

Reprint

ISSN 1997-2571 (Web Version)

# Journal of Innovation & Development Strategy (JIDS)

*(J. Innov. Dev. Strategy)*

---

Volume: 5

Issue: 2

August 2011

---

*J. Innov. Dev. Strategy 5(2): 1-9 (August 2011)*

**EFFECT OF SPINDLE SPEED AND TWIST VARIATION ON COTTON YARN QUALITY**

M.R. CHOWDHURY



GGF  
Nature is Power

An International Scientific Research Publisher

*Green Global Foundation*®

Publication and Bibliography Division

100 Leeward Glenway

Apartment # 1601

M3c2z1, Toronto, Canada

E-mails: [publication@ggfagro.com](mailto:publication@ggfagro.com), [editor@ggfagro.com](mailto:editor@ggfagro.com)

[http://ggfagro.com/ejournals/current\\_issues](http://ggfagro.com/ejournals/current_issues)



JIDS\*\* issn 1997-2571, HQ:19-10 central place, saskatoon, saskatchewan, s7n 2s2, Canada

**EFFECT OF SPINDLE SPEED AND TWIST VARIATION ON COTTON YARN QUALITY**

M.R. CHOWDHURY

Department of Textile Technology, Ahsanullah University of Science &amp; Technology

Corresponding author &amp; address: Dr. Mohammed Rubaiyat Chowdhury, E-mail: rubaiyat707@yahoo.com

Accepted for publication on 10 July 2011

**ABSTRACT**Chowdhury MR (2011) Effect of spindle speed and twist variation on cotton yarn quality. *J. Innov. Dev. Strategy* 5(2), 1-9.

In this experiment it was observed that with increased spindle speed & TPI, yarn quality attributes like strength, evenness & thick thin places are highly affected. Thin places, strength, C.V.% and hairiness also increase with increasing spindle speed.

**Key words:** HVI, AFIS, IPI**INTRODUCTION**

Spindle Speed is very important for yarn quality of a spinning mill. Production rate and quality are two most important parameters for a spinning mill and these depend on spindle speed of ring frame. Any sort of imperfection in spinning can affect the final product that is in the yarn and can be visible in grey fabric produced from it. So spindle speed in a mill is set very carefully. The only criteria of setting this is by trial and error method. For setting the spindle speed one must consider the optimum speed which is satisfactory for both production rate and quality of the final product. The number of turns about its axis per unit of length observed in a yarn or other textile strand. Generally this is indicated as turns per inch or tpi. It is expressed also as turns per centimeter or meter or by helix angle in a structure of known diameter.  $TPI = \sqrt{\text{count} \cdot TM}$  (Booth 1979). Spindle is the main dependent element on production (Klein 1993) Spindle speed & twist variation plays a vital role on the quality of final product. The experiment was carried to understand the varying effect of Spindle speed & Twist variation over the yarn quality.

**MATERIALS AND METHODS****Raw Material Used**

CIS 50% + SYRIAN 50%

|                    |         |
|--------------------|---------|
| ▶ SCI              | = 132   |
| ▶ UHML(mm)         | = 1.127 |
| ▶ UI%              | = 82.6  |
| ▶ SFI%             | = 7.7   |
| ▶ Avg Mic          | = 4.79  |
| ▶ Maturity Ratio   | = 0.87  |
| ▶ Strength (g/tex) | = 30.5  |
| ▶ Elongation(%)    | = 6.3   |
| ➤ Rd               | = 80.2  |
| ➤ +b               | = 10.7  |
| ➤ Tr cnt           | = 36    |
| ➤ Tr ar            | = 0.30  |
| ➤ NRE%             | = 69.8% |

**Machinery used**

Table 1. Name of the Machineries

| Name of Machine     | Model   | Manufacturer | Country of Origin |
|---------------------|---------|--------------|-------------------|
| Table 1'- Blow Room | BDT-019 | Trutzschler  | India             |
| Carding             | TC-03   | Trutzschler  | India             |
| Pre-comb Drawing    | SB-D15  | Rieter       | Switzerland       |
| Lap Former          | SL-100  | Toyota       | Japan             |
| Comber              | VC-5-A  | Toyota       | Japan             |
| Post-comb Drawing   | RSB-D35 | Rieter       | Switzerland       |
| Simplex             | FL-100  | Toyota       | Japan             |
| Ring Frame          | DTM-129 | Merzoli      | China             |

**Spindle Speed Taken:** Four different spindle speed were selected for the test which are mentioned below -

- 13100
- 14100
- 15100
- 16100

#### **Sample selection**

For the experiment 1 to 10 no spindle cops were taken from ring frame yarn count 30KH for the spindle speed 13100, 14100, 15100, 16100 with respective TPI 23, 24, 24.9 & 24.9

#### **Test method**

##### **AFIS Test:**

At first samples were collected from the bales. Then the sample was put on balance. It provided the sliver length with respect to sample weight. Then a sliver made by hand & provided the required data to AFIS (Uster AFIS Pro, 2001). Then the sample was fed & started testing.

##### **HVI Test:**

Samples were collected from bales. Then the sample was fed to the HVI 3 cabinet gradually. Required setting were provided to the HVI (HVI Tester, 2005). Then started testing gradually.

##### **UT-4 Test:**

10 cops from 1 to 10 spindle for every speed were collected & TPI was changed. Required settings were provided for UT-4 setting (Uster Tester, 2005). Then 10 cops were taken for each spindle speed & TPI. After the test IPI was calculated.

##### **CSP Test:**

The cops were set on the wrap reel machine. Then switched on the machine. After wrapping yarn machine was switched off. Then count was calculated.

After that the wrap yarn was set on the strength tester. Started the machine. This provided the strength of yarn.

#### **RESULTS AND DISCUSSION**

Effect of spindle speed and tpi on yarn quality shown in Table 2 to Table 5 and Where Table 6, Table 7 and Table 8 shows the comparison of yarn quality change with different spindle speed and tpi.

Table 2. UT-4 Report for spindle speed 13100 & TPI=23

| Nr   | U%    | CVm%  | CVml<br>m% | Thin<br>-30%<br>/km | Thin<br>-40%<br>/km | Thin<br>-50%<br>/km | Thick<br>+35%<br>/km | Thic<br>+50%<br>/km | Neps<br>+20%<br>/km | Neps<br>+280%<br>/km | sh   | H    | Rel.<br>cnt<br>±% |
|------|-------|-------|------------|---------------------|---------------------|---------------------|----------------------|---------------------|---------------------|----------------------|------|------|-------------------|
| 1    | 11.66 | 14.87 | 4.72       | 1920                | 130.0               | 5.0                 | 965.0                | 205.0               | 305.0               | 105.0                | 1.37 | 5.85 | -0.9              |
| 2    | 11.41 | 14.49 | 5.16       | 1715                | 115.0               | 10.0                | 820.0                | 125.0               | 270.0               | 75.0                 | 1.26 | 5.66 | 0.4               |
| 3    | 11.82 | 15.7  | 6.19       | 1940                | 145.0               | 5.0                 | 980.0                | 185.0               | 335.0               | 85.0                 | 1.23 | 5.73 | 0.4               |
| 4    | 11.50 | 14.85 | 5.24       | 2025                | 130.0               | 0.0                 | 995.0                | 165.0               | 240.0               | 60.0                 | 1.28 | 5.74 | -0.5              |
| 5    | 11.86 | 15.12 | 5.70       | 1940                | 185.0               | 15.0                | 1005.0               | 205.0               | 260.0               | 60.0                 | 1.41 | 5.98 | 0.4               |
| Mean | 11.64 | 14.87 | 5.40       | 1908                | 141.0               | 7.0                 | 953.0                | 177.0               | 282.0               | 77.0                 | 1.31 | 5.83 | 0.0               |
| CV   | 1.5   | 1.5   | 10.0       | 6.0                 | 19.0                | 81.4                | 8.0                  | 18.9                | 13.4                | 24.6                 | 5.1  | 2.4  | 0.6               |

Table 3. UT-4 Report for spindle speed 14100 &amp; TPI=24

| Nr   | U%    | CVm%  | CVm<br>1m% | Thin<br>-30%<br>/km | Thin<br>-40%<br>/km | Thin<br>-50%<br>/km | Thick<br>+35%<br>/km | Thick<br>+50%/km | Neps<br>+200%<br>/km | Neps<br>+280%<br>/km | sh   | H    | Rel. cnt ±% |
|------|-------|-------|------------|---------------------|---------------------|---------------------|----------------------|------------------|----------------------|----------------------|------|------|-------------|
| 1    | 11.34 | 14.51 | 5.15       | 1570                | 110                 | 0.0                 | 1015                 | 160              | 285                  | 90                   | 1.29 | 5.74 | -0.0        |
| 2    | 11.63 | 14.82 | 4.66       | 2030                | 135                 | 5.0                 | 998                  | 160              | 295                  | 105                  | 1.31 | 5.76 | 0.6         |
| 3    | 12.09 | 15.53 | 5.81       | 1860                | 170                 | 5.0                 | 960                  | 200              | 285                  | 85                   | 1.29 | 5.69 | 0.0         |
| 4    | 11.39 | 14.42 | 5.08       | 1555                | 130                 | 10.0                | 945                  | 185              | 330                  | 105                  | 1.36 | 5.86 | 0.9         |
| 5    | 11.49 | 14.60 | 4.75       | 1710                | 110                 | 0.0                 | 880                  | 180              | 335                  | 90                   | 1.27 | 5.65 | 1.0         |
| 6    | 11.69 | 15.07 | 4.58       | 2190                | 250                 | 0.0                 | 1195                 | 240              | 375                  | 135                  | 1.27 | 5.84 | -1.6        |
| 7    | 12.49 | 15.84 | 5.58       | 2540                | 245                 | 5.0                 | 1290                 | 260              | 315                  | 75                   | 1.32 | 5.45 | 0.5         |
| 8    | 11.61 | 14.88 | 5.25       | 1855                | 125                 | 0.0                 | 1020                 | 220              | 340                  | 95                   | 1.35 | 5.82 | 0.3         |
| 9    | 11.46 | 14.02 | 6.00       | 2126                | 176                 | 0.0                 | 1110                 | 230              | 385                  | 135                  | 1.39 | 5.87 | -0.9        |
| Mean | 11.67 | 14.85 | 5.10       | 1937                | 161                 | 2.8                 | 1046                 | 203              | 372.2                | 101.7                | 1.31 | 5.71 | -0.0        |
| CV   | 3.0   | 3.0   | 8.1        | 16.5                | 33.6                | 12.4                | 12.4                 | 17.5             | 11.1                 | 20.7                 | 3.2  | 2.2  | 0.9         |

Table 4. UT-4 Report for spindle speed 15100 &amp; TPI=24.9

| Nr   | U%    | CVm%  | CVm<br>1m% | Thin<br>-30%<br>/km | Thin<br>-40%<br>/km | Thin<br>-50%<br>/km | Thick<br>+35%<br>/km | Thick<br>+50%<br>/km | Neps<br>+200%<br>/km | Neps<br>+280%<br>/km | sh   | H    | Rel. cnt<br>±% |
|------|-------|-------|------------|---------------------|---------------------|---------------------|----------------------|----------------------|----------------------|----------------------|------|------|----------------|
| 1    | 11.63 | 14.89 | 5.62       | 1895                | 135.0               | 0.0                 | 940.0                | 185.5                | 265.0                | 72.5                 | 1.51 | 6.55 | 0.4            |
| 2    | 11.94 | 15.20 | 6.12       | 1955                | 167.5               | 5.0                 | 922.5                | 182.5                | 342.5                | 100.0                | 1.31 | 6.01 | 0.6            |
| 3    | 11.63 | 14.00 | 6.44       | 1808                | 187.5               | 0.0                 | 995.0                | 237.5                | 415.0                | 120.0                | 1.44 | 6.29 | 0.8            |
| 4    | 11.70 | 14.89 | 5.34       | 1945                | 177.5               | 7.5                 | 942.5                | 150.0                | 270.0                | 70.0                 | 1.50 | 6.19 | -1.5           |
| 5    | 11.69 | 14.90 | 5.23       | 2050                | 190.0               | 10.0                | 1017.5               | 175.0                | 360.0                | 82.5                 | 1.54 | 6.24 | 0.1            |
| 6    | 11.78 | 14.98 | 4.99       | 2010                | 175.0               | 0.0                 | 972.5                | 195.0                | 315.0                | 80.0                 | 1.41 | 5.92 | -0.6           |
| 7    | 12.52 | 15.90 | 5.26       | 2868                | 395.0               | 22.5                | 1257.5               | 270.0                | 285.0                | 55.0                 | 1.33 | 5.74 | -0.6           |
| 8    | 12.70 | 16.24 | 5.56       | 2748                | 325.0               | 5.0                 | 1435.0               | 357.5                | 422.5                | 115.0                | 1.31 | 5.63 | 0.2            |
| 9    | 11.62 | 14.00 | 5.10       | 1005                | 152.5               | 7.5                 | 895.0                | 150.0                | 267.5                | 52.5                 | 1.36 | 5.98 | -0.4           |
| 10   | 11.67 | 14.93 | 5.11       | 1965                | 190.0               | 2.5                 | 1035.0               | 222.5                | 335.0                | 115.0                | 1.37 | 6.08 | 0.9            |
| Mean | 11.89 | 15.16 | 5.38       | 2115                | 209.5               | 6.0                 | 1041                 | 212.5                | 327.8                | 86.3                 | 1.41 | 6.06 | 0.0            |
| CV   | 3.3   | 3.3   | 6.2        | 17.6                | 39.5                | 113.2               | 16.5                 | 29.9                 | 17.8                 | 28.9                 | 6.1  | 4.4  | 0.8            |

Table 5. UT-4 Report for spindle speed 16100 &amp; TPI=24.9

| Nr.  | U%    | CVm % | CVm 1m% | Thin -30% /km | Thin -40% /km | Thin -50% /km | Thick +35% /km | Thick +50% /km | Neps +200% /km | Neps +280% /km | sh   | H    | Rel. cnt ±% |
|------|-------|-------|---------|---------------|---------------|---------------|----------------|----------------|----------------|----------------|------|------|-------------|
| 1    | 11.44 | 14.61 | 5.01    | 1868          | 120.0         | 0.0           | 957.5          | 175.0          | 282.5          | 65.0           | 1.30 | 5.82 | 0.6         |
| 2    | 11.72 | 14.94 | 5.02    | 2073          | 177.5         | 7.5           | 957.5          | 190.0          | 307.5          | 67.0           | 1.29 | 5.79 | -0.7        |
| 3    | 12.77 | 16.32 | 6.45    | 2748          | 340.0         | 2.5           | 1447.5         | 327.5          | 425.0          | 132.5          | 1.27 | 5.39 | -0.5        |
| 4    | 12.24 | 15.54 | 4.67    | 2673          | 277.5         | 17.5          | 1367.5         | 247.5          | 242.5          | 45.5           | 1.32 | 5.75 | 1.1         |
| 5    | 11.37 | 14.50 | 4.17    | 1920          | 210.0         | 5.0           | 967.5          | 155.0          | 277.5          | 65.0           | 1.27 | 5.59 | -0.6        |
| 6    | 11.41 | 14.61 | 5.08    | 1830          | 165.0         | 15.0          | 877.5          | 195.0          | 280.0          | 75.0           | 1.34 | 5.83 | 0.5         |
| 7    | 11.41 | 14.42 | 4.17    | 1953          | 162.5         | 0.0           | 852.5          | 117.5          | 265.0          | 62.5           | 1.33 | 5.82 | -0.0        |
| 8    | 11.83 | 15.19 | 6.07    | 1990          | 155.0         | 7.5           | 950.0          | 230.0          | 377.5          | 125.0          | 1.28 | 5.75 | 0.8         |
| 9    | 11.39 | 14.59 | 5.09    | 1710          | 110.0         | 0.0           | 867.5          | 160.0          | 310.0          | 100.0          | 1.24 | 5.72 | 0.1         |
| 10   | 12.28 | 15.93 | 7.15    | 2215          | 277.5         | 5.0           | 1040.0         | 195.0          | 345.0          | 75.0           | 1.26 | 5.75 | -1.1        |
| Mean | 11.79 | 15.07 | 5.34    | 2098          | 199.5         | 0.0           | 1029           | 199.3          | 311.3          | 81.3           | 1.29 | 5.72 | 0.0         |
| CV   | 4.1   | 4.4   | 17.2    | 167           | 37.9          | 102           | 20.2           | 29.3           | 18.0           | 35.2           | 2.6  | 2.4  | 0.7         |

Table 6. Compare yarn quality which produced by different spindle speed &amp; TPI

| Speed | U%    | CVm%  | CVm<br>1m% | Thin<br>-30%<br>/km | Thin<br>-40%<br>/km | Thin<br>-50%<br>/km | Thick<br>+35%<br>/km | Thick<br>+50%/km | Neps<br>+200%<br>/km | Neps<br>+280%<br>/km | sh   | H    | Rel. cnt<br>±% |
|-------|-------|-------|------------|---------------------|---------------------|---------------------|----------------------|------------------|----------------------|----------------------|------|------|----------------|
| 13100 | 11.64 | 14.87 | 5.40       | 1908                | 141.0               | 7.0                 | 953.0                | 177.0            | 282.0                | 77.0                 | 1.31 | 5.83 | 0.0            |
| 14100 | 11.34 | 14.85 | 5.15       | 1570                | 110                 | 0.0                 | 1015                 | 160              | 285                  | 90                   | 1.29 | 5.74 | -0.0           |
| 15100 | 11.89 | 15.16 | 5.38       | 2115                | 209.5               | 6.0                 | 1041                 | 212.5            | 327.8                | 86.3                 | 1.41 | 6.06 | 0.0            |
| 16100 | 11.79 | 15.07 | 5.34       | 2098                | 199.5               | 0.0                 | 1029                 | 199.3            | 311.3                | 81.3                 | 1.29 | 5.72 | 0.0            |

Table 7. Comparison of CV% with different Spindle Speed

| Speed | U%  | CVm% | CVm<br>1m% | Thin<br>-30%<br>/km | Thin<br>-40%<br>/km | Thin<br>-50%<br>/km | Thick<br>+35%<br>/km | Thick<br>+50%/km | Neps<br>+200%<br>/km | Neps<br>+280%<br>/km | sh  | H   | Rel. cnt<br>±% |
|-------|-----|------|------------|---------------------|---------------------|---------------------|----------------------|------------------|----------------------|----------------------|-----|-----|----------------|
| 13100 | 1.5 | 1.5  | 10.0       | 6.0                 | 19.0                | 81.4                | 8.0                  | 18.9             | 13.4                 | 24.6                 | 5.1 | 2.4 | 0.6            |
| 14100 | 3.0 | 3.0  | 8.1        | 16.5                | 33.6                | 12.4                | 12.4                 | 17.5             | 11.1                 | 20.7                 | 3.2 | 2.2 | 0.9            |
| 15100 | 3.3 | 3.3  | 6.2        | 17.6                | 39.5                | 113.2               | 16.5                 | 29.9             | 17.8                 | 28.9                 | 6.1 | 4.4 | 0.8            |
| 16100 | 4.1 | 4.4  | 17.2       | 167                 | 37.9                | 102                 | 20.2                 | 29.3             | 18.0                 | 35.2                 | 2.6 | 2.4 | 0.7            |

Table 8. Comparison of Yarn Quality with IPI &amp; CSP produced by different Spindle Speed &amp; TPI

| Spindle speed & TPI variation | IPI   | CSP  |
|-------------------------------|-------|------|
| 13100 & 23.00                 | 466.0 | 2297 |
| 14100 & 24.00                 | 533.9 | 2373 |
| 15100 & 24.90                 | 546.9 | 2476 |
| 16100 & 24.90                 | 510.6 | 2421 |

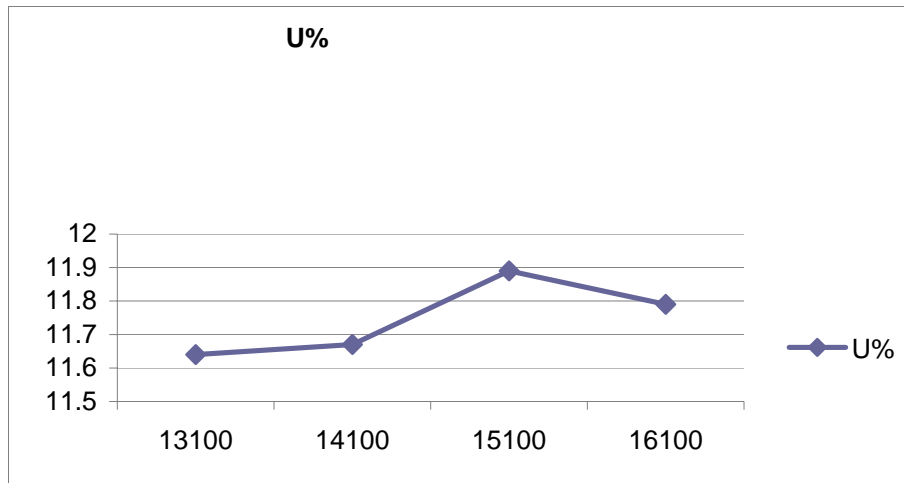


Figure 1. Spindle Speed Vs U%

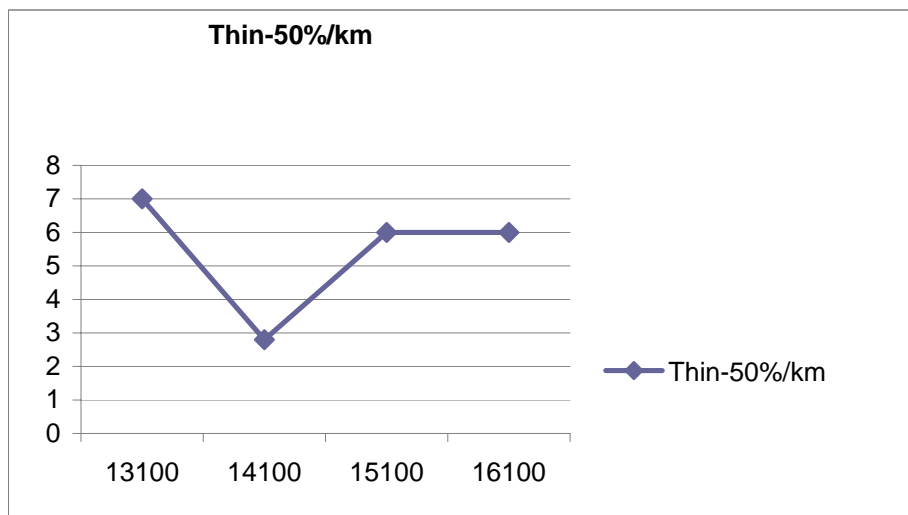


Figure 2. Spindle Speed Vs Thin -50%/km

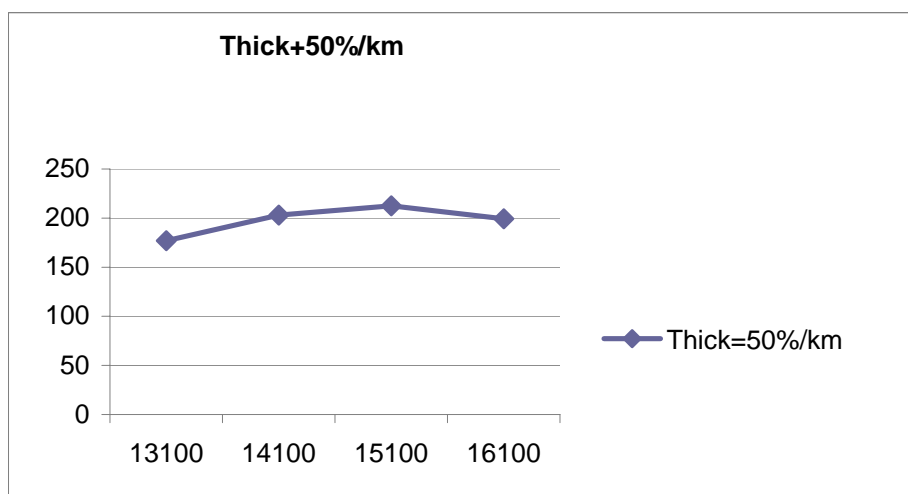


Figure 3. Spindle Speed Vs /Thick +50%/km



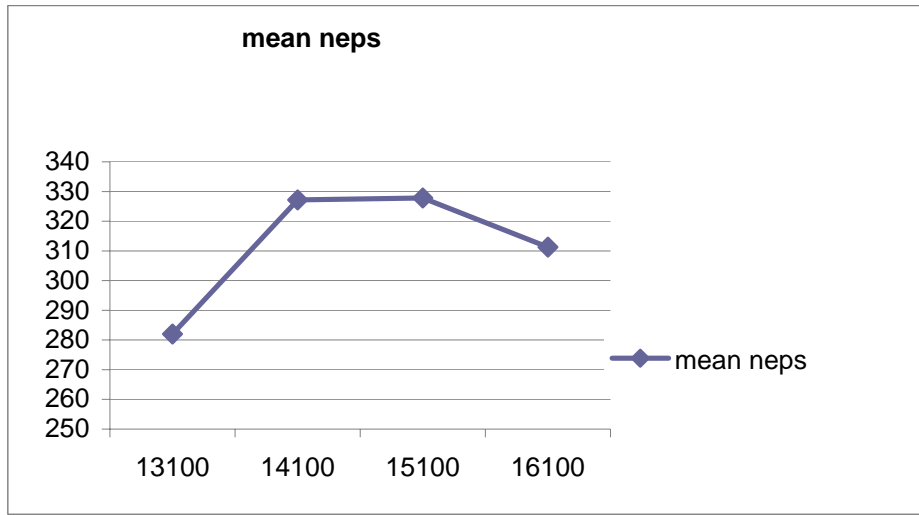


Figure 4. Spindle Speed Vs neps +200

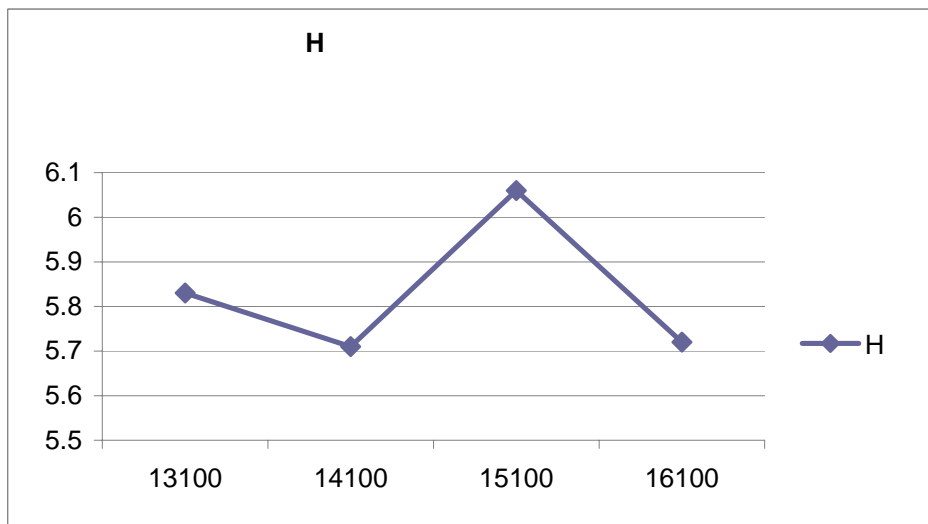


Figure 5. Spindle Speed Vs Hairiness

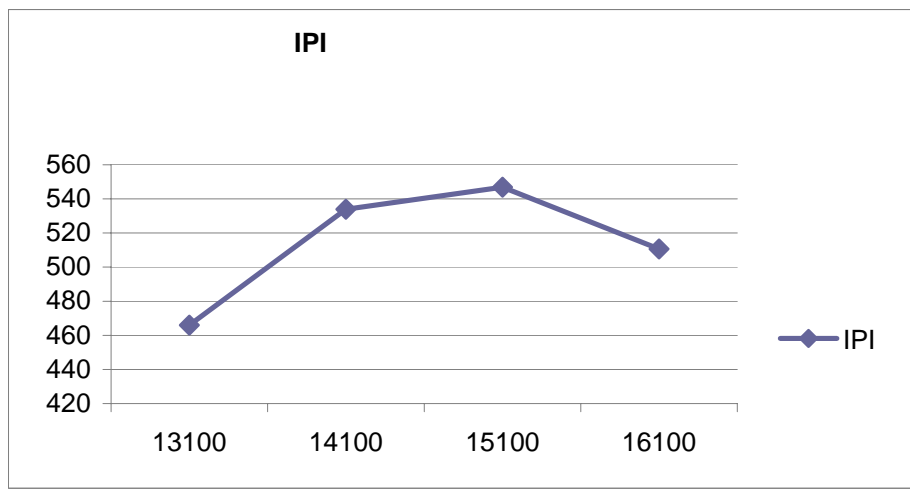


Figure 6. Spindle Speed Vs IPI

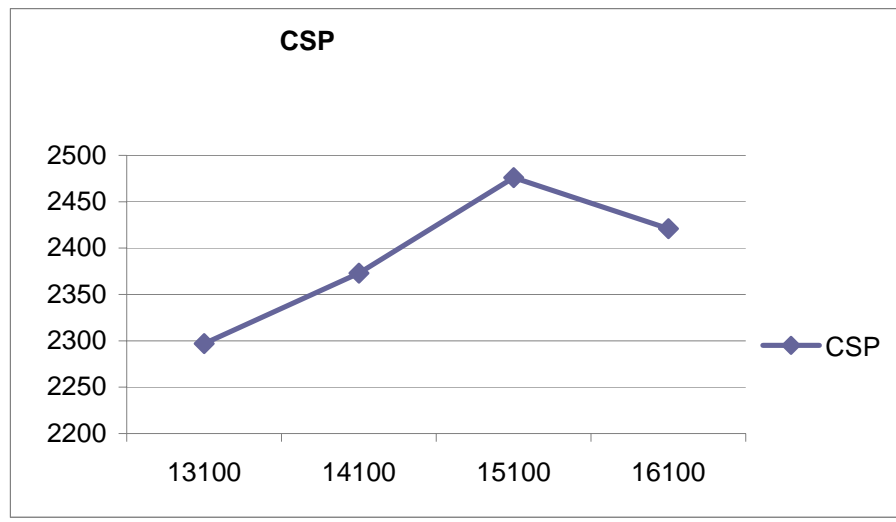


Figure 7. Spindle Speed Vs CSP

### DISCUSSION

It was evident from Table 2 to Table 8 and from figure 1 to figure 7 strength is affected by the spindle speed & TPI variation. With increased spindle speed the strength was reduced but with increased TPI the strength was increased. It was observed that when spindle speed was 16100 with TPI 24.9 the CSP value was less than the spindle speed 15100 with TPI 24.9. Actually yarn strength is affected by the TPI variation. Hairiness was affected also by the TPI variation. It was found that when the TPI was increased the hairiness was reduced. It was observed that the hairiness was less for the spindle speed 14100 & TPI 24. In the experiment it was observed that the U% is less for speed 13100. On the other hand U% is higher for speed 16100. It was evident that IPI value increased with increasing spindle speed & TPI such as IPI value was 466.0 for spindle speed 13100 & TPI 23.00 on the other hand IPI value was 546.9 for spindle speed 15100 & TPI 24.9. So spindle speed lower yarn quality better.

### CONCLUSION

It was found in the experiment that with increased spindle speed & TPI, yarn quality attributes like strength, evenness & thick thin places are highly affected. Thin places, strength, C.V.% and hairiness show a tendency to increase with increased spindle speed.

### REFERENCES

- Booth JE (1979) Principles of Textile Testing p.214-215.
- Klein W (1993) The Textile Institute Manual of Textile Technology- Volume -4 Short Staple Spining 2<sup>nd</sup> Edition, Page – 9-11.
- Manual of HVI Tester (2005)
- Manual of USTER Tester-4 (2003)
- Uster AFIS Pro (2001)