# To Study The Effect Of First Nozzle Pressure On Polyester Yarn Properties In Murata Twin Spinning

S.B.Mhetre, A. L. Gulve.
*D.K.T.E. Society's Textile and Engineering Institute,*
*Ichalkaranji, Maharashtra,India.*

## Abstract

This paper focuses on the assessment of the various properties of yarn prepared with different pressures of first nozzle of Murata Twin Sinner. We produced $2/60^{S}$ polyester yarn with various nozzle pressure combinations of first and Second nozzle by keeping the second nozzle pressure constant at 5 $kg/cm^2$.The combinations are 1.8 $Kg/cm^2$& 5$Kg/cm^2$, 2$kg/cm^2$& 5$kg/cm^2$and 2.2$kg/cm^2$& 5$kg/cm^2$ for first and second nozzle respectivelyat the same time keeping all other machine parameters unchanged. The yarn was prepared from 1 denier polyester fiber with 40 mm length. Then the yarns were twisted on TFO. The effect of first nozzle pressure was assessed by testing the yarn for imperfections, Tenacity and Breaking elongation.

## 1. Introduction

Air jet spinning is one of the new spinning methods which is accepted as most promising technology. Air-jet spinning produce so called fasciated yarn having outside binding fibers wrapped around core of parallel fibers. Murata MTS 881 twin spinner uses concepts[1].The Murata Jet Spinner, the MJS 801, was first exhibited at ATME-International in 1982 and, at present, is the most commercially successful air-jet spinning system.[2, 3]The MJS is provided with two air-jet nozzles which create vortices rotating in opposite directions. The second nozzle N2 is used to apply twist to the fiber bundle coming out of the front roller. This is the so-called 'false twist nozzle', and good yarn cannot be produced by this nozzle alone. The other nozzle N1 is situated between N2 and the front roller. The air in this nozzle rotates in the opposite direction to that in N2. The fiber bundle coming out of the front roller is twisted by N2, however, since the fiber bundle is rotated in the opposite direction by N1, the fiber bundle receives an untwisting action and some of the twist in the fiber bundle between the front roller and N1 is reduced. Because of the reduced twist, some of the fibers are separated from the main fiber bundles, and become wound around the fiber bundle by the force of the N1 nozzle. The fiber strand coming out of N1 is then twisted by N2 [4].

It is can be seen that the yarn formation principle is different from conventional spinning system. The effect of nozzle pressure properties on yarn properties might not be same.Various works have been reported regarding that aspect. The effect of nozzle pressure on yarn strength is noted [5, 6]. Nozzle pressure helpsin reduction of yarn faults such as unevenness %, imperfections and hairiness [7, 8]. Nozzle pressure settings show increase in yarn strength and breaking elongation %.Threesamples of $2/60^S$ count was been manufactured from 100% polyester fiber of 1 denier and 40 mm long at three different nozzle pressure combinations. (N1=1.8 Kg/cm$^2$& $N_2$=5 Kg/cm$^2$, $N_1$= 2 kg/cm$^2$& $N_2$= 5 kg/cm$^2$ and $N_1$= 2.2kg/cm$^2$& $N_2$=5kg/cm$^2$) where $N_1$ is first nozzle pressure and $N_2$ is second nozzle pressure.

## 2. Materials and Methods

In this work $2/60^S$ count was been prepared from 100% polyester fiber of 1 denier and having 40mm length. Thefollowing specifications are used for preparing the yarn is shown in table 1 and table 2.

Table 1: Specifications of polyester fiber.

| Specification | 2.5%SL | 50%SL | U.R. | MIC | Strength | Elongation |
|---|---|---|---|---|---|---|
| Mean | 33.43 | 17.65 | 52.77 | 7.74 | 27.57 | 8.7 |

Table 2: Murata Twin Spinner machine parameters

| Sr. no. | Machine Parameters | Setting |
|---|---|---|
| 1 | Speed | 260 MPM |
| 2 | Total draft ratio | 247 |
| 3 | Mean draft ratio | 35 |
| 4 | Feed ratio | 0.97 |
| 5 | Take up ratio | 0.99 |
| 6 | Transverse angle | 10° |
| 7 | Slub catcher setting | 2mm |

Three samples 100% polyester yarn were prepared on Murata Twin Spinner (MTS) by changing first nozzle pressure $N_1$=1.8 kg/cm$^2$, 2 kg/cm$^2$ and 2.2 kg/cm$^2$by keeping second nozzle pressure at $N_2$=5kg/cm$^2$.

## 2.1 Testing Methods

1)2.5 % SL, 50 % SL, UR, Strength, Elongation of fiber sample are tested on HFT Premier Tester.

2) U%, Thick places/km (+50%), Thin places/km (-50%) and Neps/km (+2005) of the MTS yarn are tested on USTER TESTER 4-SX R1.8.0.

3) Breaking Elongation % and Tenacity (RKM) of MTS yarn tested on Premier Tensomax 7000 V 2.5.

# 3. Results and Discussion

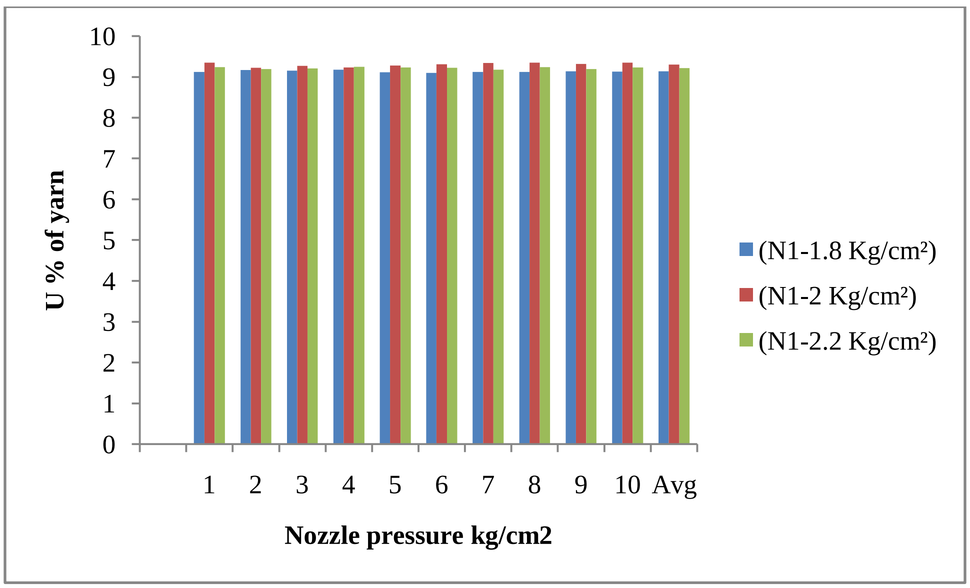
## 3.1 U % of yarn

The yarn properties are subject to variation, e.g. weight per unit length etc., and it is therefore necessary to decide which property will be the most useful one to measure in order to derive a numerical assessment of the irregularity. Most of the properties are related in some way and the specific purpose any one may be studied, but perhaps the most popular approach is to consider the variation in weight per unit length or thickness. Hence, yarn may be studied from this angle.

It is observed from graph 1 and table 3 that as the first nozzle pressure setting $N_1$ changes from 1.8 Kg/cm² to 2 Kg/cm² the evenness (U%) is rise from 9.13 to 9.30, This happen may be due to increasing the nozzle pressure increases the yarn unevenness owing to concentration of mass in very short lengths due to greater incidence of wrapper fibers. But further increase in pressure causes some improvement it is may be due to controlled air current in first nozzle pressure, which helps to bind protruding fiber tightly to yarn core and form compact yarn structure.

**Table 3: U% of yarn.**

| Nozzle Pressure | ($N_1$-1.8 Kg/cm²) | ($N_1$-2 Kg/cm²) | ($N_1$-2.2 Kg/cm²) |
|---|---|---|---|
| 1 | 9.12 | 9.35 | 9.24 |
| 2 | 9.17 | 9.22 | 9.19 |
| 3 | 9.15 | 9.27 | 9.21 |
| 4 | 9.18 | 9.23 | 9.25 |
| 5 | 9.11 | 9.28 | 9.23 |
| 6 | 9.1 | 9.31 | 9.22 |
| 7 | 9.12 | 9.34 | 9.18 |
| 8 | 9.12 | 9.35 | 9.24 |
| 9 | 9.14 | 9.32 | 9.19 |
| 10 | 9.13 | 9.35 | 9.23 |
| **Avg** | **9.13** | **9.30** | **9.22** |



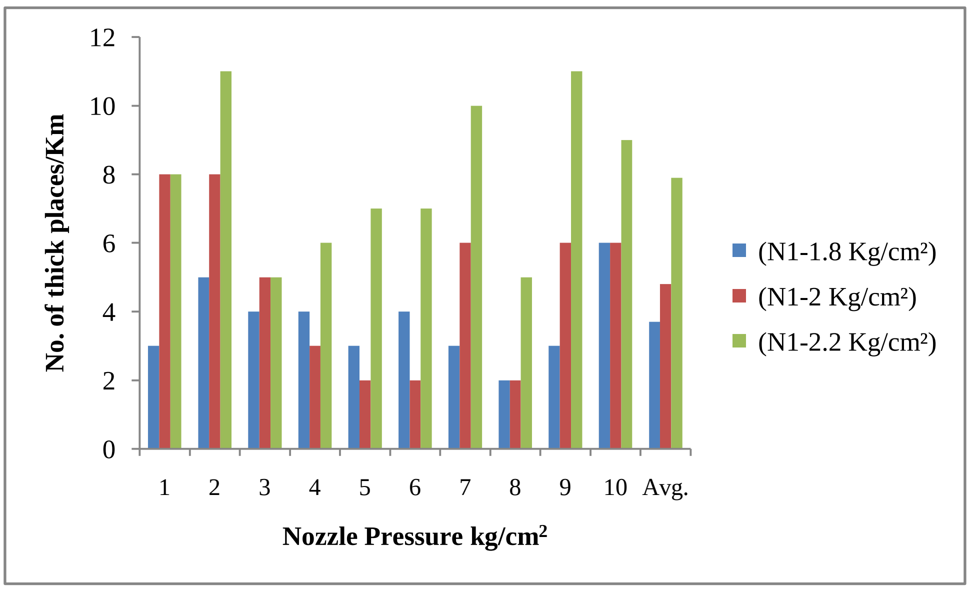

**Graph 1:Effect of nozzle pressure on U% of yarn.**

## 3.2 Thick place

It is observed from graph 2 and table 4 that as the first nozzle pressure increased from 1.8 Kg/cm² to 2 Kg/cm² and 2.2 Kg/cm$^2$ then average number of thick places is also increases gradually, this happen may be due to increasing the nozzle pressure increases the concentration of mass in very short lengths due to greater incidence of wrapper fibers.

**Table 4: Thick places in yarn**

| Nozzle Pressure | ($N_1$-1.8 Kg/cm²) | ($N_1$-2 Kg/cm²) | ($N_1$-2.2 Kg/cm²) |
|---|---|---|---|
| 1 | 3 | 8 | 8 |
| 2 | 5 | 8 | 11 |
| 3 | 4 | 5 | 5 |
| 4 | 4 | 3 | 6 |
| 5 | 3 | 2 | 7 |
| 6 | 4 | 2 | 7 |
| 7 | 3 | 6 | 10 |
| 8 | 2 | 2 | 5 |
| 9 | 3 | 6 | 11 |
| 10 | 6 | 6 | 9 |
| **Avg.** | **3.7** | **4.8** | **7.9** |



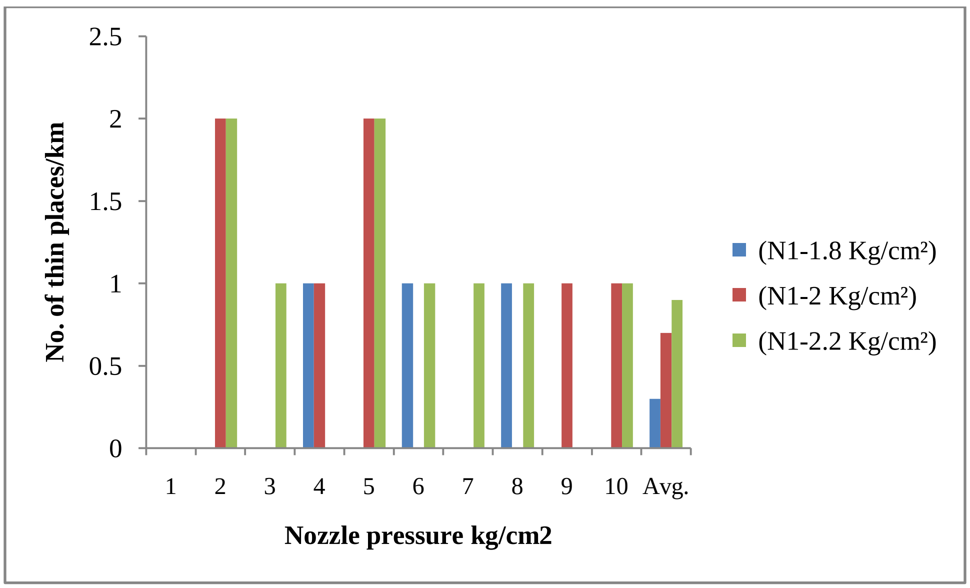

**Graph 2:Effect of nozzle pressure on number of thick places in yarn.**

## 3.3 Thin places

It is observed from graph 3 and table 5 that there is increase in number of thin places from 0.3 to 0.7 and 0.9 respectively, as the first nozzle pressure changes from 1.8 kg/cm$^2$ to 2.2 kg/cm$^2$.This may be due to change in nozzle pressure cause change in the force which makes the yarn rotate, and the wrapping effect will change cause random distribution of fibers along the length of yarn.

**Table 5:Thin places in Yarn**

| Nozzle Pressure | ($N_1$-1.8 Kg/cm²) | ($N_1$-2 Kg/cm²) | ($N_1$-2.2 Kg/cm²) |
|---|---|---|---|
| 1 | 0 | 0 | 0 |
| 2 | 0 | 2 | 2 |
| 3 | 0 | 0 | 1 |
| 4 | 1 | 1 | 0 |
| 5 | 0 | 2 | 2 |
| 6 | 1 | 0 | 1 |
| 7 | 0 | 0 | 1 |
| 8 | 1 | 0 | 1 |
| 9 | 0 | 1 | 0 |
| 10 | 0 | 1 | 1 |
| Avg. | 0.3 | 0.7 | 0.9 |



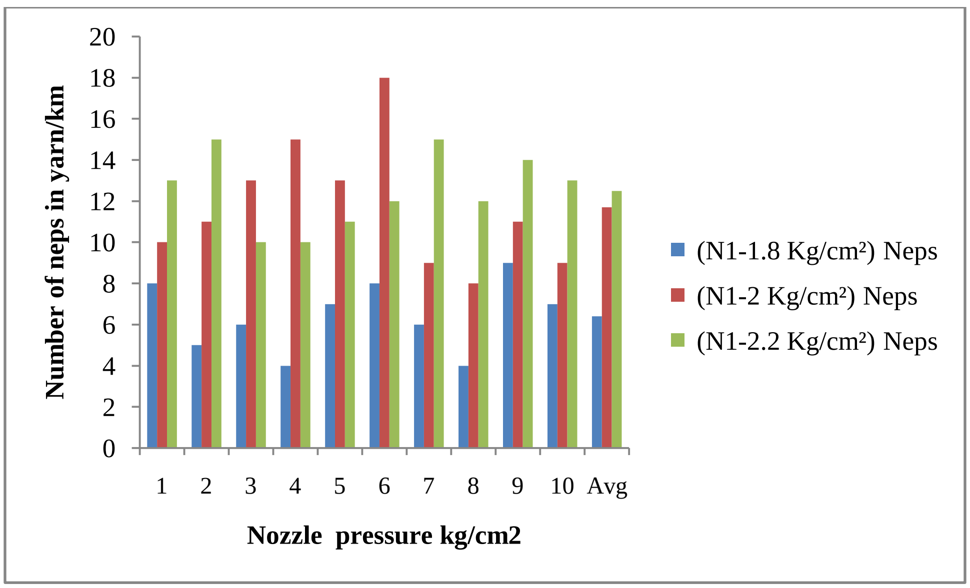

**Graph 3: Effect of nozzle pressure on number of thin places in yarn.**

## 3.4 Neps

It is observed from graph 4 and table 6 that as the first nozzle pressure increased from 1.8 Kg/cm² to 2 Kg/cm², 2.2 Kg/cm² the number of neps increases from 6.4 to 11.7 and 12.5 respectively, this may be due to increasing the nozzle pressure increases the concentration of mass in very short lengths due to greater incidence of wrapper fibers.

**Table 6:Neps in yarn**

| Nozzle Pressure | ($N_1$-1.8 Kg/cm²) | ($N_1$-2 Kg/cm²) | ($N_1$-2.2 Kg/cm²) |
|---|---|---|---|
| 1 | 8 | 10 | 13 |
| 2 | 5 | 11 | 15 |
| 3 | 6 | 13 | 10 |
| 4 | 4 | 15 | 10 |
| 5 | 7 | 13 | 11 |
| 6 | 8 | 18 | 12 |
| 7 | 6 | 9 | 15 |
| 8 | 4 | 8 | 12 |
| 9 | 9 | 11 | 14 |
| 10 | 7 | 9 | 13 |
| **Avg.** | **6.4** | **11.7** | **12.5** |




**Graph 4:Effect of nozzle pressure on number of neps in yarn.**

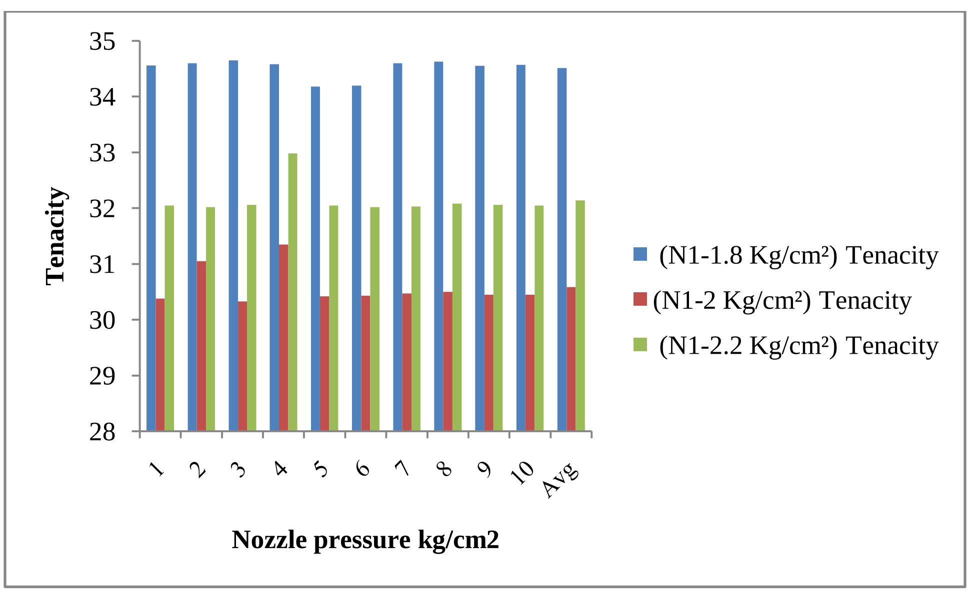
## 3.5 Tenacity

As used in yarn manufacture and textile engineering, tenacity denotes the strength of a yarn or a filament of given size. Numerically it the breaking force in grams per denier unit of yarn or filament size (grams per denier, gpd).

It is observed from graph 5 and table 7 that Yarn tenacity increases form 30.58gpd to 32.14gpdas the first nozzle pressure $N_1$ changes from2 Kg/cm² to 2.2 Kg/cm² this is happen may be because of increase in first nozzle pressure help to increase in number of wrapper fibers per unit length in the yarn core. But the yarn tenacity also increases in first nozzle pressure $N_1$ (2 Kg/cm² to 1.8 Kg/cm²) form 30.58 to 34.51,further increase in first nozzle pressure decrease in yarn strength this may be due to more fibers to be detached from the main strand.

**Table 7:Yarn tenacity**

| Nozzle Pressure | ($N_1$-1.8 Kg/cm²) | ($N_1$-2 Kg/cm²) | ($N_1$-2.2 Kg/cm²) |
|---|---|---|---|
| 1 | 34.56 | 30.38 | 32.05 |
| 2 | 34.6 | 31.05 | 32.02 |
| 3 | 34.65 | 30.33 | 32.06 |
| 4 | 34.58 | 31.35 | 32.98 |
| 5 | 34.18 | 30.42 | 32.05 |
| 6 | 34.2 | 30.43 | 32.02 |
| 7 | 34.6 | 30.47 | 32.03 |
| 8 | 34.63 | 30.5 | 32.08 |
| 9 | 34.55 | 30.45 | 32.06 |
| 10 | 34.57 | 30.45 | 32.05 |
| **Avg.** | **34.51** | **30.58** | **32.14** |




**Graph 5:Effect of nozzle pressure on tenacity of yarn.**

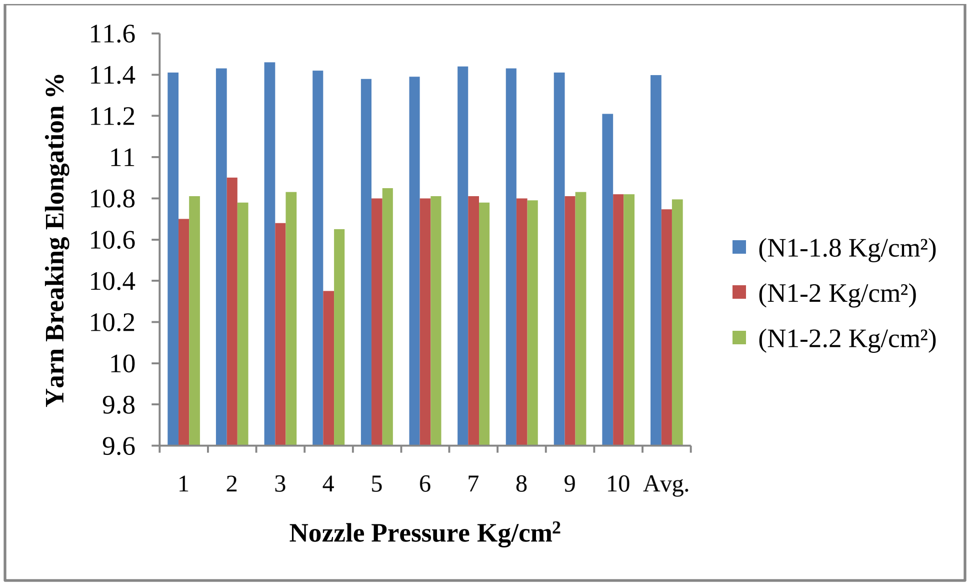
### 3.6 Breaking Elongation (%)

The breaking elongation of the air jet spun yarn depends not only on the yarn breaking load and the fiber modulus, but also on the proportion of fibers that slip or break. If all the core fibers in the yarn were to break without slipping, then the breaking elongation of the yarn will depend on the breaking load and the fiber elastic properties.

It is observed from graph 6 and table 8 that the Breaking elongation % is decreases from 11.40% to 10.75% as first nozzle pressure $N_1$ setting (1.8 Kg/cm² to 2 Kg/cm²) this may be due do randomly distribution of wrapper fibers along the length of yarn . But the Breaking elongation % also increases from 10.75% to 10.80% as the first nozzle pressure $N_1$ changes from 2 Kg/cm² to 2.2 Kg/cm² this may be due to further increase in pressure cause compactly distribution of fibers along the length of yarn.

**Table 8:Breaking Elongation of yarn**

| Nozzle Pressure | ($N_1$-1.8 Kg/cm²) | ($N_1$-2 Kg/cm²) | ($N_1$-2.2 Kg/cm²) |
|---|---|---|---|
| 1 | 11.41 | 10.7 | 10.81 |
| 2 | 11.43 | 10.9 | 10.78 |
| 3 | 11.46 | 10.68 | 10.83 |
| 4 | 11.42 | 10.35 | 10.65 |
| 5 | 11.38 | 10.8 | 10.85 |
| 6 | 11.39 | 10.8 | 10.81 |
| 7 | 11.44 | 10.81 | 10.78 |
| 8 | 11.43 | 10.8 | 10.79 |
| 9 | 11.41 | 10.81 | 10.83 |
| 10 | 11.21 | 10.82 | 10.82 |
| **Avg.** | **11.40** | **10.75** | **10.80** |




**Graph 6:Effect of nozzle pressure on Breaking Elongation of yarn.**

## 4. Conclusion

In this study the effect of first nozzle pressure on the properties of yarn is been discussed. Here it is found that at 1.8 kg/cm$^2$nozzle pressure yarn gives better U%.Yarn shows least thick, thin places and neps at same pressure. Yarn shows high tenacity of 34.51 gpdand breaking elongation of 11.40 % at 1.8 kg/cm$^2$. So it can be conclude that polyester yarn gives best results at nozzle pressure combination of nozzle ($N_1$ and $N_2$)1.8 kg/cm$^2$ and 5 kg/cm$^2$.

## 5. References

1. T. Nakahara. Air-jet Spinning Technology. Text. Tech. Int., 1988, 73-74.
2. Air jet spinning machine. US Patent No. US 7,628,005 B2, Dec 8, 2009.
3. H.W. Krause. "Staple fiber spinning systems." Text. Inst. 1985, 76, 3, 185-195.
4. Dr.Basu, A. 'progress in air-jet spinning', Textile Progress, 29:3 1999, 1 – 38.
5. Y.C. Zeng, K.F. Wang and C.W. Yu. Predicting the Tensile Properties of Air-Jet Spun Yarns. Textile Research Journal 2004; 74; 689-694.
6. Y.C. Zeng and C.W. Yu.Numerical Simulation of Fiber Motion in the Nozzle of an Air-Jet Spinning Machine. Textile Research Journal 2004; 74; 117-122.
7. A. Lawrence and M.A. Baqui, Effects of machine variable on the structure and properties of Air-jet fasciated yarns, Textile Research Journal 61(3), March, 1991, P123-130.
8. R. S. Rengasamy, V. K. Kothari, and A. Patnaik1 and H. Punekar2 Airflow simulation in nozzle for hairiness reduction of ring spun yarns. Part I JOTI 2006 Vol. 97 No. 1 89-196.