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Study on Yarn Quality Variation from Spinning Position To Position in Ring Frame

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Abstract: *Ring frame is the last machine for producing yarn by spinning. For producing a better quality yarn, some of the factors are important. It also need to ensure the quality of yarn is same for all the position of ring frame. Sometimes it shows variation. In this study, we tried to find the problems for which the quality of yarns are varied & finally provided some solution how to minimize the variation. we observed the spinning position of Ring spinning machine such as Traveler, Apron, Drafting Arrangement, Lattice apron, Ring cup, Spacer etc. that can make deviation on the final yarn properties like C.S.P, T.P.I, I.P.I, CV%, Naps , hairiness, U%, Thick place, Thin place, Mic, +b (yellowness) and so on. From different points +b (yellowness) is one of the important factors. Here, we have to emphasized on +b (yellowness) value of fibre when bale mixing. If we can minimize the variation of +b (yellowness) value of yarn among the bales we can produce a less quality variation in the final yarn.*

Keywords: *Yarn Quality, Ring Frame, Spinning, +b (yellowness).*

I. Introduction:

Ring spinning is a method of spinning textile fibers such as cotton, flax, or wool to make a yarn. It was developed from the throstle frame, which in its turn transformed from Arkwright's Water frame.[1] At the very beginning, there was Saxony wheel which was a double band treadle spinning wheel. At the early 1770s water, the frame was developed by Arkwright.[2, 3] The throstle frame was a converted form of water frame. It is said that the Ring Frame was first conceived by John Thorp who was named as Richard Marsden.[4] Commercially Ring Frame was used in the 1830s and its manufacturing began from 1850s.During the American civil war, there was, the American Industry boasted 1091 mills with 5,200,000 spindles which can process 8,00,000 bales of cotton. At that time the largest mill Naumkeag steam cotton company had 65584 spindles. After the war for providing employment, mills were established in the south. [5]

Besides, there was another development which was developed by Richard Roberts using the more advanced engineering Technique in Manchester.[5] It was capable of coarser count production. On the other hand, there was a finer count production system in Lancashire.[5, 6] There was lack of skilled spinners in New England but there was a plentiful spinner in Lancashire.[7]Mr Samuel Brooks and his agent Blakey concentrated on development on improving the spinning frame. After a successful development, they brought about a machine offering 180,000 spindles.[8]

After a development of the different stages nowadays ring spinning is brought about a new era to the modern developed spinning system. In a modern Ring Frame machine, there is Drafting rollers, Spindles, Attenuated roving, Thread guides, Anti ballooning rings, Traveller, Rings, Threads on rovings, spacer and so on. [9]Which has an individual task in keeping a balanced quality and production? Currently, there is available spinning systems are Com4 spinning, Compact Spinning, Air-Jet spinning, and Air-Vortex spinning etc.[10]The main machine manufacturer companies are Rieter (Switzerland), Toyo Ta (Japan), Zinser, Suessen (Germany), and Marzoli (Italy). All these machines require controlled atmospheric conditions.[11]

Almost all machinery manufacturers are now offering auto doffing systems and linking arrangement with winding machine. Rieter has developed a ring traveller system called as Zenit and Arcus. Suessen has established a high-speed ring spinning machine for converting staple fibre into yarn, named as Flomax RC. Suessen Elite spinning system consists of profile tube, lattice apron, an additional delivery top roller, Com4spin process of Rieter developed a condensing zone. It is inserted between the drafting and the yarn formation stages of ring spinning systems. Texparts developed various types of traveler according to yarn quality and final count.

II. Materials & Methodology:

2.1 Materials:
The used yarn is 100% cotton which is in Talha Spinning Mills Ltd. The Fineness was 4.1, T.M is 4.2 & yarn count is 30 Nm.

2.2 Machine Description:
The used machine for ring spinning was from Jingwei Machinery Co. Ltd which origin was Germany, Model number E1520. It has 504 spindles & spindle speed 9000 rpm. The machinery used for yarn testing are Uster AFIS pro, Uster HVI, Uster UT-4, Wrap Reel, Electric Balance, Electronic Twist Tester, Uster auto sorter, Wrap block, Electronic moisture meter, Lea strength tester &Usterclassimate.

2.3 Research Direction:
- First of all, we selected a Ring Frame machine which produced 30 counts carded yarn.
- Then we selected 5 spindles from which we test the yarn count variation.
- After that, we select 5 roving and yarn sample for the same spindle from that spindle.
- Determine the count for each roving and bobbin separately.
- Find out the variation in roving and yarn.
- Then we try to find out every possible machine parts fault as far as possible.
- Finally, we take USTER quality test report by USTER AFIS, USTER HVI SPECTRUM, USTER -3 machine.
- Depending on the quality test report we try to establish a solution from our basic knowledge and experience for reducing variation in final yarn quality.

2.4 Methods:
The roving bobbins (1) are inserted in holders (3) on the creel (Fig. 01). Guide bars (4) guide the roving's (2) into the drafting system (5), where they are drawn to their final count. The drafting system is at an angle of 45-60" and is one of the most important units on the machine since it exerts a very considerable influence on the uniformity of the yarn in particular.

After the resulting thin ribbon of fibres (6) leaves the delivery roller, the twist necessary for imparting l8strength is provided by the spindle (8) rotating at high speed. In the process, each rotation of the traveller on the spinning ring (10) produces a twist in the yarn. Ring traveller (9) is also necessary for taking up this yarn onto a tube mounted on the spindle. This traveller a remnant of the flyer on the roving frame moves on a guide rail around the spindle, the so-called ring (10).

The ring traveller has no drive of its own; it is dragged with the spindle (8) via the yarn attached to it. The rotation of the ring traveller lags somewhat behind that of the spindle due to the relatively high friction of the ring traveller on the ring and the atmospheric resistance of the traveller and the thread balloon between yarn guide eyelet (7) and traveller (9).

This difference in speed between the spindle and the traveller results in the thread being wound onto the tube. in contrast to the roving frame, the ring spinning machine spindle operates with at higher speed than the traveller (9). The yarn is wound up into a cylindrical cop form by rising and lowering of the rings, which are mounted on a continuous ring rail.

The layer traverse of the ring rail is also less than the full winding height of the tube. The ring rail, therefore, has to be raised slightly (shift traverse) after each layer has been wound. For a time, machines were also built featuring shift traverse produced by lowering the spindle bearing plate rather than raising the ring rail. These machines are no longer available.

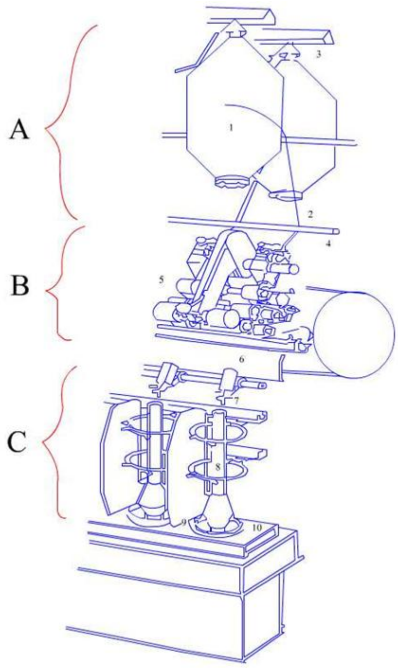

Figure Error! No text of specified style in document.**1 -** Mechanism of drafting arrangement system

III. Results & Discussion:

3.1 Roving Test report

Nr	U%	CVm%	CVm% 1m	CVm% 3m	Rel. Cnt%
1	3.57	4.49	1.57	1.14	-0.0
2	3.93	4.92	1.62	0.96	-0.3
3	3.76	4.71	1.57	0.99	-0.3
4	3.89	4.87	1.85	1.15	0.2
5	3.83	4.79	1.44	1.00	-1.6
6	3.84	4.95	1.70	1.26	2.0
7	3.80	4.79	1.52	0.77	-1.4
8	3.83	4.84	1.77	1.03	-0.4
9	3.70	4.67	1.82	0.97	0.5
10	3.78	4.78	1.80	0.95	1.3
Mean	3.79	4.78	1.67	1.02	0.0
CV	2.7	2.8	8.5	13.2	1.1
USP^{tm}**13**		15	20	12	

Figure Error! No text of specified style in document.**-2:** Uster quality test report

From the above test report on 10(Serially 1-10) Roving for 100% cotton, every parameter is varied from every spinning position. For producing 30 Ne cotton, here the roving hank is 0.84 Ne. But for the same roving count, we can see a large variety of their parameter for every spinning position to position. For that reason, the quality varies a lot in the next stage in ring frame where we get 30 Ne carded yarn. The lowest value of U% (Unevenness) is 3.57 and the highest value is 3.93. The CV m (Co efficientof variation) also changes in every position. CVm (1m) means the testing of variation in quality of roving within every 1m length. The short the measuring length the fine will be the testing result. So for every 1m point we get the highest value of variation 1.85 and the lowest value of variation is 1.44. and the mean value is 1.67. On the meanwhile, for every 3m variation we can see the highest value is 1.14 and the lowest value is 0.95 which is comparatively lower than CVm(1m). The value below the mean value indicates the Co efficient of variation which means the deviation from the standard value. Again, the value below the cv value indicates the USP (usterstatistics percentile) value.In fact, USP value is used as a key performance indicator to the spinner. With the help of USP, the spinning mill can easily determine the performance gap of final yarn. These value of USP is constant for 30 Ne carded cotton yarn.

So from the result, we can say, the more the variation in parameter the more will be the variation in the final yarn quality. We have to try as far as possible to minimize the variation among the values. So that we can ensure a better result by minimizing variation.

Test result for 100% Cotton (carded) ring spun yarn

Nr	U%	CVm%	CVm% 1m	CVm% 3m	CVm% 10m	Rel. Cnt%	H	sh	Sh 1m	Sh 3m	Sh 10m
1	11.04	13.97	5.07	3.97	2.92	-1.0	4.37	0.96	0.23	0.17	0.06
2	11.22	14.25	5.07	3.73	2.93	-1.0	4.24	0.94	0.21	0.15	0.06
3	11.98	15.16	5.87	4.39	2.97	-0.2	4.28	0.98	0.15	0.10	0.06
4	11.36	14.39	4.81	3.71	2.84	-2.3	4.09	0.91	0.18	0.13	0.05
5	11.45	14.58	4.93	3,65	2.87	-1.1	4.20	0.93	0.14	0.10	0.06
6	11.55	14.67	5.25	4.16	3.24	1.7	4.13	0.91	0.13	0.09	0.06
7	11.97	15.27	4.96	3.30	2.32	-1.5	4.40	1.00	0.17	0.11	0.06
8	11.44	14.55	4.79	3.75	2.79	1.0	4.04	0.91	0.13	0.09	0.06
9	11.03	14,05	5.05	3.73	3.05	3.6	4.15	0.91	0.13	0.09	0.04
10	11.72	14.90	5.10	3.54	2.60	0.8	4.22	0.93	0.12	0.09	0.04
Mean **CV** **USP^{tm}13**	11.48 3.0	14.58 3.0 28	5.09 6.1 62	3.79 8.2 50	2.85 8.8 60	0.0 1.8	4.21 2.7 8	0.94 3.5 <5	0.16 24.2	0.11 26.8	0.05 12.7

FIGURE ERROR! NO TEXT OF SPECIFIED STYLE IN DOCUMENT.**-3:** YARN QUALITY TEST REPORT

The above chart shows about test result of 30 Ne 100% cotton yarn. From the above chart, we can see that the mean value of unevenness is 12.21. Similarly the mean value of CVm , CVm(1m), CVm(3m) ,CVm(10m) ,H,

sh is subsequently 15.53, 4.75, 3.75, 2.88, 4.23, 0.98. Again, the mean value for thick, thin and naps is thin(-30%) 2648, thin(-40%) 327, thick(+50%) 216.5, thick(+70%) 28.0, Naps(+140%) 1497, Naps(+200%) 249 etc. From the graph we can show that within the same machine the parameters vary a lot.

Uster quality test report (Bale Management)

Nr	SCI	MIC	MAT	LEN	AMT	Unf	SFI	Str	Elg	Moist	Rd	+b	Trcnt	Tr area	Tr grade	C grade
1	124	4.00	0.86	29.95	431	80	11.4	29.3	5.3	13.6	76.2	10.6	20	0.15	1	22-1
2	142	4.00	0.89	28.75	646	81.3	9.1	34.8	5.8.	13.6	73.8	10.5	32	0.24	2	32-1
3	146	4.00	0.89	29.06	624	80.6	9.9	37.0	5.1	13.6	74.3	10.9	24	0.25	2	22-2
4		4.00		0.00							71.9	9.2	30	0.25	2	41-3
5	137	4.00	0.87	29.16	736	83.1	9.5	30.5	6.3	13.6	71.4	9.3	29	0.17	1	42-1
6	129	4.00	0.87	29.51	816	81.1	9.1	31.4	5.7	13.6	67.8	10.9	17	1.63	8	43-1
7	126	4.00	0.86	28.63	627	81.2	11.4	29.8	6.3	13.6	73.1	8.7	24	.15	1	41-3
8	124	4.00	0.86	26.95	667	81.9	10.2	28.7	4.9	13.6	75.8	9.4	24	.22	2	31-3
9	134	4.00	0.87	29.03	733	81.7	8.6	31.1	6.8	13.6	74.0	10.4	30	.19	2	32-3
10	135	4.00	0.86	27.97	386	84.0	10.9	28.5	4.5	13.6	74.6	8.5	31	.20	2	41-3
11	128	4.00	0.86	30.25	391	81.1	9.0	29.2	4.7	13.6	74.6	9.6	30	.17	1	31-3
12	143	4.00	0.86	30.48	617	84.2	6.9	29.7	5.9	13.6	71.9	9.7	41	.28	3	42-1
13	123	4.00	0.86	28.83	498	80.6	13.1	29.5	6.2	13.6	73.7	8.5	23	.19	2	41-3
14	160	4.00	0.88	28.55	405	86.3	6.8	33.0	7.0	13.6	73.8	11.5	28	.56	4	23-1
14	125	4.00	0.86	26.95	412	83.0	9.4	27.7	5.2	13.6	73.1	10.0	29	.31	3	32-2
16	137	4.00	0.88	29.11	501	80.7	8.8	33.5	7.0	13.6	74.8	10.5	22	.16	1	22-2
17	133	4.00	0.87	29.18	671	82.4	8.3	30.3	5.1	13.6	71.2	10.5	39	.80	5	32-2
18	113	4.00	0.85	26.31	497	81.1	12.4	26.9	4.9	13.6	73.5	9.2	35	.29	3	31-4
19	136	4.00	0.88	29.21	783	81.5	8.5	32.5	4.6	13.6	73.5	9.5	32	.18	2	31-4
20	135	4.00	0.86	28.50	672	82.9	10.8	29.9	5.6	13.6	75.1	10.2	31	.31	3	22-2
21	137	4.00	0.87	28.88	525	83.2	9.4	30.0	5.9	13.6	73.1	10.9	15	.12	1	22-2
22	99	4.00	0.86	26.49	456	77.3	16.9	28.2	4.0	13.6	73.7	9.2	29	0.17	1	31-4
23	146	4.00	0.88	29.01	482	83.0	7.5	33.0	6.7	13.6	74.9	9.4	23	0.21	2	31-3
24	92	4.00	0.86	26.62	478	76.3	15.9	27.9	4.0	13.6	71.4	9.7	34	0.23	2	42-1
25	156	4.00	0.89	29.49	702	83.3	8.1	35.5	4.9	13.6	76.4	10.0	21	0.12	1	21-4
26	123	4.00	0.87	28.91	568	79.7	10.3	31.0	6.9	13.6	73.5	10.3	24	0.24	2	32-1
27	135	4.00	0.87	29.31	633	81.3	8.3	32.1	6.6	13.6	74.5	9.8	28	0.25	2	32-1
28	138	4.00	0.86	28.65	463	83.8	8.3	29.6	6.8	13.6	73.7	10.3	15	0.12	1	32-1
29	133	4.00	0.86	28.17	540	82.9	9.1	29.7	7.2	13.6	73.0	10.4	11	0.8	1	32-1
30	126	4.00	0.86	28.75	487	81.5	10.1	28.9	6.1	13.6	74.5	9.4	39	0.25	2	31-3
31	123	4.00	0.86	30.02	446	80.7	8.4	28.8	6.3	13.6	71.0	10.7	27	0.25	2	32-1

32	134	4.00	0.87	30.02	679	80.8	7.7	32.3	5.5	13.6	73.9	9.5	45	0.34	3	31-4
33	118	4.00	0.86	29.06	490	79.7	9.1	29.4	6.5	13.6	72.8	9.6	26	0.12	1	32-2
34	148	4.00	0.89	27.61	463	82.7	9.7	34.8	6.5	13.6	76.5	10.8	21	0.15	1	12-2
35	161	4.00	0.88	30.15	496	84.8	6.9	34.3	6.6	13.6	75.5	10.0	47	0.37	3	22-2
MEAN	132	4.00	0.87	28.75	559	81.8	9.7	30.8	5.8	13.6	73.6	9.9	28	.28	2	
DEV	15	0.0	0,01	1.08	120	2.0	2.2	2.5	0.9	0.0	1.7	0.7	8	.27	1	
%CV	11.0		1.3	3.8	21.5	2.4	23.2	8.0	15.6	0.0	2.3	7.3	29.3	.97.2	65.2	

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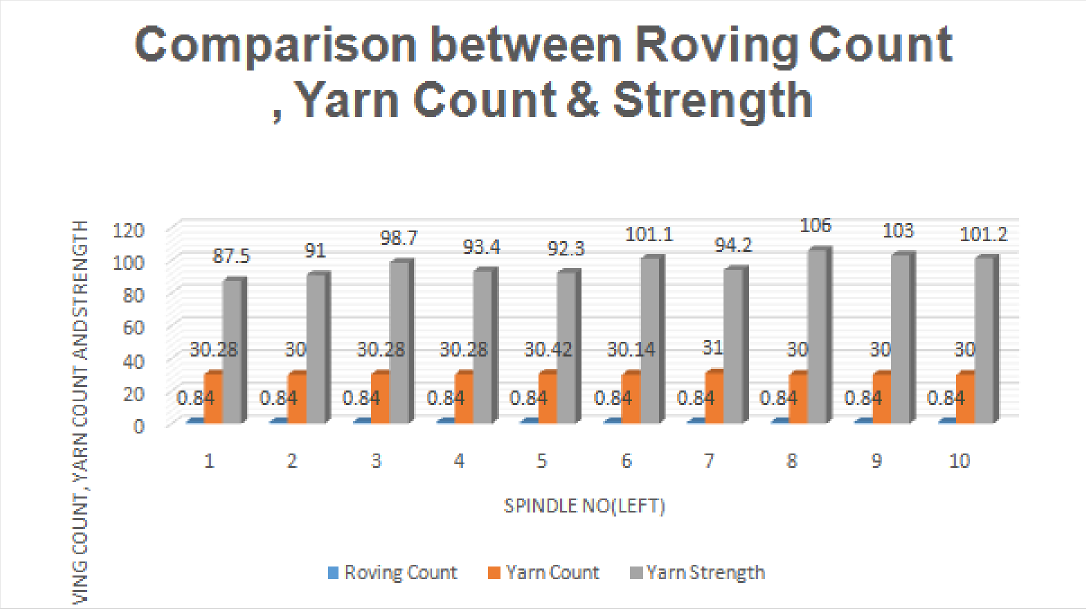
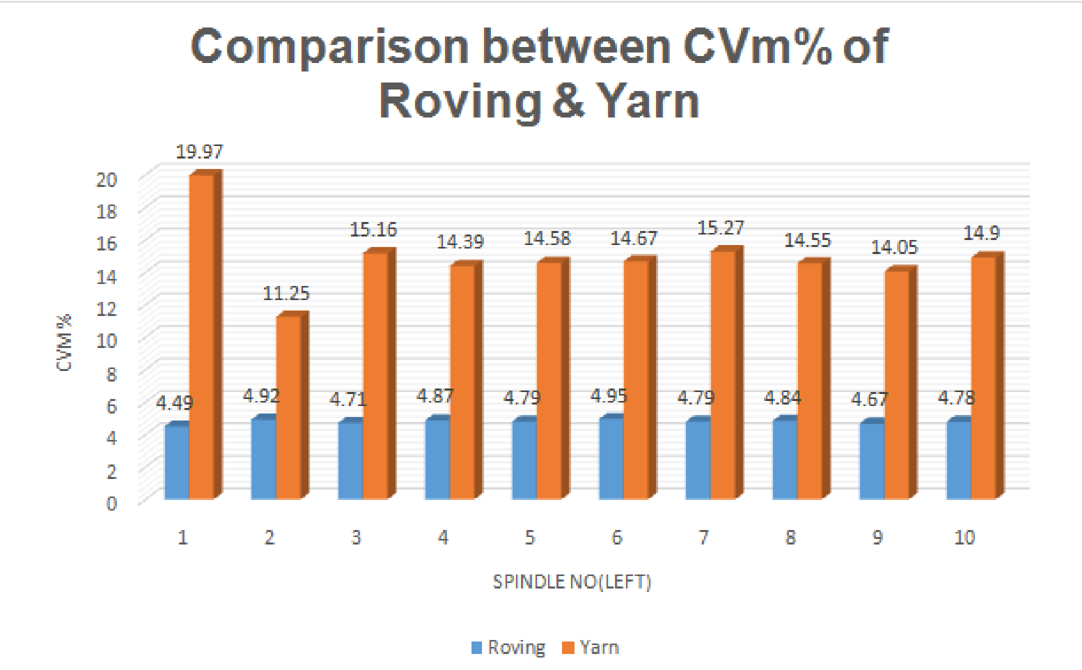
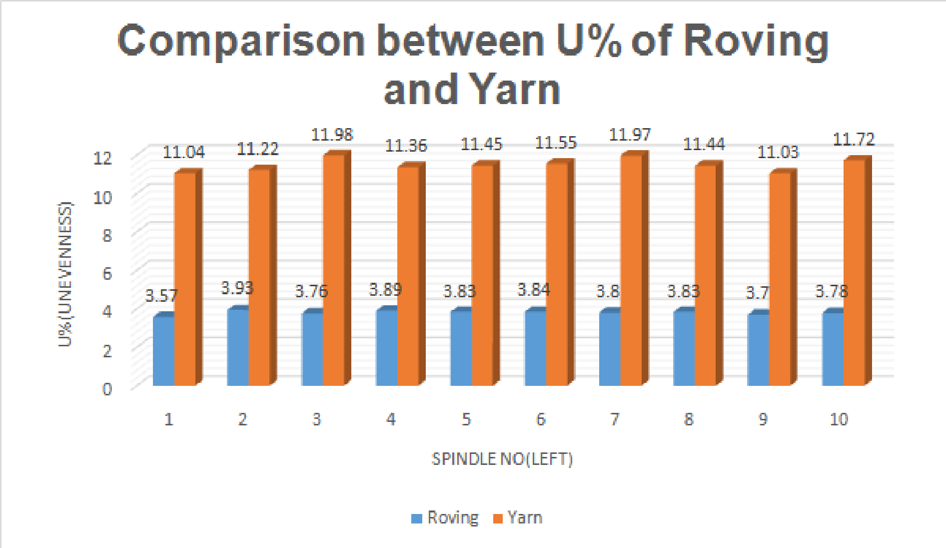
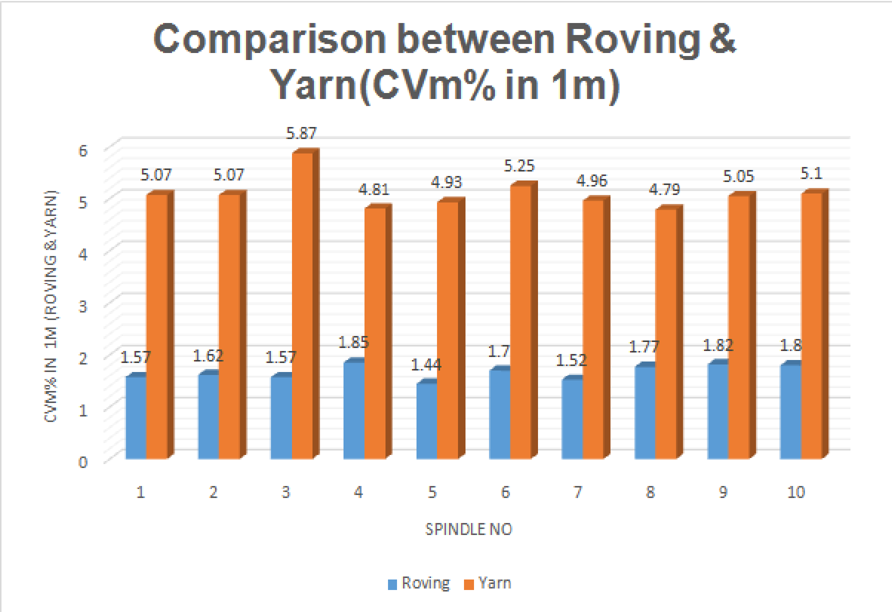
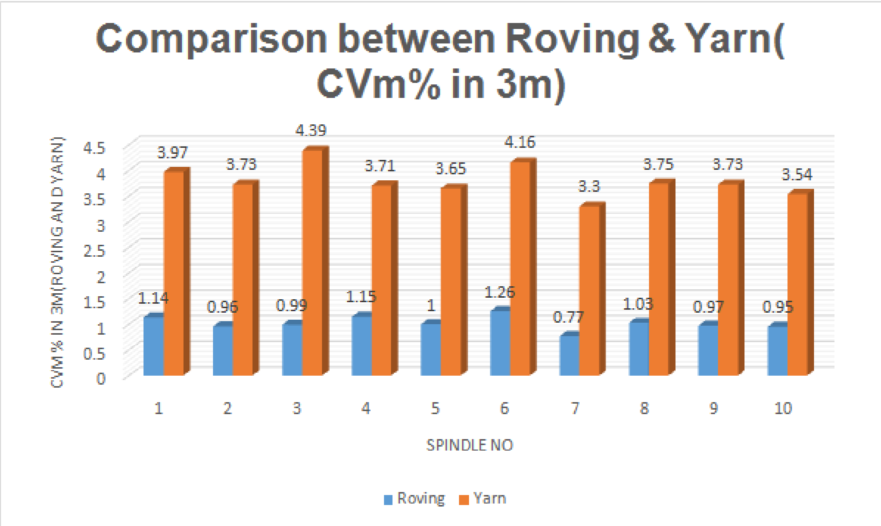





Comparison between U% of Roving and Yarn
U%(UNEVENNESS)
0
2
4
6
8
10
12
11.04
11.22
11.98
11.36
11.45
11.55
11.97
11.44
11.03
11.72
3.57
3.93
3.76
3.89
3.83
3.84
3.8
3.83
3.7
3.78
1
2
3
4
5
6
7
8
9
10
SPINDLE NO(LEFT)
Roving
Yarn


Comparison between Roving & Yarn(CVm% in 1m)
CVM% IN 1M (ROVING & YARN)
0
1
2
3
4
5
6
5.07
5.07
5.87
4.81
4.93
5.25
4.96
4.79
5.05
5.1
1.57
1.62
1.57
1.85
1.44
1.7
1.52
1.77
1.82
1.8
1
2
3
4
5
6
7
8
9
10
SPINDLE NO
Roving
Yarn


Comparison between Roving & Yarn(CVm% in 3m)
CVM % IN 3M(ROVING AND YARN)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
3.97
3.73
4.39
3.71
3.65
4.16
3.3
3.75
3.73
3.54
1.14
0.96
0.99
1.15
1
1.26
0.77
1.03
0.97
0.95
1
2
3
4
5
6
7
8
9
10
SPINDLE NO
Roving
Yarn

IV. Discussion

From the above chart, we can say there are so many reasons for introducing in the final yarn. It's not so easy to eradicate quality variation from spinning position to position completely. From the very beginning fibre bale mixing stage or selection of raw cotton to every operation,fibre is passing through directly or indirectly related with deviation from the given parameter.

In our point of view, we can say that for reducing deviation from the given parameter we have to first select raw cotton bale as the same length as far as possible. Bale management should be maintained properly. We have to mix up wastages in the bale management as a small amount as we can. We have to check and clean the machine parts regularly and have to change as the due date. We have to observe the function if the autoleveller is performing properly or not because finisher drawframe is the final stage where the quality of yarn can be made according to given parameter otherwise the deviation could occur largely. Selection of raw material must be done very carefully. Hand gloves should be used by the worker otherwise hand touch can cause harm for yarn. Every step of operation such as cleaning,mixing, drafting, twisting, winding, building, front roller surface speed, delivery speed, and every small individual small part such as traveller, spacer, apron, lattice apron, roller, suction system every machine parts has to function properly. In my point of view, we can modify the drafting system, suction system (etc), use of appropriate traveller, apron and lattice apron then the quality variation could be significantly minimized.

We know if we use pure quality of cotton we can ensure an output without quality variation. But Factory will not do that. Because if they use pure quality of cotton and do not reuse the wastage they cannot ensure a good profit at the end of the day. From the back section (Blowroom, carding, drawframe) and front section (ring frame) we get a lot of wastages such as Dropping-1,dropping-2, hard waste, soft waste, bonds waste, pneumaphil and so on. But for the next bale mixing it is used. So we cannot ensure accurate count or accurate quality of final product. Rather we can ensure that if we mix foreign matter or wastage in a small amount we can ensure minimize the variation of yarn. The list of wastages produced in spinning are following.

Section	Wastage
Blow room (3%)	Dropping-2,Lap waste
Carding (3-5%)	Dropping-1, Sliver waste, Vaccum waste
Draw frame (0.5%)	Sliver waste
Simplex (0.5%)	Roving waste, Sliver waste
Ring frame (2-3%)	Pneumaphil, Hard waste, Roller Lapping, Sweeping, Vaccum Waste

We have to know the limit of using wastage in the next bale mixing for ensuring the minimum quality variation from every spinning position. Generally +b(yellowness) and Micronire value is tested for knitting yarn and only +b(Yellowness) is measured for weaving yarn. As here (In Talha spinning mill) only weaving yarn is produced only +b(yellowness) is very important. Because before weaving sizing is done which add a value and add strength to the yarn. So from our project work we come to know that we have to emphasized on +b(YELLOWNESS) value of fibre when bale mixing. If we can minimize the variation of +b (yellowness) value of yarn among the bales we can hope for a less quality variation in the final yarn.

V. Conclusion:

The Ring Spinning is the most widely used form of spinning machine. Due to significant advantages in comparison with the new spinning processes. The ring spinning machine is used in the textile industry to simultaneously twist staple fibres into yarn and then wind it onto bobbins for storage. Though ring spinning can brought about a large variation in yarn undoubtedly it can produce the best quality of yarn in the end.

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