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The influence of rubber cot (top roller) diameter, degree of top roller hardness, and its loading in ring spinning on the result of unevenness yarn

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ABSTRACT: Research has been conducted on the use of 5 (five) variations on the rubber roller diameter (Top Roll), degree of hardness (Shore Hardness) rubber, and load variation in ring spinning (Ring Frame- Lakshmi Rieter/1979) respectively, and the work was done for learning as much as possible how the unevenness (U%) of its yarn from yarn count of tex 29.55, 13.13, and 9.85 respectively. The effect of rubber roller diameter smaller values result in unevenness (U%) yarn increased; influence the degree of hardness of rubber rollers which would lower the value the higher the evenness (U%) yarn increased; influence the degree of hardness of rubber rollers which would lower the value the higher the evenness (U %), while the effect of load will result in greater value unevenness (U%) were increased (more threads are uneven). The results showed that the unevenness (U%) thread results will be better if we use a large diameter rubber roller (36 x 17 mm) with a high degree of hardness (60 ° - 80 °) for cotton and the loading ranging is between 0.70 to 1.50 kg/cm. Particularly in the manufacture of yarn finer, the influence and effect of the above results are quite striking unevenness.

I. INTRODUCTION

There have been many studies conducted with regard to the assessment of machinery parts attached to the results of the spinning process. But as it seems, and the writer's observation until now, there has not been a clear standard for rubber rollers above conditions (Top Roll) in ring spinning. It is right, in the field of spinning mill; there is standard of rubber cot diameter, but this condition for a special fiber processing only.[1,2,3]

Starting from this fact, the writer ventured to try to conduct a study of the relationship between the quality and condition of the rubber roller on the results of unevenness (U%) yarn. As is well known, that the flatness of a rubber roller will affect the quality of its yarns. Rubber rollers are many obvious defects will result in conditions that are less yarn perfectly. In the event of the stretch, then for rubber rollers that are too loud or too soft, it will generate the conditions position the fibers in the yarn is uneven. Roller rubber hardness degrees is too low to process a particular fiber material, can produce floating fibers, and this happens because the stretch is not perfect (slip fibers). Looking for rubber rollers condition that the degree of hardness is too high (hard), can result in broken fibers, as if stretching occurs when the force's executioners.[4,5,6] Figure 1 shows floating fiber and figure 2 shows the cracking fibers.

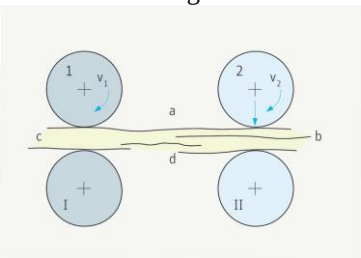

Figure 1. The floating fibers (d), Guided fibers (a,b and c)

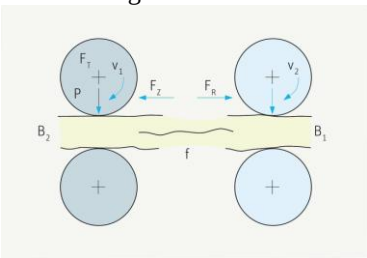

Figure 2. The cracking fiber

In addition to the condition of the rubber, that is attached to a given loading condition on its rubber rollers, are also associated with large / small diameter rubber roller is used, then there will be future-is-new problem. Finally the writer's mind, in this case moved to think and solve problems that might occur in the resulting thread. Hopefully the

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research conducted by the writer can provide significant input to the need, and other thoughts can arise from the recognized expert in particular textile engaged in the world of spare parts of textile machines.[7,8,9]

II. METHODOLOGY

A.Machine

Machines used with the following specifications as shown in Table 1.[10,11,12]

Table 1. Specification of Machine (Lakshmi-Rieter)

Spinning System	Loading with air pressure
Type	Ring LR – 01
Year	1979
Strain system	High Draft
RPM Motor	1480 – 1520
TPM (twist / meter)	5704-1524

B.Raw materials

Cotton fibers

The raw material used with the following specification as shown below.

- Effective length : 30.20 mm
- Micronaire : 157.48 militex
- Maturity : 70.30
- Pressley index : 5.22 (10^3 K.gram/cm^2)

The basic ingredients of the rubber roller manufacturer[13]

The basic material for the manufacture of rubber rollers consist of:

- Perbunan N.300 (Nitrile, chemically, is a copolymer of butadiene and acrylonitrile. Acrylonitrile content varies in commercial products from 18% to 50%. As the nitrile content increases, resistance to petroleum base oils and hydrocarbon fuels increases, but low temperature flexibility decreases. Due to its excellent resistance to petroleum products, and its ability to be compounded for service over a temperature range of -35°C to +120°C (-30°F to +250°F), nitrile is the most widely used elastomer in the seal and compounds industry today).
- ZnO (Zinc oxide is chemical compound and an inorganic compound with the formula ZnO. ZnO is a white powder that is insoluble in water, which is widely used as an additive in numerous materials. Brand names: ReliaMed, Repara, Tenderwrap; Formula: ZnO; Melting point: 3,587°F (1,975°C); Molar mass: 81.408 g/mol).
- Brown Pactis (Softener)
- Staric Acid (Stearic acid is chemical Compound and the saturated fatty acid with an 18 carbon chain and has the IUPAC name octadecanoic acid. It is a waxy solid, and its chemical formula is CH3(CH2)16CO2H. Its name comes from the Greek word στέαρ "stéar", which means tallow. Formula: C18H36O2; Boiling point: 709°F (376.1°C); Molar mass: 284.4772 g/mol; Density: 847.00 kg/m^3).
- Utracil (Tetrasodium EDTA, as cleaning product, up to 0.2% in water, and physical state : Powder).
- DBP (Dibutyl phthalate is Chemical Compound and a commonly used plasticizer. It is also used as an additive to adhesives or printing inks. It is soluble in various organic solvents, e.g. in alcohol, ether and benzene. DBP is also used as an ectoparasiticide. IUPAC ID: Dibutyl phthalate; Formula: C16H22O4; Density: 1.05 g/cm^3; Molar mass: 278.34 g/mol; Boiling point: 644°F (340°C); Soluble in: Water, Alcohol, Ether).
- Deg (Diethylene glycol, an organic compound)
- Lub Rollers 101 (it's almost the same with oil lubricant, also same with SAE 20-30 oil).
- C.IR (Cumaro Resin 90)
- TM (Thulium was used for harderning and to make a shine cot; Atomic weight: 168.93421, melting point: 1818 K, boiling point: 2223 K, density: 9.32 gr/cm^3 , Phase at room temperature: Solid, ionization energy: 6.184 eV, oxidation state: +3
- Retarder (retarders are used to slow the chemical hardening of rubber materials such as cot for spinning).

As for the rubber to adjust the degree of hardness (Shore Hardness), ie by adjusting the concentration of ZnO.

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C.Stages of thread formation

From the raw material (cotton fiber) to be made to become 3 (three) kinds of yarn count ie. 29.55 tex, 13.13 tex and 9.85 tex. All sample tests are 375 units of unevenness (U%) yarn.[14] The implementation of research can be seen as shown in Figure 3.

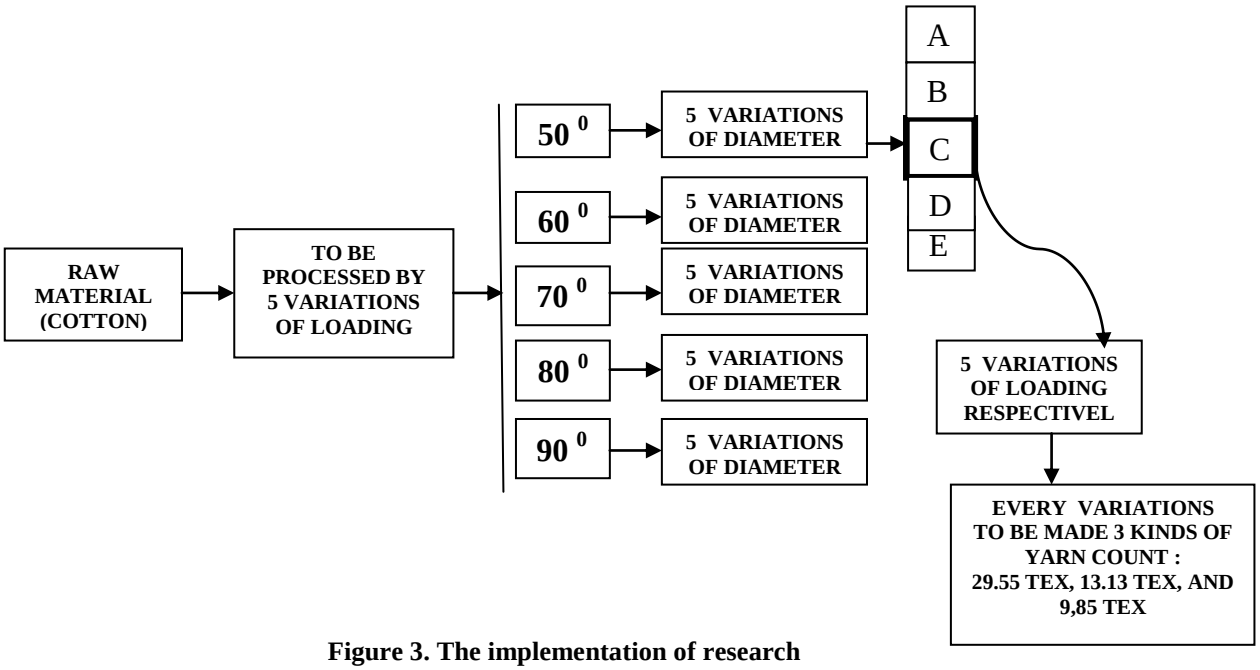

Figure 3. The implementation of research

D.Tests were carried out

Implementation testing of yarn produced, in this case the emphasis is only on the evenness (U%) yarn spinning ring alone.

E.Degrees of rubber hardness testing tools [15,16]

Tools to test the degree of hardness of rubber rollers, using a "Shore Hardness Tester" made in Indonesia, in 2002.

F.Testing tools unevenness (U%) yarn [17,18]

Tools to test the ruggedness entire thread generated, using "Uster Tester Evenness" made Zellweger Ltd.., Switzer land, Uster Tester Model-CH.8610.

III.PRESENTATION AND ANALYSIS OF RESULTS

A.Test results unevenness (U%) yarn

Here's a test result of unevenness (U%) for cotton yarn as shown in Table 2.

Table 2. Test result of unevenness (U%) for cotton yarn

No. Var.	Outside and Inside Diameter (mm)	Yarn Count (Tex)	Test result of unevenness (U%) for cotton yarn														
			Degree of top roller hardness 50					Degree of top roller hardness 60					Degree of top roller hardness 70				
			Loading (kg/cm^2)					Loading (kg/cm^2)					Loading (kg/cm^2)				
			0.7	0,9	1,1	1,3	1,5	0,7	0,9	1,1	1,3	1,5	0.7	0,9	1,1	1,3	1,5
1	36x17	29,55 13,13 9,85	12,04 12,87 14,73	12,09 12,91 14,80	12,11 12,92 15,10	12,31 13,01 15,60	12,56 13,06 15,81	11,87 12,75 14,21	11,90 12,77 14,28	11,91 12,80 14,40	12,01 12,85 14,69	12,16 12,91 14,77	11,75 12,62 13,72	11,80 12,65 13,80	11,82 12,66 13,92	11,86 12,75 14,2	11,93 12,83 14,36

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2	33x17	29,55 13,13 9,85	12,11 13,10 14,79	12,14 13,16 14,86	12,16 13,25 15,23	12,21 13,36 15,75	12,22 13,40 15,97	11,92 12,90 14,25	12,00 12,95 14,31	12,05 13,01 14,52	12,10 13,08 14,78	12,15 13,15 14,89	11,79 12,84 13,76	11,86 12,85 13,83	11,87 12,89 13,95	11,90 12,90 14,23	11,94 12,95 14,42
3	30x17	29,55 13,13 9,85	12,15 13,32 15,03	12,15 13,36 15,10	12,19 13,40 15,30	12,24 13,50 15,89	12,36 13,65 16,10	11,94 13,17 14,30	11,96 13,20 14,32	11,97 13,22 14,58	12,06 13,30 14,93	12,11 13,41 15,10	11,82 12,93 13,81	11,87 12,95 13,92	11,89 13,10 14,06	11,94 13,16 14,28	12,05 13,25 14,89
4	27x17	29,55 13,13 9,85	12,16 13,48 15,10	12,20 13,50 15,27	12,22 13,60 15,50	12,30 13,68 15,71	12,37 13,78 16,72	11,98 13,24 14,65	12,05 13,31 14,68	12,10 13,40 14,70	12,11 13,42 15,05	12,28 13,51 15,28	11,85 12,93 14,31	11,87 13,04 14,35	11,91 13,11 14,43	11,96 13,22 14,61	12,12 13,33 15,02
5	24x17	29,55 13,13 9,85	12,20 13,54 16,45	12,24 13,61 16,70	12,30 13,70 16,91	12,36 13,76 17,25	12,41 13,88 17,92	12,00 13,35 15,85	12,10 13,39 16,01	12,15 13,42 16,25	12,17 13,53 16,40	12,26 13,68 16,72	11,89 13,18 15,30	11,90 13,21 15,45	11,95 13,32 15,68	12,05 13,35 15,81	12.15 13,43 15,98

No. Var.	Outside and Inside Diameter (mm)	Yarn Count (Tex)	Test result of unevenness (U%) for cotton yarn									
			Degree of top roller hardness 80					Degree of top roller hardness 90				
			Loading (kg/cm^2)					Loading (kg/cm^2)				
			0,7	0,9	1,1	1,3	1,5	0,7	0,9	1,1	1,3	1,5
1	36x17	29,55 13,13 9,85	11,50 12,41 13,45	11,62 12,45 13,56	11,65 12,52 13,61	11,70 12,60 13,70	11,78 12,69 13,81	11,20 12,26 13,01	11,25 12,28 13,20	11,40 12,35 13,25	11,50 12,40 13,43	11,54 12,48 13,50
2	33x17	29,55 13,13 9,85	11,61 12,62 13,42	11,70 12,65 13,58	11,76 12,78 13,63	11,77 12,83 13,76	11,80 12,91 13,95	11,25 12,47 13,11	11,38 12,53 13,26	11,41 12,60 13,31	11,61 12,63 13,40	11,62 12,70 13,46
3	30x17	29,55 13,13 9,85	11,65 12,75 13,52	11,72 12,80 13,61	11,76 12,83 13,78	11,80 12,91 13,81	11,83 12,98 14,02	11,28 12,56 13,35	11,40 12,63 13,41	11,45 12,65 13,45	11,65 12,73 13,51	11,68 12,81 13,92
4	27x17	29,55 13,13 9,85	11,70 12,78 13,85	11,75 12,81 13,90	11,78 12,90 14,04	11,85 12,93 14,25	11,93 13,02 14,87	11,40 12,60 13,05	11,42 12,64 13,58	11,46 12,70 13,63	11,66 12,76 13,79	11,75 12,83 14,60
5	24x17	29,55 13,13 9,85	11,72 12,90 14,75	11,76 12,94 14,88	11,81 13,10 15,10	11,87 13,16 15,26	12,01 13,28 15,80	11,50 12,71 14,10	11,52 12,73 14,25	11,55 12,81 14,31	11,70 12,88 14,76	11,78 13,06 15,65

B.Effect of diameter rubber rollers

The individual parameters produce the following effects: High roller pressure causes strong compression and a correspondingly long friction field, but only up to an optimum pressure. Since, in modern drafting arrangements, pressures have already reached the optimum, no further improvement in fiber guidance can be expected from pressure increases. Very hard top rollers, e.g. steel rollers (Fig. 4, **a**), give very high pressure in the center of the nip line. However, since the outer layers can evade the pressure, there is a steep decline in the pressure curve from the center towards each edge. It is therefore clear that the friction field cannot be very long in directions away from the nip line. An improvement is obtained with a covering (Fig. 4, **b**) of medium hardness, and the optimum for loose but compact fiber material is a soft covering (Fig. 4, **c**), since it completely surrounds the fiber body. Similar results are obtained with rollers of different diameter (Fig. 5). Rollers of larger diameter, which spread the total pressing force over a greater area, give a lower pressure peak but a larger pressure width. The increased friction penetrates more deeply into the drafting zone. [19]

The mass of the fiber body exerts its effect mainly through the number of fibers. A very low mass is identical with a lack of contact surface and hence a lack of friction. The friction field is short. High density, i.e. strong compression, facilitates wide spreading of pressure and friction and thus gives a long friction field. The cross-section of the body of fibers is of decisive importance. A thin strand, which readily moves apart, can take up neither pressure nor friction and therefore does not give a well-defined friction field.[18]

This is a problem in so far as the fibers spread out during each drafting operation; the body of fibers thus becomes gradually broader. Attempts are made to oppose this by compressing the fiber strand within condensers in the drafting arrangement. However, this is not optimally effective, since undesired delaying forces are produced by friction at the stationary condensing elements, and the resulting broad fiber ribbon is not really rounded but only folded on itself. Only a round cross-section gives the optimum result. Better still is a roving). If influence is to be exerted on the friction

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field by adjustment of individual parameters, then it should be borne in mind that strong interactions are found throughout the whole drafting process.

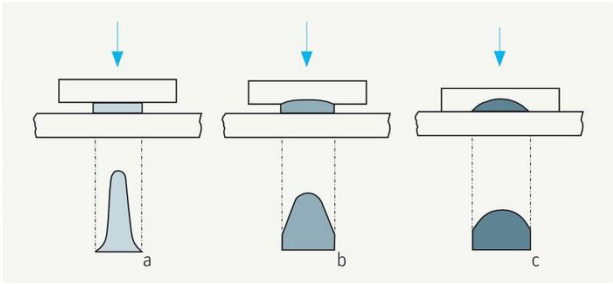

Figure 4. High roller pressure causes strong compression

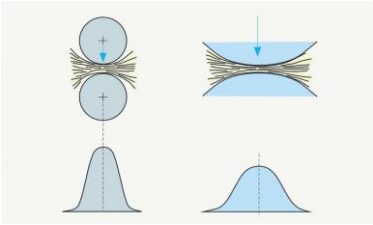

Figure 5. Effect of diameter rubber rollers

Diameter rubber rollers vanishingly small (as can be seen in table 1), shows the results of unevenness (U%) yarn, cotton for the same number has been rising (increasingly uneven yarn) as can be seen also drawing on the example in the graph (Fig.6).[20]

- At the time of the stretch in the stretch rollers, there is imbalance between the expenditure of material from the back of the rubber roller withdrawal. The back rubber rollers is more smaller in diameter from the front rubber rollers, so the process is not perfect stretch, which ultimately produced yarns conditions are not in accordance with the plan.
- Due to an imbalance in the process of stretching, clearly spread fibers uneven yarn that eventually becomes uneven.
- Diameter of rubber rollers that are too small, resulted in the rubber roller is easily damaged, this happens because of the next round of iron rollers which squeeze past the rubber roller, rubber roller be lost and the rapid deterioration that ultimately flawed top roller was carried to the thread. In other words, the resulting string becomes uneven., The value of U% to rise.
- Influence of small diameter rubber rollers, more seen on the evenness (U%) fine threads (cotton yarn 9.85 tex). Here are 2 examples of the depiction of data in Table 1 to be made in Graphic for cotton yarn Tex 29.55; 13.13 and 9.85 (diameter top roller = 36 x17 mm and 33 x 17mm) with loading from 0.7 up to 1.5 kg/cm2 respectively.

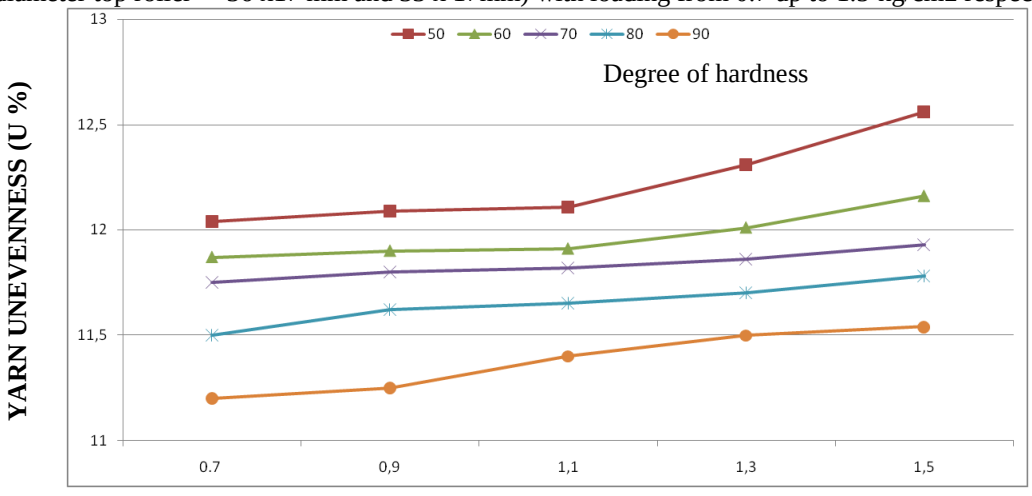

Figure 6. The relationship between degree of hardness, loading and the result of yarn unevenness (U %) (Diameter : 36x17 , 29.55Tex)

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C.Effect of loading

Enlarged loading on rubber rollers for the whole process of cotton yarn and show appreciation unevenness (U%) is generated, and this applies to the use of rubber hardness degree of the high and the low. U% rise in the value of yarn, fiber damage is possible, due to improper adjustment of the level of loading and the stretching process. Clamps on the rubber rollers and steel rollers bawahr are out of sync with the withdrawal process, the fibers can cause floating or broken fibers.

D.Effect of degree of hardness (Shore Hardness)

Hard rubber rollers having a better durable properties, when compared with the soft rubber material (rubber material similar conditions). For cotton material (not synthetic), with a degree of hardness of rubber is quite good which allows the results of normal yarn evenness, is the condition of 60 ° - 80 °.

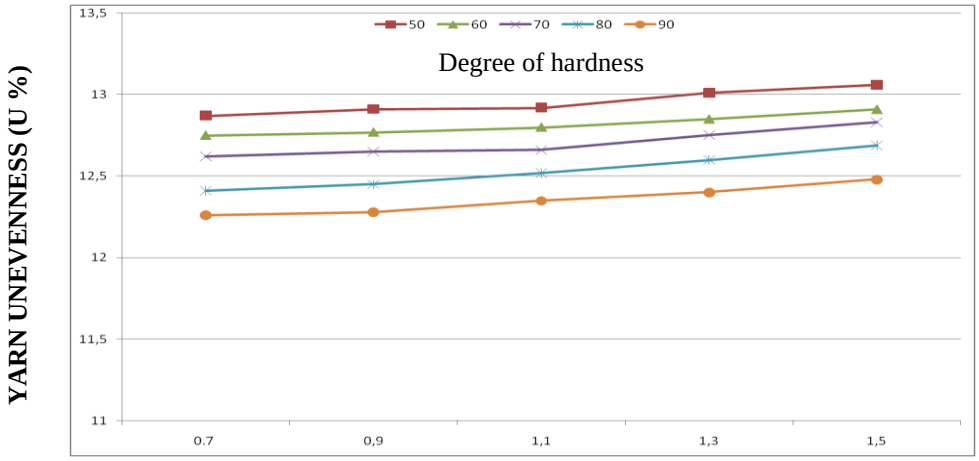

Figure 7. The relationship between degree of hardness, loading and the result of yarn unevenness (U %) (Diameter : 36x17 , 13.13Tex)

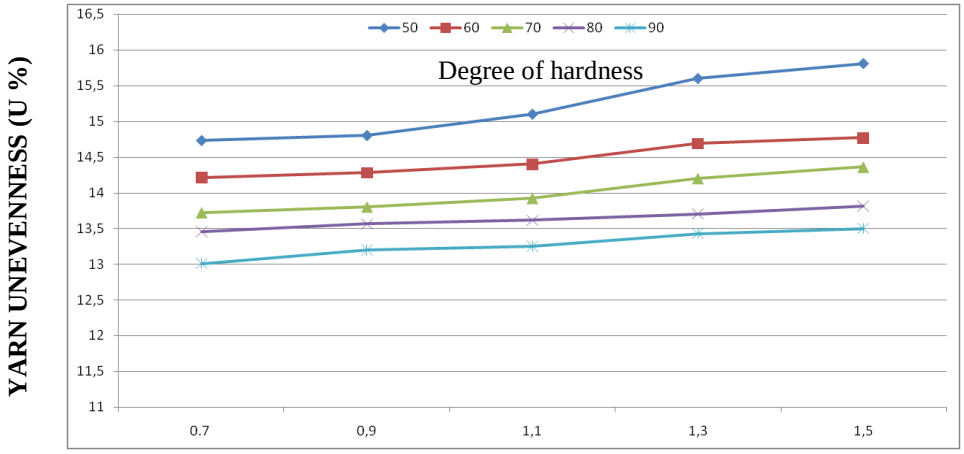

Figure 8. The relationship between degree of hardness, loading and the result of yarn unevenness(U %) (Diameter : 36x17 , 9.8Tex)

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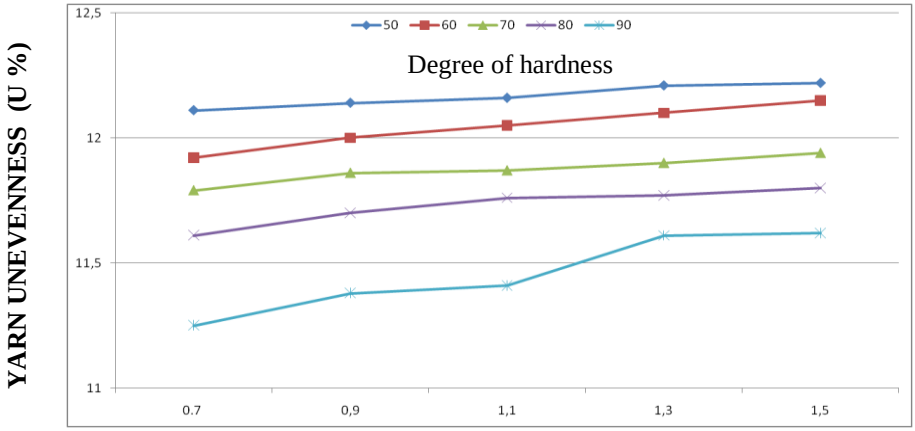

Figure 9. The relationship between degree of hardness, loading and the result of yarn unevenness (U %) (Diameter : 33x17 , 29.55Tex)

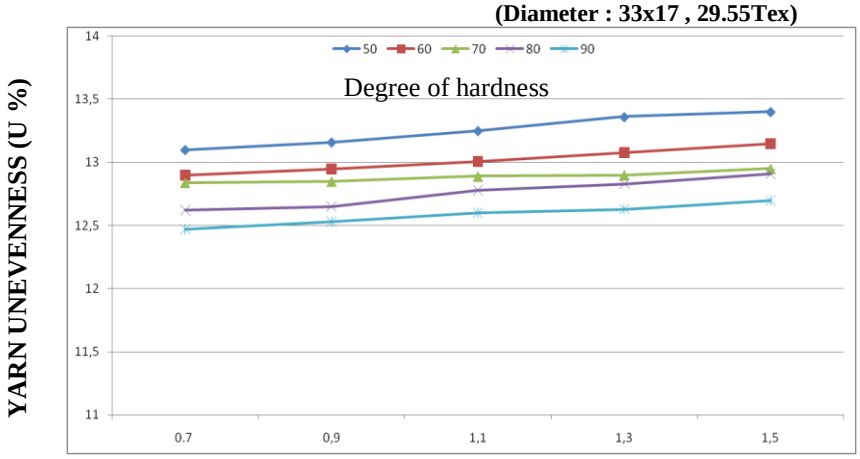

Figure 10. The relationship between degree of hardness, loading and the result of yarn unevenness (U %) (Diameter : 33x17 , 13.13Tex)

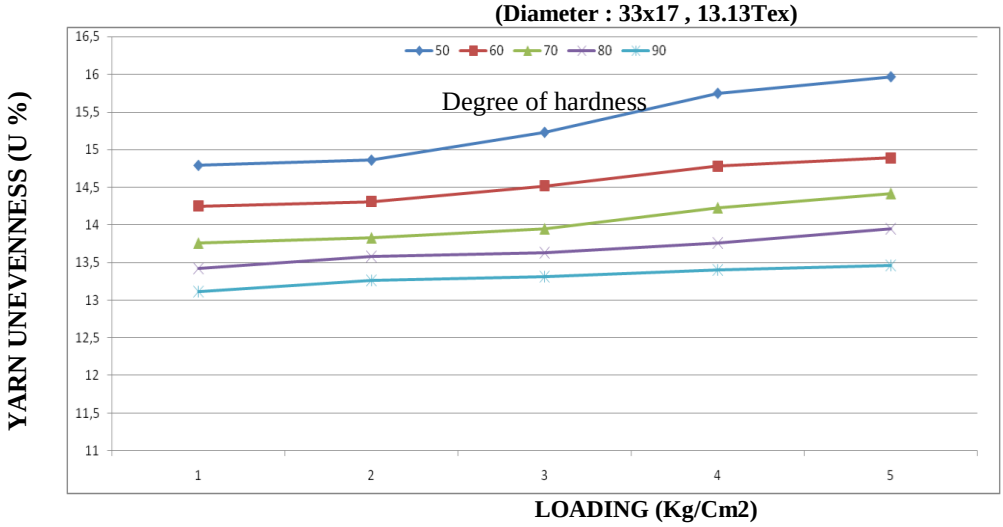

Figure 11. The relationship between degree of hardness, loading and the result of yarn unevenness (U %) (Diameter : 33x17, 9.8Tex)

Overview of the combined effects of loading, the degree of hardness of rubber and rubber roller diameter of the resulting yarn evenness

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From the test results in Table 2 , we can see a combination of the use of the diameter of the small rubber roller with loading and degree of hardness of rubber, which can still be resulted the value unevenness (U%) is still the tandard for all the number of threads. In other words, forecasting in a logical and rational to get the value of unevenness (U%) threads can be done by looking at the results of the research, which according to the degree of hardness of rubber, rubber diameter and loading levels to be done. So the balance of the combined influence of the above it is supporting at perfection as the strain at the time of spinning. By looking at the default value of unevenness (U%) are there for the whole number of threads, cotton then the determination of the rubber is good to do, also deliverance the raw material and the magnitude can be determined much & spinning process has not been implemented.

Here are a few cotton spinning process conditions (See Table 2) during the study, where the average value of unevenness (U%) threads are still met.

Tex 29.55 (U% '= 14.15 - max.limit), conditions that qualify include:

- Diameter 36 x 17 mm, rubber hardness 60 ° degrees and loading up to 1.3 kg / cm.
- Diameter 36 x 17 mm, rubber hardness degree of 70 ° - 80 ° and loading from 0.7 to 1.5 kg / cm.
- Diameter 33 x 17 mm, degree of hardness 60 ° and load up to 0.9 kg / cm.
- Diameter 33 x 17 mm, rubber hardness degree of 70 ° - 80 ° and the imposition of 0.7 to 1.5 kg / cm.
- Diameter 27 x 17 mm, rubber hardness 70 ° degrees and charging up to 1.1 kg / cm. Looking for rubber hardness 80 ° degrees and loading from 0.7 to 1.5 kg / cm. Diameter 24 x 17 mm, the degree of hardness of 80 ° and load up to 1.1 kg / cm.

For Tex 13.13 conditions eligible, among other things:

- Diameter (33-36) x 17 mm, degree of hardness 60 ° - 80 ° and deducted 0.7 to 1.5 kg / cm.
- Diameter 30 x 17 mm, rubber hardness 60 ° degrees and the imposition of only 0.7 kg / cm.
- Diameter 30 x 17 mm, rubber hardness degree of 70 ° - 80 ° and the imposition of all standards.
- Diameter 27 x 17 mm, the degree of hardness of 70 ° and and the loading up to 1.1 kg / cm. For the degree of hardness of 80 ° of loading up to 1.5 kg / cm.
- Diameter 24 x 17 mm, rubber hardness 80 ° degrees and charging up to 1.5 kg / cm.

For Tex 9.85 sufficient condition to meet, among others:

Diameter 36 x 17 mm, rubber hardness 60 ° degrees and charging up to 1.1 kg / cm.

Diameter 36 x 17 mm, degrees rubber hardness 70 ° and load up to 1.5 kg / cm, so it is for the violence of 80 °.

- Diameter 33 x 17 mm, rubber hardness 70 ° degrees and charging up to 1.3 kg / cm. Looking for a degree of hardness of 80 ° loading can be done up to 1.5 kg / cm.
- Diameter 30 x 17 mm, the degree of hardness of 80 ° and load up to 1.1 kg / cm.
- Diameter 27 x 17 mm, rubber hardness 80 ° degrees and loading to 0.9 kg / cm.

Compared to the uster standard, so we can choose which loading, degree of hardness and diameter roller wiil be used in spinning process (see Table 2).

From all the above conditions, it can be summarized understanding of the research that has been organized in the farm, namely: Diameter of the small rubber rollers (optimum), essentially still be put to good use, and this should be supported by adjustments to the amount of loading on the rubber roller is also by adjusting the degree of hardness of rubber rollers. Encumbrances are carried out on the rubber rollers in the area stretching should be tailored to the conditions of the rubber roller, also the type of material being processed. Thus the desire to get the value of ruggedness (U %) lower yarn (yarn over average), however, is likely to be achieved.

IV. CONCLUSION/RECOMMENDAIONS

Data from the research that has been done, it can be concluded:

- The degree of the lower rubber hardness, diameter rubber rollers and charging the same amount, resulting in a value of unevenness (U%) higher yarn (not flat).
- Imposition of a growing low to the rubber roller diameter and the same degree of violence, will result in the value of unevenness (U%) the lower the yarn again (yarn increasingly flat).
- Diameter smaller rubber rollers, rubber hardness degrees and the same load produce the yarn unevenness (U%) more higher than normal.
- In order to process cotton material, the degree of violence is suitably between 60 ° - 80 °.

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