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Modification of weaving process by integrated sizing-weaving loom

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Abstract
Typical weaving system has been introduced a number of difficulties of fabric manufacturing. Some faults such as hard sizing, light sizing, excessive warp strain, warp crossing etc. is occurred by typical sizing which could not be identified before weaving. If the sizing process is carried out on loom, sizing parameters would be adjustable according to demand. A miniature sizing unit was integrated with an ordinary power loom. The miniature sizing box was made of wood which consist of electric heater. A hot air dryer was used to dry the warp yarn after sizing. A conventional loom was used to weave the fabric of $\frac{40's \times 40's}{108\times44} \times 10"$ specification with PPM (Picks Per Minute) near to 160. Satisfactory weaving efficiency (about 90%) was achieved for weaving with proposed integrated sizing-weaving loom. Here warp yarn entered in weaving zone just after sizing, thus ends breakage rate would be reduced. This study also proposed a new weaving process which abolish sizing machine from typical weaving flow chart.

Keywords: Sizing, Tensile strength, Weaving, Loom, Weavers beam etc.

1. Introduction
It is good news for Bangladesh that the textile industry have a stable position on knit sector in the world market. It is predictable that knit sector will bloom in large scale for country within near future. This success may be possible due to its lower initial invest and no back process complexity. Small entrepreneur capable to run a small project with a few number of machine and a narrow floor space using a lower amount of power supply. This is known that, many Bangladeshi entrepreneur already established large weaving project, but due to lack of power supply (electricity and gases) it has not able to run successfully. At present country already suffering for gas and electricity crisis [1]. In modern weaving industry to support a sizing machine at least 150 looms is required which causes huge amount of electricity consumption. Some industrial area in India, many investor have lost their least profit and business due to shortage of power supply [2].
Weaving process has been introduced chronological development from its beginning [3]. A lot of research works was completed on elimination of sizing process. Most of the attempts was use of high qualified warp (high strength, U% etc.) and modification on shedding system [4, 5]. But none of them successfully run being today. Sizing is a very complex process and difficult to maintain accuracy. A lot of parameters affecting the sizing performance of warp yarn during weaving [6]. If improper and uneven sizing is applied on yarn, they are considered as wastage which is not recoverable [7]. It is possible to minimize the typical sizing complexity, by individual machine parameter setting system. Sizing parameter can be change according to fabric quality demand, which is not possible by weaving as well as typical sizing process. This property may be facilitating the production of diversifying product. Online quality control cannot be possible by typical weaving system. If any fault is occurs in the production process, it is require terminating the whole system. But in integrated sizing-weaving system, individual machine may be responsible for individual problem, remaining are unaffected. Modification of weaving process by on-loom sizing is an assembly, where the sizing is carried out just before weaving. It means that one miniature sizing unit for one loom. It will be possible for a small entrepreneur to establish a small weaving plant with a few numbers of integrated sizing-weaving looms.

They occupy a small floor space and consume a lowest amount of power supply which can be getting easily from REB Line. So integrated sizing- weaving loom will be a highly prospective system in our country perspective.

2. Materials & Method

2.1 Materials

2.1.1 Raw material

2.1.1.1 Yarn

Woven fabric is an interlacement of warp yarn and weft yarn [8]. Here 40's count combed yarn with 25 TPI & 143 IPI (Imperfection Index) were used as warp. For weft 40's count combed yarn with 23 TPI & 127 IPI (Imperfection Index) were used.

2.1.1.2 Size chemicals

Different types of size ingredients were used in sizing process. Excellency of sizing work depends on selection of size ingredients. In this project modified starch (Tapioca), Paraffin wax Tallow & binder is used as size ingredients. The details size recipe is shown in Table 2.1.

Table 2.1: Typical used sizing recipe.

SL. NO.	Name of ingredients	Amount in gm/lit.
01	Starch	50.00
02	Paraffin wax	3.00
03	Dalda (tallow)	4.00
04	Binder	4.00

2.2 Equipment introduced

2.2.1 Size box

A wooden size box (Figure 2.1) was made to perform sizing on loom. It is 24 inch long, 13 inch lower width, 20 inch tapper width and 7 inch depth. Two squeezing roller and one immersion roller were attached in size box with diameter 2 and 1.25 inch respectively. This miniature size box contain mixed size chemical after size cooking. In order to apply heat continuously an electric heater was installed in the size box.

2.2.2 Temperature regulator

A temperature regulator was used to control size bath temperature so that size viscosity could not be increased. It consist a thermostat sensor of 0-110^{0}c capacity. It has two input pin & one output pin. It can regulate temperature automatically by controlling the electric heater.

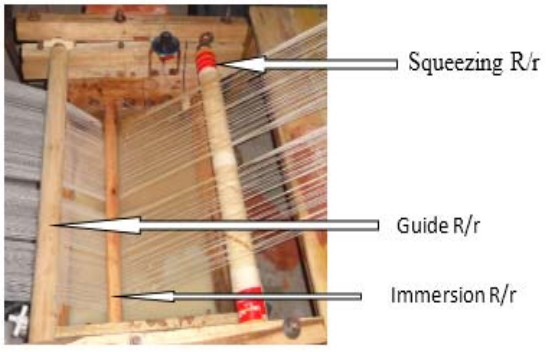

Fig 2.1: New developed wooden size box.

2.2.3 Hot air dryer:

A leaf heater was used in hot air dryer to generate heat. When it was start, it's metallic plates would be heated as well as the movable fan generate hot air and flow it for drying sized warp.

Fig 2.2: New Developed hot air dryer

2.3 Experimental method

A weavers beam was prepared by sectional warping and without sizing drawing and denting of warp was performed. The let-off device of an ordinary power loom i.e. weavers beam holder was repositioned about 4 feet back and an un-sized weavers beam was attached on it. A miniature size box was adjust with loom. Warp yarn entered into the size bath and after immersion it would be squeezed and dry. Actually the warp sizing was completely done here. The loom run at 150 rpm/ PPM (picks per minutes) with 42 PPI (Picks per inch) and fabric width only 10" for lab experiment. After weaving loom efficiency and fabric quality was observed.

2.3.3 Size mixing and cooking procedure:

The size solution was prepared in DUET lab by manually shown in Figure 2.3.

- Draw water with a volume 85-95% of predetermined solution volume. Add tapioca slowing as stirring and keep stirring for 10 minute without heat.
- Keep stirring, and apply heat to increase the temperature to 95^{o}c by 30 min.
- Keep stirring (and add wax and tallow if necessary when the temp. reached 60^{0}c).
- Keep stirring and temperature at 95^{0}c for 30 min.
- Add binder before complete cooking of size solution.

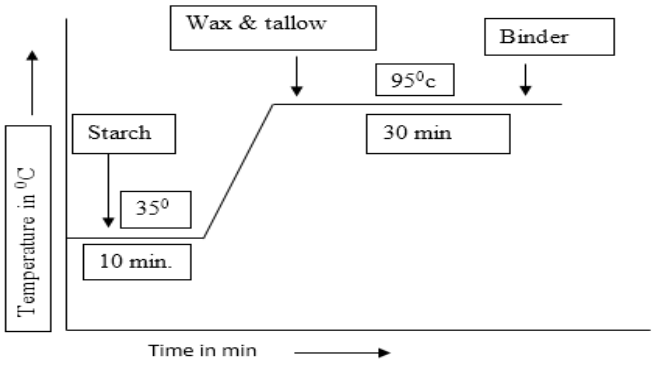

Fig 2.3: Size mixing and cooking procedure

2.3.4 Testing method

Sizing performance can be evaluate by measuring tensile strength of un-sized and sized warp. Universal strength tester (Model: M250-3CT) was used to measure tensile strength in DUET lab. The test procedure was carried out according to ASTM D 2256.

2.3.6 Experimental setup of proposed modified loom

This study indicates a simple modification. A sizing & drying system was incorporation just before weaving that is shown in Figure 2.4.

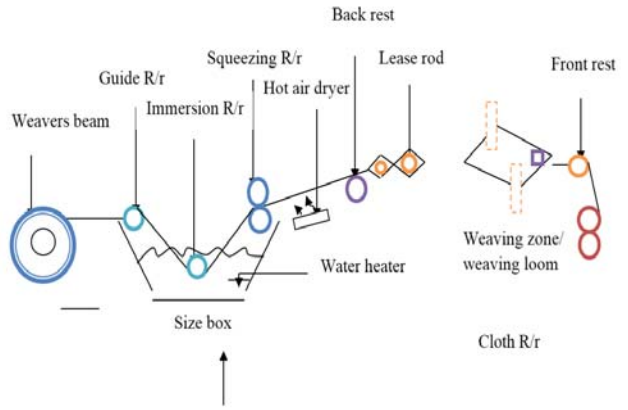

Fig 2.4: Cross sectional view of modified weaving system.

3. Results & Discussion

The experimental setup is based on laboratory process and an ordinary power loom was used to produce fabric where loom speed was lower (PPM is near to 160). Warp yarn without sizing was supply from weavers beam.

3.1 Weaving performance

In this proposed loom sizing and weaving was done simultaneously. So the sizing production rate was almost same to the fabric production rate. Satisfactory running weaving efficiency of proposed integrated sizing loom was achieved about 90%. It also observed that weaving operation just after sizing causes the good results of end breakage rate which was be reduced that's why efficiency would be increased.

Finally a weft rib fabric of $\frac{40's \times 40's}{108\times44} \times 10"$ specification with satisfactory quality was produced.

3.2 Sizing performance

The concentration and viscosity of size bath would be control by maintaining the continuously flow size in the bath. Since the size material was added on warp yarn to increase the strength of yarn. So the sizing performance can be evaluated by measuring the tensile strength of un-sized and sized yarn. The tensile strength (Number of observation-10) comparison between un-sized warp yarn and sized warp yarn is shown in Table 3.1& Table 3.2. From mentioned table the tenacity of sized warp was increase up to (16.043-11.481) 4.562 g/tex with elongation 11.52 @ peak. It was clear that the sizing on loom was carried out properly.

Table 3.1: Testromatric result of Un-sized warp.

Parameters	Elongation @ peak	Strain @ peak	Tenacity (g/tex)
Min	8.9	3.551	8.496
Mean	11.523	4.607	11.481
Max	13.371	5.348	14.458
S.D	1.389	0.558	2.132
CV%	12.05	12.114	18.566

Table 3.2: Testromatric result of sized warp.

Parameter	Elongation @ peak	Strain @ peak	Tenacity (g/tex)
Min	7.04	2.815	13.015
Mean	9.917	3.964	16.043
Max	13.369	5.346	19.56
S.D	2.088	0.836	2.452
CV%	21.053	21.08	15.255

4. Conclusion

It was great challenge to perform faults free sizing in traditional weaving process. This study proposed a new weaving process with eliminating the traditional sizing process. The proposed integrated sizing-weaving loom initially run successfully in laboratory condition about 90% efficiency. Also it was observed that the tenacity of sized warp and quality of fabric with in the satisfactory level. Extra floor space was required due to replace the weavers beam from its normal position. Adequate drying system should be incorporated and the proposed system can be implemented on automatic modern power loom. If the existing production rate would be increased up to acceptable level and price of proposed loom is economically suitable, then it will be used as commercial fabric production process.

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