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*Short communication*

# STUDY ON REDUCTION OF AIR CONSUMPTION FOR AIR JET LOOM

M.M. ISLAM[1*] AND A.M.A. HANIFA[2]

[1]Lecturer, Department of Textile Engineering, Southeast University, Bangladesh; [2]Student of Textile Engineering Department, Southeast University, Bangladesh.

*Corresponding author & address: Md. Mahamudul Islam, E-mail: mahamudul.islam1234@gmail.com

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**ABSTRACT**

Islam MM, Hanifa AMA (2013) Study on reduction of air consumption for air jet loom. *Ins. Engg. Tech.* 3(1), 13-18.

It is well known, high energy cost is the main shortcoming of air-jet weaving loom compared to other shuttle-less loom (e.g. projectile and rapier). This makes air-jet looms less popular in Textile industries in countries like Bangladesh that suffers from very high energy costs and unavailability of power supply, in spite of their higher production speeds. Air-jet weaving loom manufacturers have continuously been working on the reduction of air consumption in their new designs to overcome this shortcoming. However, weaving mill practices are as important as machine designs on air consumption. In this study, therefore, our aim is to investigate the possibilities to reduce air consumption on current air-jet weaving looms without changing machine design and without making a new investment in a weaving mill. A decrease of air consumption by 11 cfm was accomplished in a weaving mill by just decreasing the air pressure. Thus, a company having 96 looms could save 75, 15,648 Taka/ year of 350 days/96 loom in electricity costs with almost no expense. The study also has born four different techniques for reduction of air consumption on air jet loom. This paper explains the experimental work conducted in the weaving mill to minimize air consumption on air-jet looms.

***Key words**: main valve pressure, relay nozzle left, relay nozzle right, pick start, pick arrival expected*

## INTRODUCTION

In air jet weaving machines weft is accelerated and taken through the shed by the flow impedance between the flowing air and the weft. Air jet weaving machines belong to the set of intermittent-operation of loom (Adanur and Mohamed, 1994). The energy resulting from air pressure directed from the central air tank to the loom changes into kinetic energy in the nozzle, which accelerates and delivers the weft in the air channels differently shaped by loom types. The air leaving the nozzle mixes with the still air, it disperses and the speed of the axis of the flow drops quickly as it moves away from the nozzle (Adanur and Mohamed, 1999). Different systems have mainly been used to reduce air consumption on commercial air jet loom:

- Air pressure
- Main Valve drive time & Relay Valve drive time
- Pick insertion & pick arrival time
- Multiple nozzles with guides
- Multiple (relay) nozzles with tunnel reed

By maintaining the air pressure of the air jet loom along the main valve & relay valve drive time low air will be consumed without hampering product quality (Adanur and Mohamed, 1995).

## EXPERIMENTAL DETAILS

### *Action plan*

- Selection of machines working with same fabric construction.
- Study of air consumption on selected machines.
- Factors responsible for variation in air consumption.
- Air leakages and its effect on air consumption.

### *Check points*

### *Check points of compressor & loom surroundings:-*

a) Air leakages in the pipe
b) Bends in pipe
c) Compressor to loom distance
d) Worker practices
e) Vibration of machines

### *Loom settings check points:-*

1) Shedding
   (i) Shedding height
   (ii) Shed angle
2) Picking
   i. Nozzle settings
   ii. Opening & closing time
   iii. Distance between the nozzles
   iv. Number of nozzles
   v. Weft insertion rate

3) Timing

i. Opening & closing time of main nozzle
ii. Opening & closing time Tandem nozzle
iii. Opening & closing time Relay
iv. Opening & closing time Stretch nozzle

***Loom maintenance check points:-***

a) Condition of gears, belts, oiling and greasing
b) Condition of spares i.e. heald frames, reeds etc.
c) Machine and area cleaning

**Experiment**

***Detail information about loom***

| | | |
|---|---|---|
| Loom Model No. | : | Picanol *OMNI*plus 800 |
| Loom Type | : | Tappet |
| Loom maximum speed (RPM) | : | 1000 |
| Loom running speed i.e. using speed (RPM) | : | 800 |
| Loom efficiency | : | 80% |
| Running Fabric Construction | : | (7+10+12)*12L-70D/71*49 |
| Fabric Type | : | Twill (3/1) |

***Measurement by changing the pressure keeping Loom settings constant:***

| SL. No. | MVP (bar) | RNL (bar) | RNR (bar) | PS | PA exp | Air using (cfm) |
|---|---|---|---|---|---|---|
| 1. | 6.0 | 4.5 | 5.0 | 75 | 250 | 68 |
| 2. | 6.0 | 5.5 | 6.0 | | | 76 |
| 3. | 6.5 | 5.0 | 5.5 | | | 73 |
| 4. | 4.5 | 4.0 | 5.3 | | | 66 |
| 5. | 5.0 | 4.0 | 5.0 | | | 65 |

***Measurement by Changing the PS & PA exp keeping the pressure constant:***

| SL. No. | MVP (bar) | RNL (bar) | RNR (bar) | PS | PA exp | Air using (cfm) |
|---|---|---|---|---|---|---|
| 1. | 6.0 | 5.3 | 6.5 | 75 | 250 | 79 |
| 2. | | | | 65 | 230 | 77 |
| 3. | | | | 85 | 270 | 77.5 |

***Measurement by Changing the MV drive & RV drive duration keeping the pressure constant:***

| SL. No. | MVP (bar) | RNL (bar) | RNR (bar) | MV Drive time | RV Drive time | Air using (cfm) |
|---|---|---|---|---|---|---|
| 1. | 6.0 | 5.5 | 6.2 | 105 | 96 | 78.4 |
| 2. | | | | 130 | 120 | 83.9 |
| 3. | | | | 90 | 93 | 75.3 |

***Measurement by changing the weft yarn count keeping the pressure constant:***

| SL. No. | Yarn count | MVP | RNL | RNR | PS | PA exp | Air using (cfm) |
|---|---|---|---|---|---|---|---|
| 1. | 7 Ne OE | 6.0 | 5.5 | 6.0 | 75 | 250 | 76.5 |
| 2. | 9 Ne OE | | | | | | 73.5 |
| 3. | 10 Ne OE | | | | | | 73.4 |
| 4. | 12 Ne OE | | | | | | 73. |
| 5. | 12L-70D | | | | | | 74.5 |
| 6. | 10L-40D | | | | | | 72.9 |

## RESULTS AND DISCUSSION

### *Morphological study*

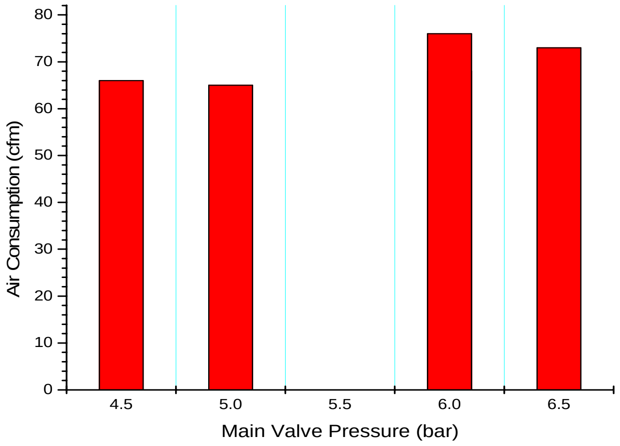


Fig. 1. Main Valve pressure vs. air consumption

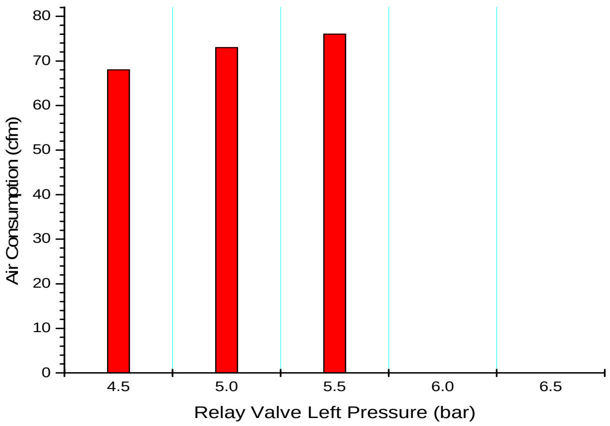


Fig. 2. Relay Valve Left pressure vs. air consumption

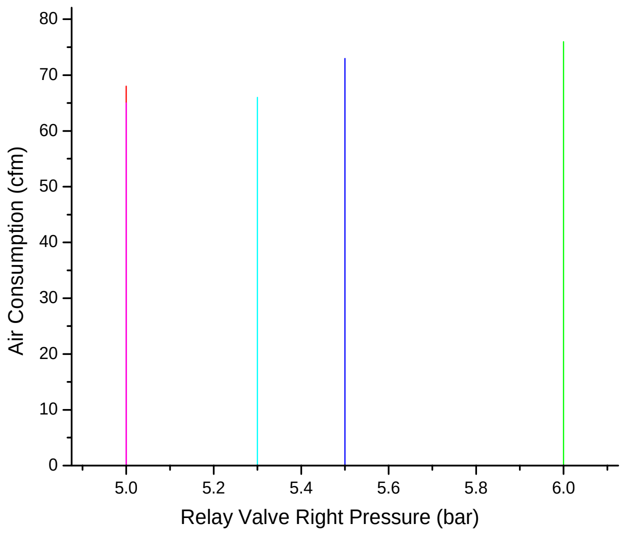


Fig. 3. Relay Valve Right pressure vs. air consumption

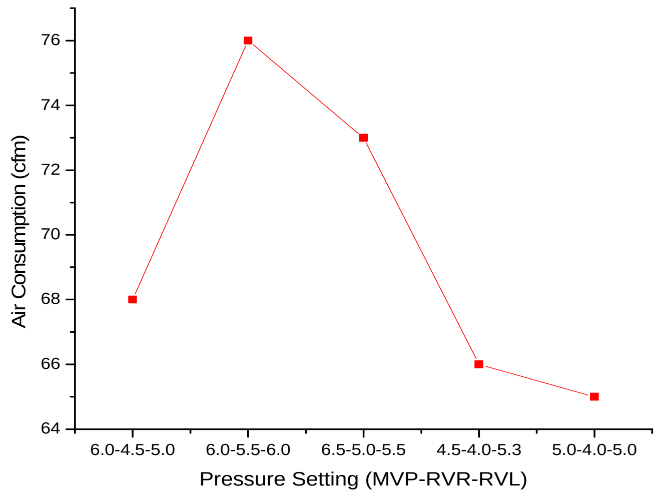


Fig. 4. MV-RVL-RVR pressure settings vs. Air consumption

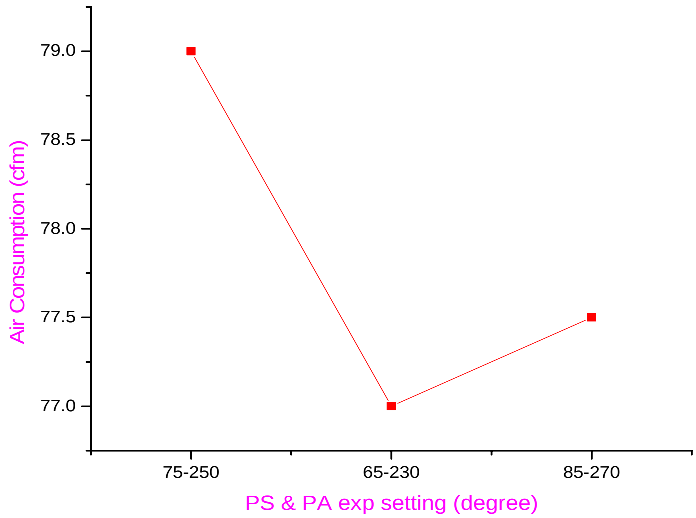


Fig. 5. PS & PA exp time vs. Air consumption

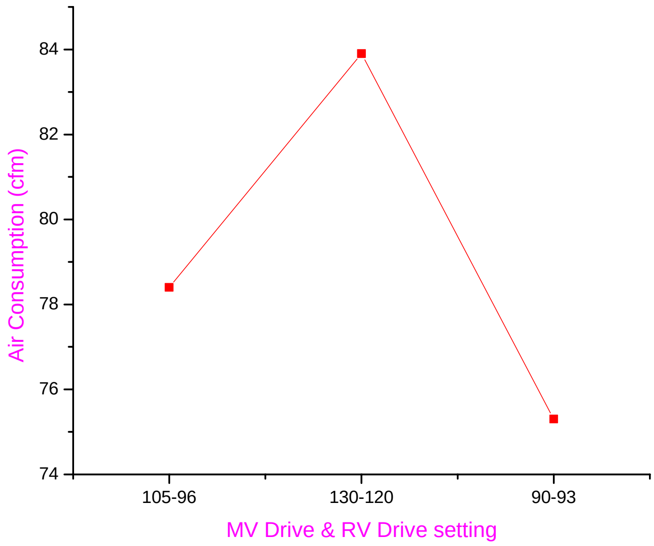


Fig. 6. Main Valve Drive & Relay Valve Drive time vs. Air consumption

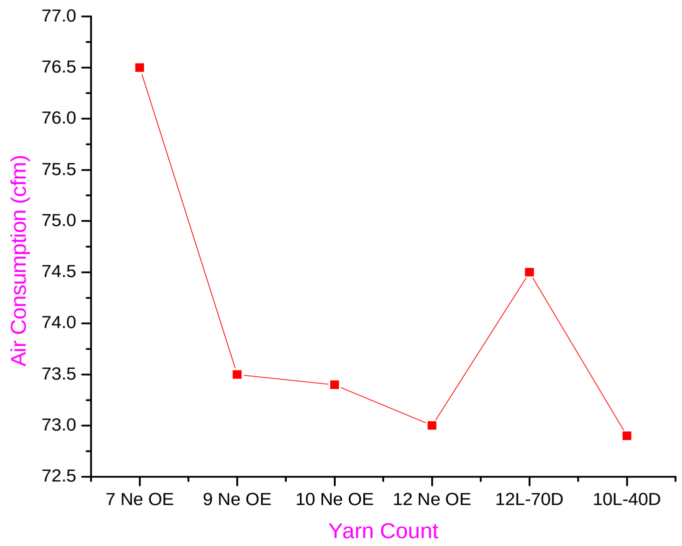


Fig. 7. Yarn count vs. Air consumption

***Data analysis: From figure 1 to 7***

- Air consumed at high pressure: 76 cfm
- Air consumed at low pressure: 65 cfm
- Air consumed at high PS & PA exp (75-250): 79 cfm
- Air consumed at low PS & PA exp (65-230): 77 cfm
- Air consumed at high pressure & high MV Drive & RV Drive timing (130-120): 83.9 cfm
- Air consumed at high pressure & high MV Drive & RV Drive timing (90-93): 75.3 cfm
- Air consumed for low count yarn: 76.5 cfm
- Air consumed for high count yarn: 73 cfm

**Cost effectiveness:**

***Amount of air saved:***

1. When pressure is changed i.e. low pressure then compressed air saved 11cfm.
2. When PS & PA exp is changed i.e. lower settings then compressed air saved 2cfm.
3. When MV Drive & RV Drive timing is changed i.e. lower settings then compressed air saved 8.6cfm.
4. When high count yarn is used then compressed air saved 3.5 cfm

***Cost savings:***

***Compressor capacity calculation:***

Ingersoll-Rand (Model: IRN 132KOF) compressor capacity = 1440$m^3$/hr i.e. 851.06 cfm
Ingersoll-Rand (Model: IRN 132KOF) compressor power consumed: 130kW/hr

So, 130 kW/hr of power produces compressed air of 851.06 cfm
Therefore, 1 kW/hr of power produces compressed air of (851.06 ÷ 130) cfm = 6.55 cfm

***Cost savings calculation:***

- 1 kW/hr or 1 Unit of power produces 6.55 cfm of compressed air
- Power cost per unit is 5.55Taka
- Ha Meem Denim Have 96 Air Jet loom (Picanol OMNIplus 800)

When pressure is changed i.e. low pressure then compressed air saved **11cfm.**

To produce 6.55 cfm of compressed air cost is 5.55 Taka
So, to produce 11 cfm of compressed air cost is (5.55*11 ÷ 6.55) Taka = **9.32 Taka/hr/loom**

Therefore, cost savings 9.32 Taka/hr/loom
Or, 9.32*24Taka/day/loom
= 223.68 Taka/day/loom
Or, 223.68*350 Taka/year of 350 days/loom
= 78,288 Taka/year of 350days/loom
Or, 78288*96 Taka/ year of 350 days/96 loom
**= 75, 15,648 Taka/ year of 350 days/96 loom**

When PS & PA exp is changed i.e. lower settings then compressed air saved **2cfm.**

Similar calculation to no. 1 we can get,

By lower settings of PS & PA exp cost saved 5.55*2 ÷ 6.55 = **1.69 Taka/hr/loom**

Therefore, cost saved per year of 350 days is 14,196 Taka/loom
Or, 14,196*96 Taka/ year of 350 days/96 loom
= **13, 62, 816 Taka/ year of 350 days/96 loom**

When MV Drive & RV Drive timing is changed i.e. lower settings then compressed air saved **8.6cfm.**

Similar calculation to no. 1 we can get,

By lower settings of MV Drive & RV Drive timing,
Cost saved 5.55*8.6 ÷ 6.55 = **7.29 Taka/hr/loom**

Therefore, cost saved per year of 350 days is 61,236 Taka/loom
Or, 61, 236*96 Taka/ year of 350 days/96 loom
= **58, 78, 656 Taka/ year of 350 days/96 loom**

When high count yarn is used then compressed air saved **3.5 cfm**

Similar calculation to no. 1 we can get,

By using high count yarn cost saved 5.55*3.5 ÷ 6.55 = **2.96 Taka/hr/loom**

Therefore, cost saved per year of 350 days is 24,864 Taka/loom
Or, 24,864*96 Taka/ year of 350 days/96 loom
= **23, 86, 944 Taka/ year of 350 days/96 loom**

## CONCLUSION

Power cost is the major cost which directly related to production cost. By saving consumed air on air jet loom (study based on picanol *OMNI*plus 800 air jet loom) power consumption may easily be reduced. Using minimum air pressure we can save maximum amount of compressed air. Due to pressure setting on air jet loom energy can be saved thus production cost will be reduced without hampering product quality. On the other hand, we can also save compressed air by setting change in main valve drive time & relay valve drive time and also by setting change on pick insertion & pick arrival time setting. From the above study it is clear that, the higher the count of yarn the lower the air consumption and vise versa. The study has born four different techniques for the reduction of air consumption on air jet loom in different amounts. So, the study gives us four different techniques to reduce air consumption as well as reduction in production cost.

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