Analysis of the spinning process by counting neps

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1. Introduction

About 40 years ago, worldwide collection and publication of yarn data began for the first time. This could only be realized after new yarn testing instruments had been introduced. If, in retrospect, one analyzes the changes of yarn mass variations as provided by the Uster statistics, a significant improvement is demonstrated on figure 1.

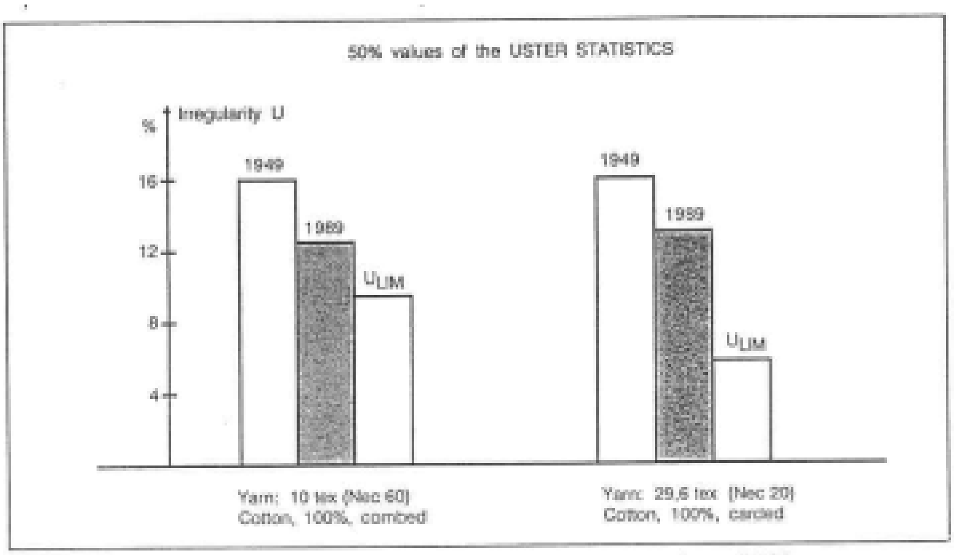

Fig.1 Reduction of the mass variations in yarns since 1949

Undoubtedly, this achievement become possible through the continuing development of machines and testing instruments. These developments were driven by free market forces, indeed, by competition, which call for improved quality and better prices. Through cooperation and mutual motivation, manufacturing have occurred. Deterioration of raw material, shorter process lines and high-speed machinery did not have a negative effect on the quality improvement [2]. In this respect, it is not by coincidence that the collection of combed yarns shows a better result than with carded yarns. It is primarily the final carding and combing processes that allow an extensive balancing-out of varying and inferior raw material parameters, such as staple, short fiber content, trash particles, neps, etc. [3, 4, 5].

The measurement of neps in yarns was only possible in about 1960. The first Uster statistics on neps were published in 1964. A statistical analysis of neps from 1964 through 1989 shows that the number of neps in combed yarns increased by approximately 260% (Figure 2).

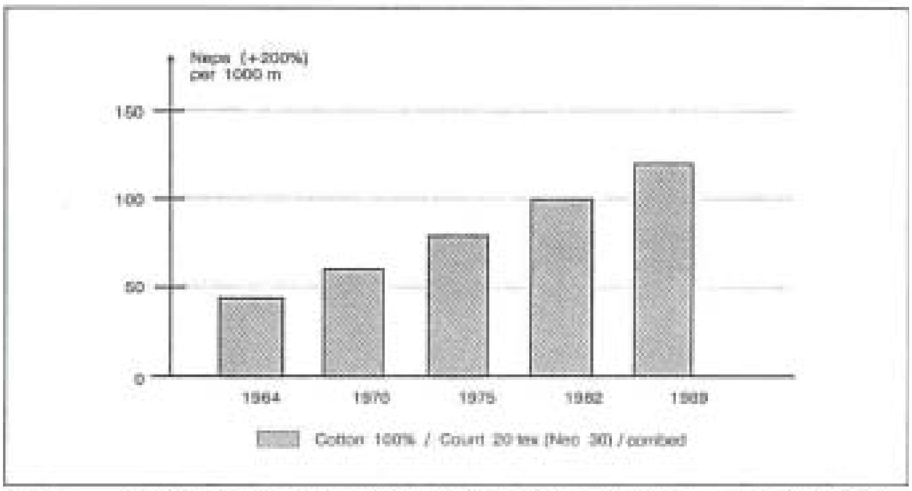

Figure 2. Number of neps from 1964 through 1989. 50% values of the USTER STATISTICS. Yarn count : 20 tex(Ne_c 30)

Although modern machines eliminate most of the additional foreign matter such as seed coat fragments and fiber neps a quality improvement with respect to a lower number of neps could not be achieved.

Although modern processing machines are used today the increasing contamination of cotton with seed coat fragments as well as the increasing number of fiber neps in the raw material have caused a deterioration of the neps quality level, particularly for combed cotton yarns.

With a systematic and reproducible measurement of neps it will be possible to make progress in the future. A measuring system which fulfills these requirements, the AFIS-N, will be described in the following paragraphs.

2. Neps

Various studies have been published concerning the formation and definition of neps, the attempts to avoid forming them or to eliminate them and their influence on yarn and fabric quality.

A most serious and feared problem represents the unequal bye absorption which, can often only be soothed by skilled actions undertaken in the dyeing and finishing departments [7]. There are many garments that cannot be produced out of yarns with too many undyed neps due to the resulting "white specks" that appear in the cloth. In the USA, the so-called "shiny neps" (Figure 3) have become a major reason of complaint. This problem exists in spite of the fact that the USDA has since the sixties spent a considerable amount of money for development projects of this nature. On this figure you see a shiny nep in a knitted fabric produced in the united states and brought to the material testing laboratory of Zellweger Uster for further evaluation vy means of a scanning electron microscope.

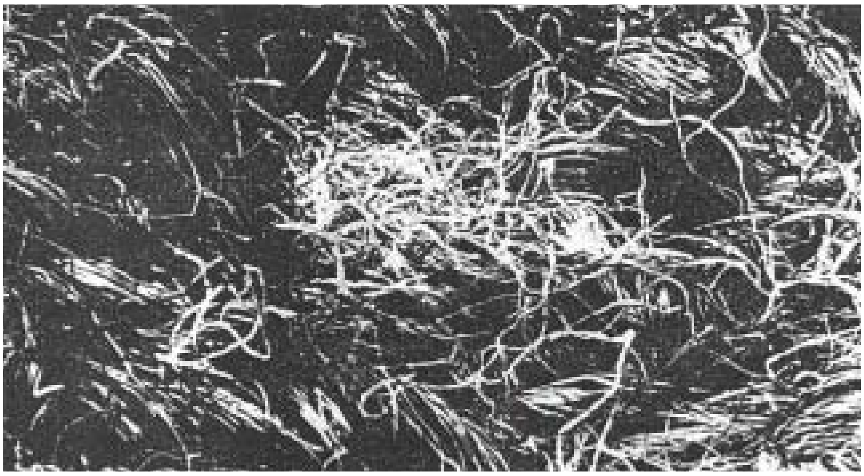

Figure 3. Nep that appears shining or as a white speck in a single color, knitted fabric.

(Photograph : Zellweger Uster)

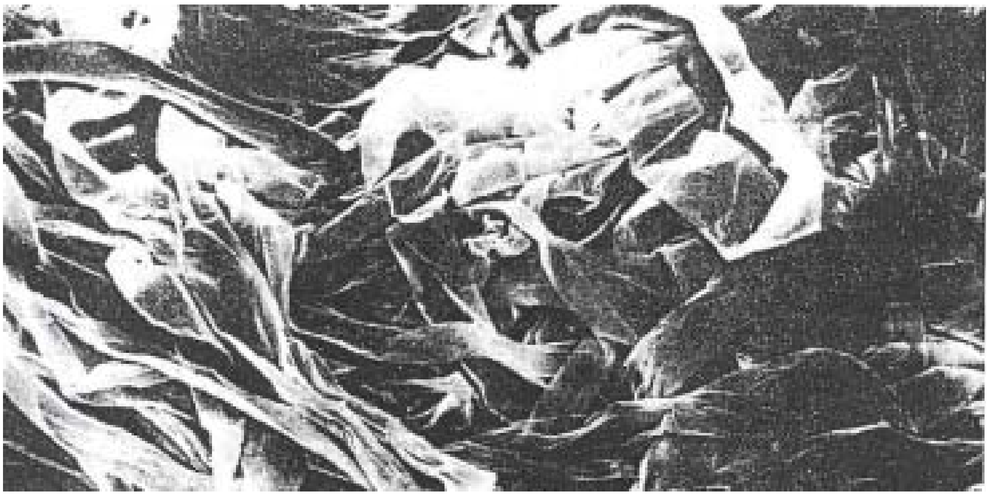

Figure 4. Photograph of a nep taken via a scanning electron microscope. The line b equals 100 micrometers (Photograph: Zellweger Uster).

Figure.4 Shows the same neps. This nep was particularly disturbing after dyeing. It produced a white speck in the fabric because there was hardly ant dye uptake by the fibers which formed the nep. The photograph demonstrates clearly that the nep consists of immature and dead fibers. For most of the fibers seen on the photograph the wall thickness is so small that the fibers have a very limited stiffness and gave a strong tendency to form neps in ginning, opening, cleaning and carding.

3. Application of the measuring system in the spinning mill

3.1 Nep levels at various processing stages

After having proved the instrument's reproducibility and the long-term stability, the AFIS-N was applied at various places in Europe for the examination of the spinning process.

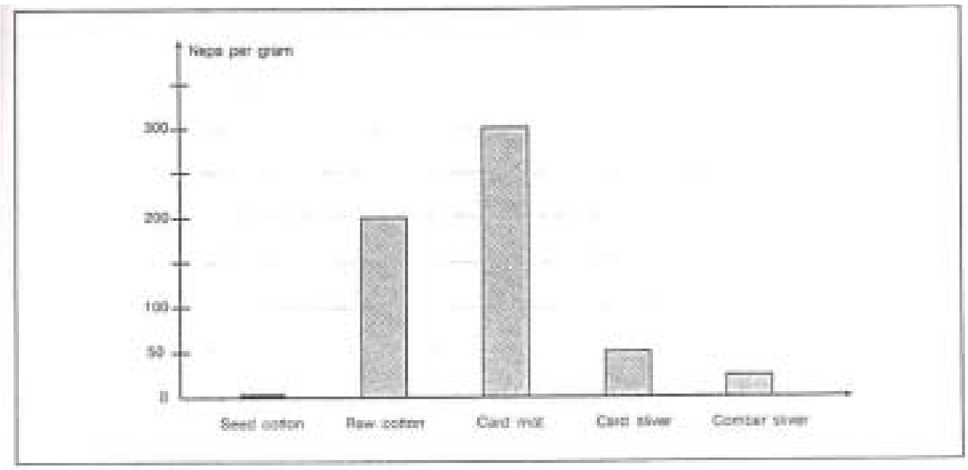

Figure 5. Number of neps at different processing stages

The Figure 5 represents the formation of neps form the seed cotton to the comber sliver.

- We have to reconsider that seed cotton does hardly contain any neps. Neps are man-made and are produced later on by the production machines.

• By the mechanical harvesting, ginning and the cleaning process, the number of neps increases dramatically. An improvement of the cotton grade aiming at trash reduction unfortunately results in higher nep contents.

• The strong contamination of cotton by trash necessitates that the raw material is cleaned more aggressively in the opening/cleaning area of the spinning mill which, in most cases, means another nep increase. The experience made with a systematic nep testing method by an electronic instrument once again puts a question mark on today's visual cotton assessment method.

• The card is the first processing stage which achieves a significant nep reduction.

• The comber also achieves an additional nep reduction. The original condition can, however,not be reached again.

3.2 <u>Raw cotton</u>

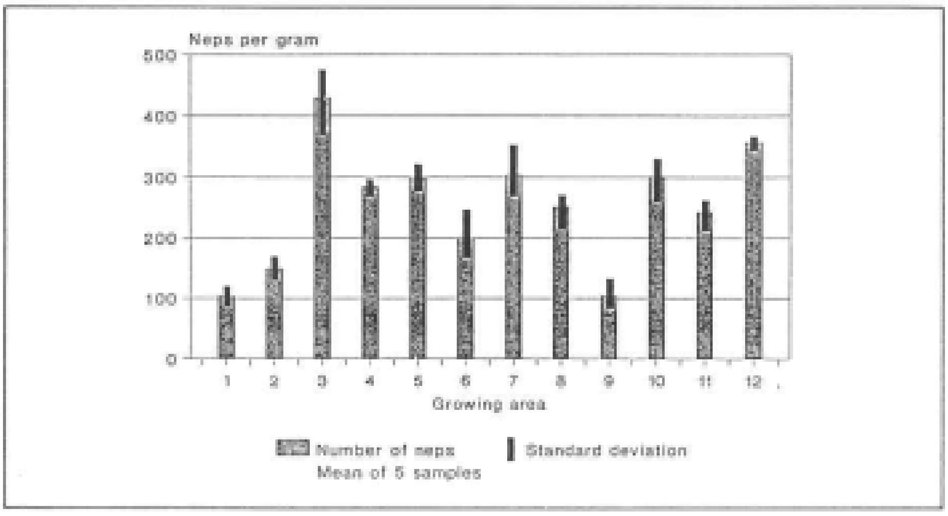

Figure 6. Nep measurement of raw cotton from various growing areas

The number of neps available in the raw cotton can vary between 100 and far over

1000 per gram. The example given in figure 6 illustrates the number of neps of various bales in a spinning mill lay-down. the result is dependent on the growing area, the harvesting and ginning methods, the opening/cleaning stages and on the fiber characteristics. Investigations with specific objectives will in future contribute to disclose relevant relationships.

3.3 **Opening and cleaning sections.**

The task of the opening/cleaning section in the spinning mill became more and more difficult by the introduction of radical harvesting and ginning methods. In spite of a reasonable classification of the cotton it is necessary to treat fibers in a more aggressive way in order to at least remove the major part of the remaining trash.

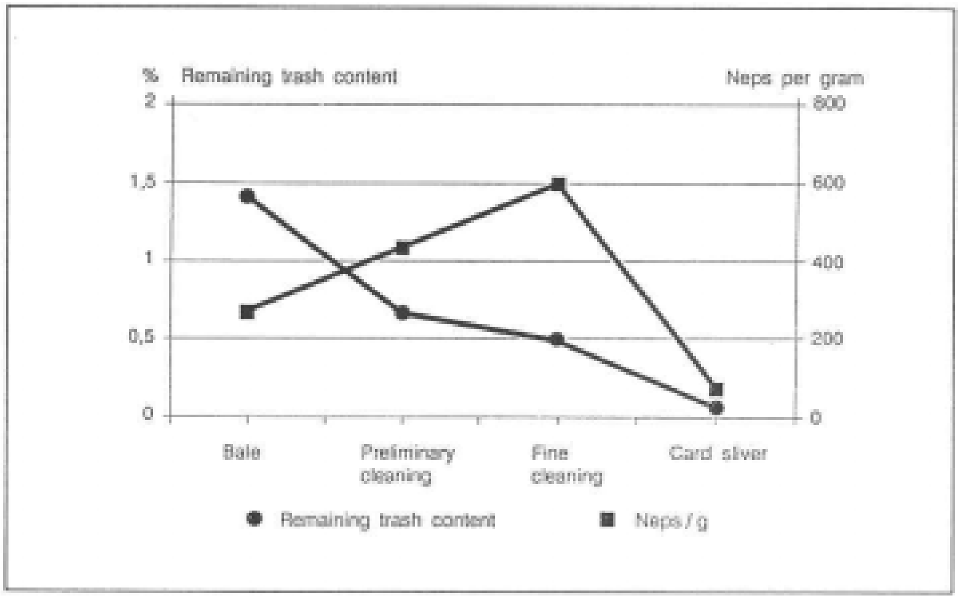

Figure 7. Remaining trash content and neps

Consequently, as is shown in Figure.7, a significant increase of the number of neps occurs, even at a very minor decrease of the remaining trash content By means of electronic instruments, we are finally in a position to optimize machines and machine settings by making comparisons between input and output. Needless to say, it will in many cases mean a compromise between the remaining trash and the number of neps.

3.4 Card

Following examinations by this electronic instrument, according to Figure 8, it was once more discovered that the card represents the "heart of the spinning mill". It is here where, for the first time, a clear nep decrease takes place in the ratio 1:4 up to 1:10

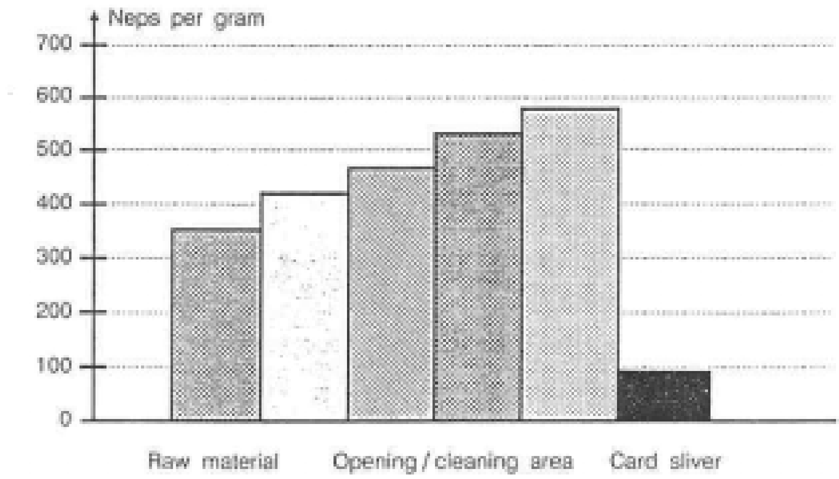

Figure 8. Neps in the opening/cleaning/carding area

As with modern high production cards a simple visual counting of neps on a fast-running card web is not possible anymore. The number of neps can only be determined in the yarn. Through the availability of comparison data, including various machine components, production efficiencies and settings, there are now completely new possibilities available in terms of machine optimization. Each optimization step can be controlled immediately.

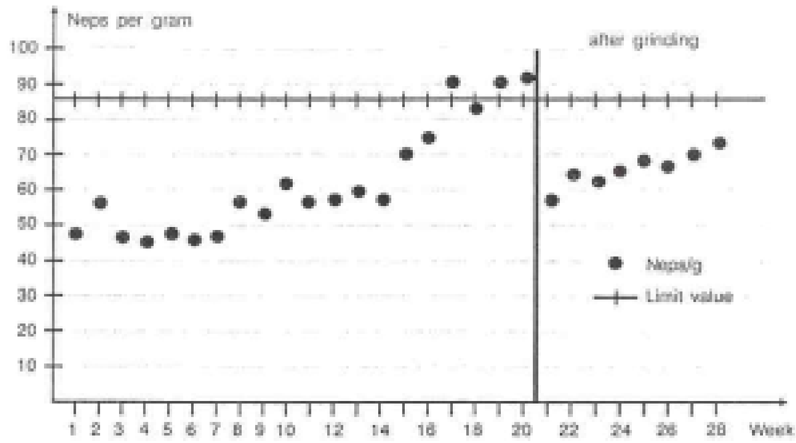

Figure 9. Process control at the card

By carrying out periodic sampling, the step-wise rise in nep content can be controlled within the set tolerance limit, as is shown in figure 9. Maintenance aimed at specific objectives including the card clothing service does not only keep quality under control, but moreover the respective costs, too.

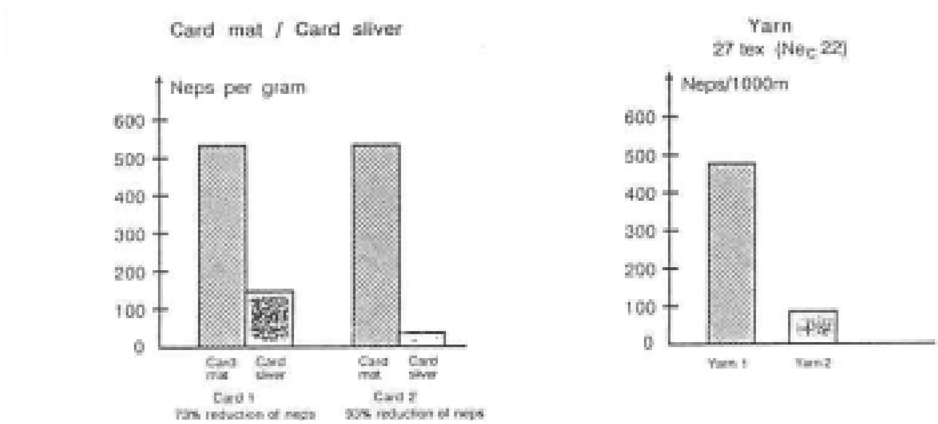

Figure 10. Influence of carding effect on neps in the yarn

As an example, Figure 10 shows the number of neps in the card mat and sliver of two cards of a spinning mill, whose ability to reduce the neps differ quite considerably. One card operated with worn clothing. The well maintained card was in a position to eliminate 93% of all neps, whereas the worn card could reduce the nep content of the card web by only 73%.

From the sliver of the "good" card a carded yarn of Nec 22 was spun with a nep level of 90 neps/1000m, whereas in the case of the "poor" card 490 neps/1000m were counted in the textile laboratory. As the following Figure 11 demonstrates, a drastic influence on the quality characteristics of the yarn also becomes inevitable.

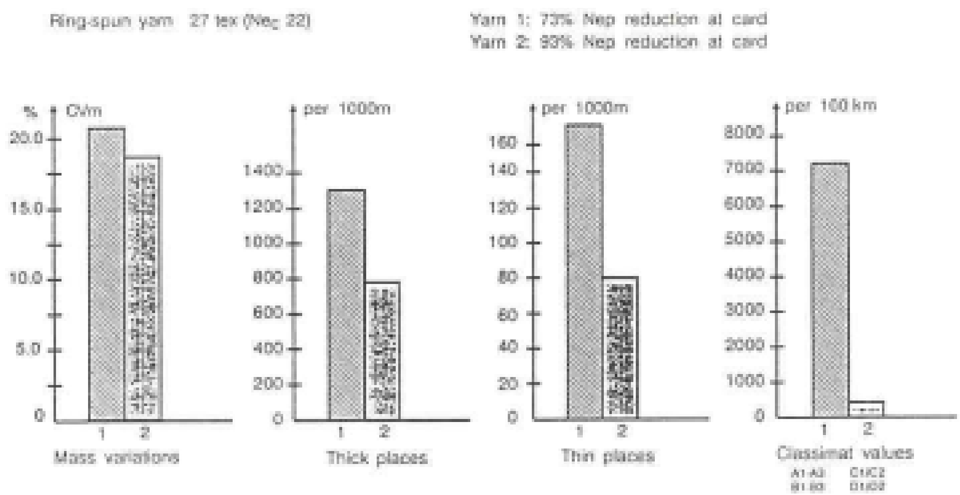

Figure 11. Influence of the carding effectiveness on yarn data

3.5 <u>Combing section</u>

Reports about the use of the AFIS instrument for creating optimum conditions in the combing section have been made already several times in the past [2]. there is, after the card, one final possibility of significantly reducing the nep level. The Figure 12 for example shows the influence of 2 different noil levels. Reductions of neps up to more than 60% are the result of the comber optimization by means of systematic nep counts.

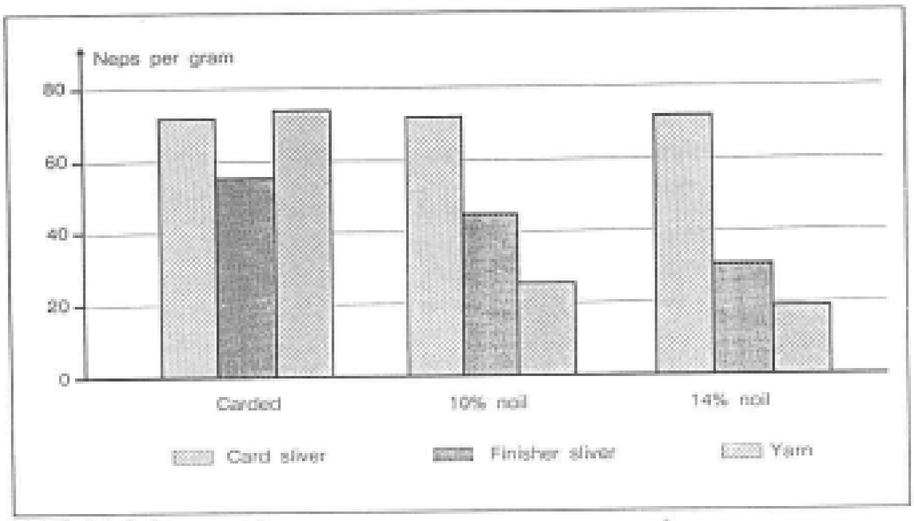

Figure 12. Number of neps at different comber noil levels

3.6 <u>Entire spinning process</u>

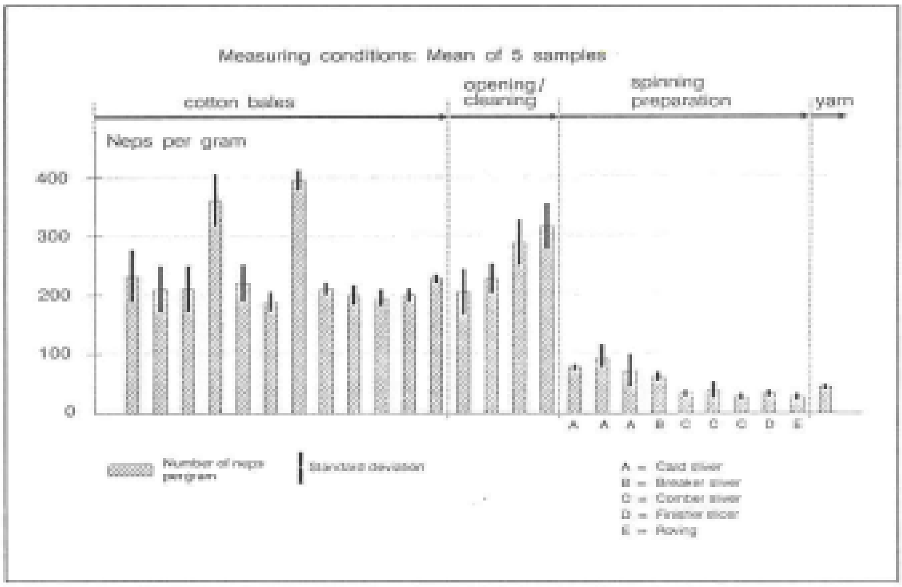

Figure 13. Analysis of the number of neps in a spinning mill Yarn count:

7,4 ex (Ne_c 80)

With the assistance of this nep counting installation it is for the first time possible to carry out an analysis of a spinning mill reaching from the raw material to the yarn, and this with a high reproducibility and within an acceptable time frame at a substantially reduced staff number. Figure 13 demonstrates such an example. Cotton growing areas that are not suitable, key machines and drastic changes in quality can be quickly identified so that appropriate measurements at the correct position can be introduced.

This slide shows the nep situation in a European spinning mill. The company was faced with a severe complaint because the nep level of the yarn was too high. One important reason for this were two bales in the opening area with a very Figure number of neps.

3.7 <u>Correlation between neps in slivers and roving and neps in yarns</u>

The Figure 13 also shows that the card and the comber operated properly. this may lead to the wrong conclusion that the fabric produced by the corresponding yarn will not be affected by the number of neps anymore. However, this may be misleading.

In order to understand the relationship between neps in fibers and in yarns the following must be taken into consideration:

- The finer the yarn produced by a roving with a given number of neps, the more neps will be counted in the yarn.

- The coarser the yarn, the more neps are invisible in the yarn body and do not affect the human eye anymore.

This relationship is shown in Figure 14.

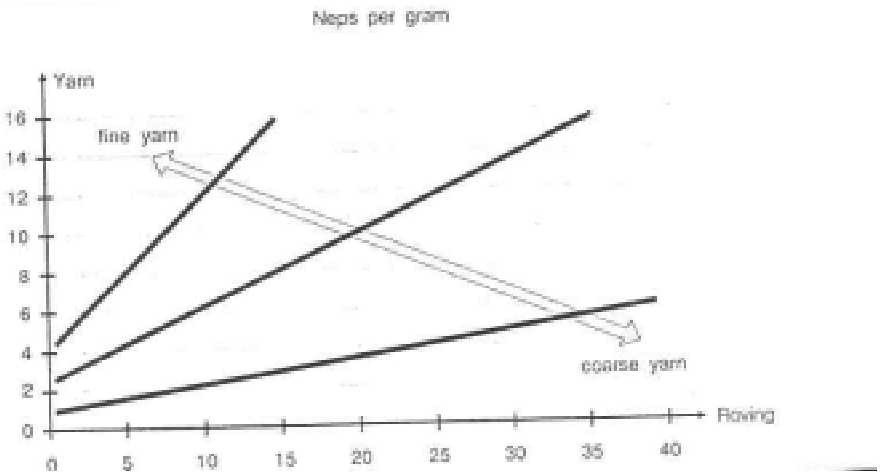

Figure 14. Relationship between neps in roving and neps in yarns.

4. <u>Comparisons and statistics</u>

The possibility of automatic nep counting with a good reproducibility reaching from the raw material up to the yarn is now available.

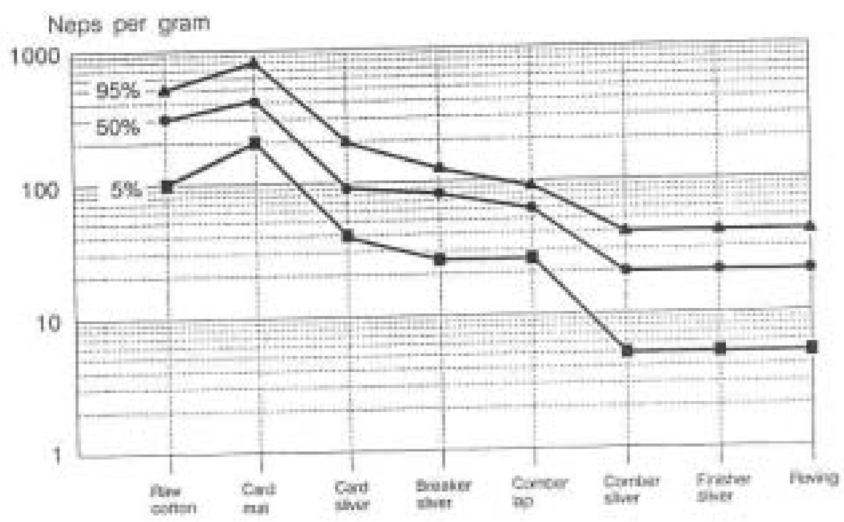

Figure 15. Uster Statistics (Provisionally) for nep counting

As a result of thousands of tests experience values could be established for all stages of the spinning process. The interpretation of this figure is the following: Only 5% of all tests were below the 5% - line and 5% of the worst samples had values above the 95% - line.

5. Summary

We have spent about 7000 hours to test the capability of a new electronic instrument for counting neps in European spinning mills and in laboratories of textile machine manufacturers. It could be pointed out that due to the high reproducibility and testing speed this instrument sheds more light onto the formation of neps in ginning, opening, cleaning, carding and combing, and it became a very powerful tool to optimize each manufacturing stage in the spinning process.

6. Acknowledgement

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7. References

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