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EXAMINATION OF FIBER NEPS COUNT DURING YARN MANUFACTURING

ИССЛЕДОВАНИЕ ОБРАЗОВАНИЯ НЕПСА ВО ВРЕМЯ ПРОИЗВОДСТВА ПРЯЖИ

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There is a direct correlation between the quality of raw material and the end product. In order to produce high-quality cotton yarns that will produce high-quality woven and knitted fabrics, emphasis needs to be given on the quality and processing of cotton lint. Neps in cotton lint, defined as a small knot of entangled and unorganized fibers cause formation of short, thick places in yarns and therefore less uniform fabric appearance.

In this study, in order to search the changes of fiber neps counts in cotton during the processing; cotton materials from different origins have been investigated in some parts of the production line of combed yarn. As a result of study, it is found that independent of cotton origins; same trends in the neps content during production can be observed. A significant incensement in neps content occurs in preliminary treatments, whereas carding and combing processes plays an important role in reduction of neps content.

Существует прямая зависимость между качеством сырья и конечного продукта. Для того чтобы выпускать высококачественную хлопчатобумажную пряжу, из которой будут производить высококачественные ткани и трикотаж, особое внимание следует уделять качеству и обработке хлопка-волокна. Непс в хлопке-волокне определяется как небольшой узел запутанных и неорганизованных волокон, который приводит к образованию коротких, толстых мест в пряже и, следовательно, придает ткани менее однородный вид.

В данной работе были проведены исследования с целью выявления изменения волокна хлопка за счет образования непса во время его обработки;

хлопчатобумажные материалы различного происхождения были исследованы на линии по производству гребенной пряжи. В результате исследования было обнаружено, что содержание непсов не зависит от процессов производства хлопкового волокна. Значительное образование непсов происходит во время предварительных обработок, в то время как процессы кардочесания и гребнечесания играют важную роль в снижении содержания непсов.

Keywords: cotton fiber, yarn, carding, neps, knitted fabrics.

Ключевые слова: хлопок-волокно, пряжа, кардочесание, непс, трикотажное полотно.

In today's highly competitive and global textile market, product quality has become of paramount importance. In order to produce high-quality cotton yarns which will produce high quality woven and knitted fabrics and end products, emphasis needs to be placed on the quality and processing of cotton lint.

There is a direct correlation between the quality of raw materials and the end products. The lower quality of cotton lint means the lower quality of yarn produced from such a raw material. High quality cotton lints are the fibers that are superior with respect to the properties such as length, fineness, elongation, and brightness, matured enough and without any trash particles, with high capacity of spinning consistency.

Starting from harvesting, cotton is exposed to the numerous processes. Mechanical outer actions during yarn manufacturing, cause significant changes of almost all properties of processed cotton. Such mechanical actions and processing conditions cause the increase of short fiber content, neps formation, decrease of fibers strength, and problems like cotton stickiness. Therefore, these matters result in decreasing of the fiber quality and economical value. One of the most important fiber parameters that cause decreasing of cotton quality is neps which can be defined as "a small knot of entangled fibers consisting entirely of fibers (i.e. a fiber neps) or of foreign matter (i.e. a seed-coat fragment) entangled with fibers".

Advanced Fiber Information System (AFIS) is the mostly used commercial instrument in global use for measuring neps. Starting from bale, important fiber parameters of each semi product and end product of yarn manufacturing can be measured and by this way each processing stage can be controlled. The role of machine in handling fibers has become more critical because of today's machinery. Accordingly, the absence of close monitoring of the process may result in significant changes in fiber characteristics. Specifically, fibers are likely to be damaged; nepped and fine trash is likely to cling to the fibers.

Problems with neps

Neps in a yarn are defined as "point agglomerations of fibres entangled into yarn causing the increase of yarn diameter". The number of neps in cotton yarn depends on two main factors: characteristics of raw material used for the yarn production and conditions of the technological process in the spinning mill. Neps in cotton lint cause short, thick places in yarns, resulting in uneven fabric appearance. Often, erratic fiber orientation in these areas can cause weak places in yarns. This can lead to spinning efficiency loss, weaving and knitting machine stoppage and fabric defects.

During manufacturing of knitted fabric, when transferring of yarns from bobbins to knitting needles, neps in yarns can block the holes of yarn guides and needle hooks, resulting in breaking of yarns. Therefore, produced knitted fabric will have a hole, which makes the value of the product minimum. Neps, which are on the surface of a fabric, can cause undyed or unprinted spots during dyeing or printing. The most disturbing effect of this white spots is that they cannot be recognized until dyeing or printing. Especially in dark colors this problem becomes much bothering. Neps sometimes contain immature fibers, which are usually weaker than normal fibers. This weakness can lead to break-off of fiber fragments, which creates excessive fiber dust fly and lint deposits. Fig. 1 shows a fiber neps (40 x magnifications).

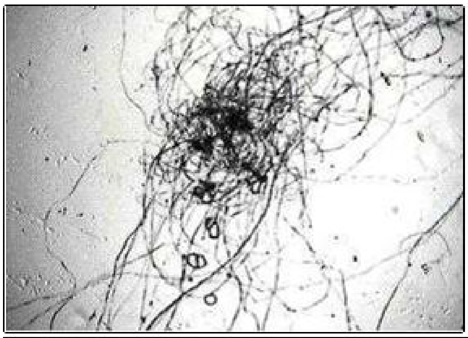

Fig. 1

Neps Formation and Categories

The structure of cotton neps is formed with a core of relatively dense, entangled fibers and an array of fibers extending from this core. In most cases, fibrous neps are found to contain at least five fibers, with the average number 16 or more. The diameter of the core ranges between 0.3 to 3 mm and may contain trash or seed coat fragments. From this core, an array of fibers extends 5 to 10 mm, sometimes even up to 25 mm in length.

Various studies have been done for classifying of neps and generally categorized according to the structure and size into three groups:

According to the structure:

– biological neps (the neps that are containing immature or dead fibers);

seed-coat neps (the seed coat fragments entangled with fibers).

– mechanical neps (the neps originated from production stage)

According to the size:

– small neps: the neps of which diameter size is at most or less than 0.3 mm, are the most difficult to remove because of their small size and low mass;

– medium-sized neps: the neps of which diameter size is between 0.4...0.9 mm, are usually efficiently removed during carding;

– large neps : the neps of which diameter size is 1 mm or over, are the easiest to remove because their relatively heavy mass reacts to the centrifugal forces of opening and cleaning machines usually efficiently removed during carding.

Materials and Methods

In this study, in order to investigate the changes of fiber and seed coat neps content and size of fibre stream during yarn manufacturing, an experimental study has been carried out in a Turkish spinning mill in combed yarn production line. In combed yarn production line 9 different cotton blends, consisting of different ratios of the Greece, Utopian, African, Uzbek, Turkish (Diyarbakır, Aegean and Hatay), Turkmen cottons were examined with reference to fiber and seed coat neps content and sizes, see Table 1 (cotton blends used in the study, taken from combed production line).

Table 1

Blend number	Blend Composition
1	100% Uzbek
2	100% Turkmen
3	71% Turkish (Hatay) , 29% Turkish (Diyarbakır)
4	69% Uzbek, 31% Greece
5	80 % Uzbek1, 13% Turkish (Aegean), 7 %African
6	74% Uzbek, 19% Turkish (Aegean), 7 % African
7	62% Uzbek, 25% Turkish (Aegean), 13% Greece
8	72% Turkish (Hatay), 19% Utopian, 9% Turkmen
9	64% Uzbek, 25% Turkish (Aegean), 11 % African

The processing stages from where the cotton samples were taken and neps contents of fibres were measured, are given in Table 2 (process stages cotton samples taken).

Table 2

Combed yarn production line	
Bale Cleaning (CVT3) Dust separator (Dustex)	Opening and Cleaning Line
Card mat Card sliver	Carding Machine
1st passage draw sliver frame	1st Passage draw frame machine
Comber sliver	Combing machine
2nd passage draw frame sliver	2nd Passage draw frame machine

For the purpose of searching the changes of fiber neps count in cotton during processing, cotton samples taken from different stages of blow room line for cotton blends have been tested in AFIS system.

In the observed cotton blends, neps number ranges from 97 count/gr to 317 count/gr . Minimum neps content belong to the third cotton blend, that is a mixture of Turkish cotton (71% Hatay - 29 % Diyarbakır), whereas maximum neps content belong to fifth cotton blend, that is 80% Uzbek, 13% Turkish (Aegean), 7% African cotton.

In Table 3 (description of fiber neps amounts) some general ranges according to Uster Statistics for the amount of fiber neps and seeed coat neps in raw cotton can be seen. The contents of fiber neps in selected cotton blends vary in a wide scale and in respect to below table, it can be stated that the amount of neps changes from low to high degree.

Table 3

Neps /gram	Description
less than 100	Very low
101 to 200	Low
201 to 300	Medium
301 to 450	High
more than 451	Very high

It is observed an increment of neps number from bale to the dust separator. Generally, the reason of increment is outer mechanical factors, which are connected with actions of working machine elements on the fibers as well as by the pneumatic transport of fibers between particular machines.

The next machine after blow room line in yarn manufacturing is the carding machine, which is also called ‘heart of spinning mill’. For evaluating the carding performances and in selecting optimum card settings, NRE % (neps removal efficiency) should be monitored. NRE shows the relation between input material, card mat and output material, card sliver. Uster reported that a 70% neps reduction by card is low, 80% is average and 90% is high. The neps removal efficiency (NRE) of a carding machine can be calculated by the following equation:

$$\frac{N\ feed - N\ del}{N\ feed} \times 100,$$

N feed = the neps number in the feed in g web (neps count/g r),

N del = the neps number in the delivered sliver (neps count/g r).

The average neps and seed coat neps numbers of the card mats and slivers are presented, besides the calculated NRE% values of carding machines used in production of combed yarns are given. It can be stated from the results that the considerable reduction of the fiber and seed coat neps content occurs in carding machines. On the basis of the results presented, it can be seen that neps removal efficiency of carding machines used for 11 different blends ranges from 63% to 87%, whereas for seed coat neps removal efficiency varies between 31% and 77%. Regarding neps removal efficiency, it can be expressed that carding machines are much more effective for removal of fiber neps than removal of seed-coat neps.

For drawing and mixing of the card slivers, 1st and 2nd passage draw frame machines are used after carding process in cotton yarn production line, besides in combed cotton yarn production, combing machines removes fibers with a certain noil level. On the basis of the results, there is not a significant change in fiber neps content at these stages of production. The reason of slight changes in neps content may arise from doubling process, because several card slivers, containing different amount of neps are gathered and drawn together. But however, 2nd passage draw frame sliver of which raw material contains higher neps content, also include much more neps.

In combed yarn production, combing process represent the final possibility of significantly reducing neps level depended on the noil level and cotton type. When average NRE% values of combing machines used for each blend are calculated, it is found that 13 to 63% of fiber neps are removed from cotton. As the noil levels of all cotton blends are set at the same level and all cotton blends are processed in the same machines, the reason of different NRE% values is due to the different cotton origins.

In this study, cottons from different origins have been investigated in respect to their neps content. Two main factors, influencing the number of neps in cotton yarn are the characteristics of raw material used for yarn production and the conditions of the technological process in spinning mill. By means of AFIS system, seed coat neps can also be evaluated apart from mechanical and biological neps. In order to determine the effect of process stages on neps content of cotton, testing of material in different production stages have been carried out.

The neps contenta of raw materials were between 81...317 neps/gr. The difference in the neps content of raw cotton fibers can be explained by the fact that cottons from different origins also subjected to different ginning conditions. In all blends, used in combed yarn production opening and cleaning processes give rise to an incensement in fiber neps. From the beginning of blow room line to the end, these incensement becomes much more. Opening and cleaning processes in blow room line are the operations in which the formation of mechanical neps can take place. In today's spinning market, together with the increment in demand of cleaner cotton and being paid higher price to the cleaner cotton, cotton fibers are exposed to two or more stages of lint cleaning in ginning process, which improves the cotton grade and remove foreign materials from cotton. However, as the lint cleaners tend to break seed-coat fragments into very small fragments and, to reduce fiber length, it becomes very difficult to remove them in opening and cleaning lines. Therefore in order to clean the fibers from these fragment sufficiently, mechanical treatments in blow room line becomes denser. During opening and cleaning processes, for removing trash and dust particles from cotton, beating, drawing and rolling motions take place and these actions cause fiber neps formation.

A first significant reduction in neps content of material takes place in carding process. In this study, with regard to fiber neps, neps removal efficiency has been ranged between 63 and 87%, whereas for seed coat neps reduction ranged between 31 and 77%. On the basis of this result, it can be stated that carding process is more effective for removal of fiber neps compared with seed coat neps. Neps removal efficiency should be calculated for each carding machines in a spinning mill, this is especially crucial important for evaluating carding performance and selecting optimum machine settings.

CONCLUSION

The draw frames can influence neps content, but the main reason of this effect is the doubling and drawing of slivers. But wrongly set machines can also cause an increment in neps content. In combed yarn production, for the purpose of removing short fibers, trash particles and neps, combing process is done, which is final possibility for reducing neps level after carding. On the basis of results, it can be stated that there is a significant effect of combing machine on neps content reduction. The calculated average NRE% of the combing machines used in this study ranges between 13% and 63%.

When the final neps contents of the cotton blends are compared, it can be stated that although neps contents of processed cottons are different, for the final neps content process conditions have a considerable influence.

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