENTAL PHASE

As already mentioned above, our approach is applicable to the spinning of short and long, natural, synthetic fibers and mixtures. In this paper we study for a process that produces wool yarn 60 metric number (Nm) with 700 turns/meter. The experiments were performed in a wool sector industry under very controlled environment conditions. It has always made the same thread, with the same parameters and quality standards, from wool, taken from an industrial point of view, the same characteristics of fineness, length, fat content and whiteness grade, but that have happened over time under various items made of batches of the same number, defined as the same characteristics.

To better understand our proposal we have selected two rovings of 0,3 grams/meter, obtained in the same industrial manufacturing process, but with significant differences in their degree of parallelism interfibrillar and especially in its excision tribocharging and isocarric elongation. For each of the rovings we have made sufficient evidences that makes results are significant from a statistical point of view.

The interfibrillar parallelism and excision tribocharging were determined by following a specific test methods tuned in Innotex Center/CTF of the Polytechnic University of Catalonia. In parallel, determine a weighted length corresponding to the arithmetic mean of the length $L_1$, in the sliver determined in the exit direction of the machine and the length $L_2$ in the other end fixed. As is well known, the fibrous structures have a marked structural asymmetry [4] [6]. Table 1 indicate the values found for the rovings, selected from a production batch of spinning, but extreme values in paralelism and excision tribocharging and isocarric elongation is concerned.

***Table 1.*** *Parallelism interfibrillar of rovings of wool 0,3 grams/meter*

| Reference | $L_1$ | $L_2$ | $L_{Average}$ |
|---|---|---|---|
| Roving 1 | 47,2 | 53,7 | 50,4 |
| Roving 2 | 50,0 | 55,6 | 52,8 |

In all experiments conducted, the length $L_2$ is greater than $L_1$, because the rear hooks of the fibers are removed when leaving them the combs from the drafting zone. It has also been demonstrated in our experience, in the gills of the preparation of fine, to decrease the weight of the roving, increase the length weighted in the two directions of analysis [2] [5] [6].

Excision tribocharging determining was performed on a dynamometer installation gradient constant elongation (Figure 2) working with samples of 200 milimeters between the jaws, to a low pulling rate (mm/min). Table 2 and Figure 3 indicate the results.

The rheological behavior in a dynamometer facility of two selected rovings and their interfibrillar parallelism, which from an industrial point of view were not significantly different, show a different behavior of the fibers of the roving into the draw zone of the ring spinning frame. The roving referenced as 2, has a higher parallelism and greater interfibrillar excision tribocharging (Figure 3).

***Fig. 2.*** *Dynamometry gradient constant elongation installation*

***Table 2.*** *Rheological behavior of the two wool rovings 0,3 g/m*

| Elongation (%) | Tribocity (cN/tex) | |
|---|---|---|
| | **Roving 1** | **Roving 2** |
| 2,5 | 18 | 26 |
| 5,0 | 89 | 84 |
| 7,5 | 141 | 144 |
| 10,0 | 120 | 156 |
| 12,5 | 106 | 124 |
| 15,0 | 87 | 111 |
| 17,5 | 69 | 97 |
| 20,0 | 52 | 89 |
| 22,5 | 41 | 75 |
| 25,0 | 34 | 64 |
| 27,5 | 26 | 39 |

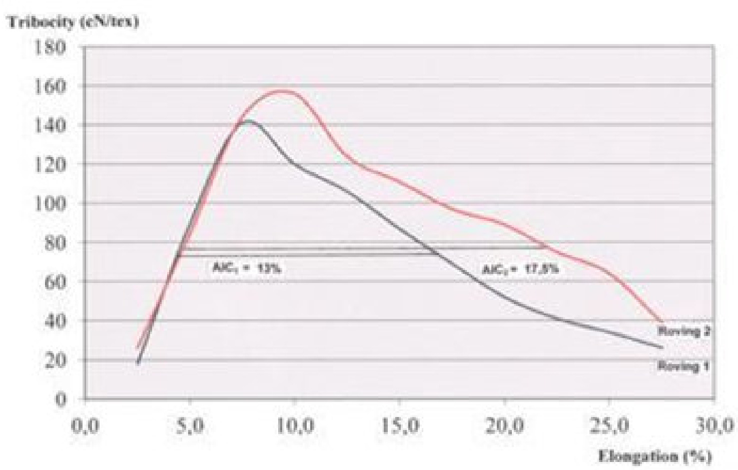


***Fig. 3.*** *Excision tribocharging between the two rovings of wool*

All these differences are realized in different isocarric elongations. Our approach can detect structural differences in the rovings also go unnoticed in mass digital eveness tester. In the roving referenced as 1 have a isocarric elongation (AIC) 13% while in the referenced 2, the isocarric elongation rises to 17,5%. An increase in the AIC parameter implies an easier stretching of the wicks in the ring spinning frame, obtaining improved quality yarns [1]. This point is especially important for those industries that have an intermediate weight rovings that used to manufacture a wide range of yarns, varying only the draft and twisting the ring spinning frame.

With the respective rovings we obtained yarns of 60 metric number on the same spindles spinning frame and under the same environmental conditions. The objective of our proposal is that rovings of the same material, different items, prepared under the same conditions along the whole process of preparation and fine hair, can be differences in the quality of the thread if its rheological behavior is different. It has manufactured a yarn sample, under industrial conditions, sufficient for the results to be significant.Table 3 indicates the results of the quality of yarns obtained with both rovings.

***Table 3.*** *Quality level of 60 metric number yarns produced from the two rovings of wool 0,3 grams/meter with different parallelism interfibrillar and different AIC*

| **Parameters** | **Yarn obtained with the roving** | |
|---|---|---|
| | **Roving 1** | **Roving 2** |
| CV mass (%) | 16,8 | 16,2 |
| Thin places (-50%) | 195,0 | 170,0 |
| Thick places (+50%) | 64,0 | 50,0 |
| Neps (+200%) | 16,0 | 12,0 |
| H | 5,7 | 5,2 |

The thin, thick and neps points are given over 1.000 meters of yarn. H hairiness index corresponds to the total length of the hairs of the yarn, in centimeters, in a measuring area of 10 mm in the hairiness tester.

In complementary work by the same author on these techniques, show adjust coefficient between the theoretical model and the industrial reality of the order of 0.989.

## 3. CONCLUSIONS

A systematic control of excision tribocharging of the rovings before being processed in the ring spinning processed into yarn, it may be appropriate to predict differences in the quality of yarns and, especially, the drafting capacity that each roving according to their isocarric elongation.

The application of these techniques to former machines to roving frame in conventional wool process also allows us to adjust the machines with more speed, reducing the time and product (waste) required a change in manufacturing. To increase, for example, the feed of a gill, increase the difficulty for drafting in the following step. These difficulties are directly related to the value of the doubling and drafting that applies: the more doubling and drafting, the greater the difficulty in later steps.


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