Comparative Analysis of Sizing Machine Parameters on Weaving Performance

Prashant Patil, Ranjit Turukmane, P.P. Raichurkar
SVKMs NMIMS MPSTME, Centre for Textile Functions, Shirpur-425405, Maharashtra, India.
Email: ranjit.turukmane@nmims.edu

Abstract

Textile sector is a major contributor's to India's export with 15% of total export. India's overall textile exports during FY 2015-16 stood at US$ 40 billion. The Indian textile industry has the capacity to produce a wide variety of products suitable to different market segments, both within India and across the world. The Indian textiles industry, currently estimated at around US$ 120 billion, is expected to reach US$ 230 billion by 2020. In this research we have optimized sizing parameters to for 40^S Ne & 60^S Ne cotton count. It was observed that by optimizing squeezing pressure, sizing machine speed and yarn stretch, the efficiency of the weaving machine for 40^S Ne and 60^S Ne were increased by 10% and 17% respectively, this will help to manufacture export oriented quality fabric to promote Make in India policy.

Keywords – Efficiency, Sizing, Stretch & Squeezing Pressure.

I. Introduction

Sizing process parameter and quality of weavers beam result in higher production at loom with minimum sizing cost. The quality of beam indicate the success of yarn sizing process. Weaving is nothing but the interlacement of warp and weft. It was noted that for better weaving performance, the warp sheet would undergo sizing process, sizing is an essential operation the weaving preparatory process which makes the yarn weavable by increasing abrasion resistance by applying thin coating of size paste. The strength of the yarn is increases by penetrating the size paste to a certain level to yarn diameter. The total yarn stretch in sizing is reduced to 1% preferably below 1%, this is possible only because of PDN and PIV gears. For satisfactory weaving the quality of the beam also important; the beam should be firm and it should not have excessive missing ends, crossed ends, taped ends (sticky ends) etc., so that it unwind smoothly in the loom shed. It also maintains good fabric quality by reducing hairiness, by increasing smoothness and maintaining absorbency of the warp sheet.

II. Material Methods

Typical features of our sizing machines are their high operator convenience and perfect process control, the sized warp beams ensure maximum efficiency in weaving. Combination size boxes with and without presetting device ensure short yarn paths. Machines designed as one-box version (floor-type execution) and as double-box version (overhead execution) can be offered in different constructions to meet every requirement. Cylinder driers in various arrangements guarantee a rapid and gentle drying of the yarn. The size paste was prepared by using modified starches, the ingredients were added to the cold water in mixer one by one, ensuring the rotation rate of stirrer to avoid uneven mixing. The prepared slurry were transferred to the cooker, where the slurry cooked at 140oC temperature for maintaining desired viscosity of the size paste. This size paste then transferred to the storage tank where softener added finally to maintain its softening properties. [1] The weaver beams were prepared on Karl Mayer sizing machine for 40^S Ne & 60^S Ne cotton warp count (Trial 1 & Trial 2) with following particulars:

Table1. Sizing machine settings for 40 & 60 Ne warp count (Trial 1 & Trial 2)

Sizing Machine Parameters	Trial 1	Trial 2	Trial	Trial 2
Count(Ne)	40	40	60	60
Total ends	21514	21514	23562	23562
Machine speed (MPM)	62	65	65	75
Moisture%	6	6.7	6.5	7
Solid content%	10	10	8	8
Viscosity	10	8	10	8
Squeeze roller pressure	16	14	17	18
Size pick up%	12	14	10	9
Total stretch	1.0	0.8	0.9	0.7
Saw box Temperature	85	85	87	87

Table 2. The weaver beams were prepared for two different count to run on the air jet loom with following details:

Manufacturer	Toyota		Details	Values		Details	Values
Make	Japan		Warp Count	40 (Ne)		Warp Count	60 Ne
Model No	JAT70		Weft count	40 (Ne)		Weft count	60 Ne
Year	2008		Speed	600		Speed	700
Machine speed	900 rpm		EPI	86”		EPI	120
Reed width	170 cms		PPI	86”		PPI	86
Main nozzle	3 Bar		Weave	2/2 Plain		Weave	2/2 Plain
Sub nozzle	4 Bar		Reed count	48/2”		Reed count	48/2”
Pre winder	2		Warp tension	1.90 kN		Warp tension	2.56 kN
Selvedge	Leno		Beam no	158 A		Beam no	89 wp
Let off	Electronic						
Take Up	Electrical						

The prepared beams of 40 Ne & 60 Ne were run on looms with above specifications. The test results were assembled and discuss below.

III. Result and Discussion

There are several parameters which are counted for mapping of size beam performance at looms. Amongst all Squeezing pressure and condition of squeezing nip, sizing machine speed and yarn stretch are thoroughly discussed in this research paper. These parameters shows consistent impact on performance on weavers beam which ultimately responsible for increasing productivity of loom.

3.1 Impact of Squeezing pressure and condition of squeezing nip on beam performance at loom

Squeezing pressure plays vital role in applying uniform coating of size paste, the two trials were taken for each count, the comparative analysis & observations are summarized below,

Table 3. Impact of Squeezing pressure and condition of squeezing nip on beam performance

Sizing Machine Parameters	40^S Ne		60^S Ne	
	Trial 1	Trial 2	Trial 1	Trial 2
Squeezing Pressure (kN)	16	14	17	18
Efficiency %	80.74	89	76.36	90

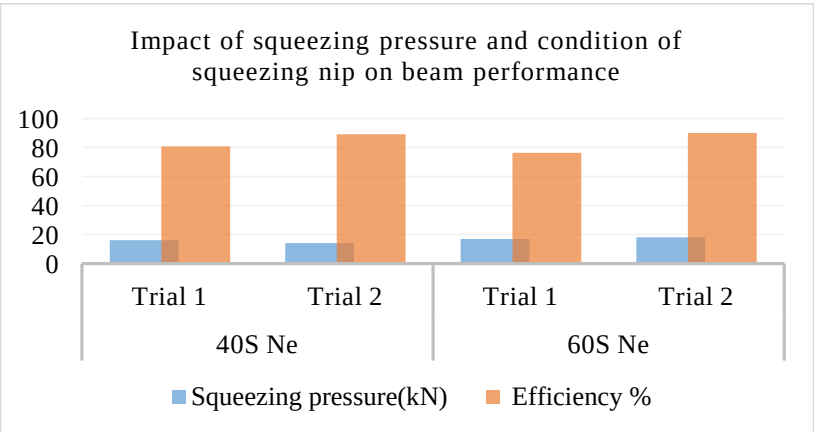

Figure 1. Comparative analysis of Squeezing pressure and condition of squeezing nip on beam performance

The sizing beams were prepared for 40^S & 60^S Ne count on Karl Mayer sizing machine by making changes in the squeezing pressure which lower for coarse count and higher for finer count, the results are summarized in table 3. Initially two beams of different counts were prepared for analyzing the effect of squeezing pressure at loom, it was seen that the beam prepared in Trial 1 with 16 kN pressure, shows little down performance with more end breakage rate as compared to Trial 2 for the same count. This difference in performance was occur due to the phenomenon of coating and penetration of size paste in the core of yarn. [2] The overall observation states that penetration is more in finer yarn at high squeeze pressure which result into increased tensile strength causes less

breakages during weaving so weavers with 60^S Ne were showed improved efficiency with less warp way breakages. The squeeze pressure forces out the excess paste picked up by the warp sheet. Besides, the pressure distributes the paste uniformly over the yarn surface and causes size penetration within the yarn structure. Higher squeeze pressure reduces the wet pick-up and add-on%. The effect of high pressure squeezing during sizing was found that for the same level of size add-on%, the high pressure squeezing facilitates better penetration of size within the yarn structure. However, the thickness of coating outside the yarn periphery reduces at high pressure squeezing. This reduces the dropping of size during weaving

3.3 Impact of impact of sizing machine speed on beam performance at loom

Machine speed is one of the important parameter which determines the level of size pick up & add on%. The two cylinder sizing machine was operates at slow speed which means the residence of warp sheet in saw box was more which often increases add on%. This would further results in to improper drying of warp sheet increases dropping percentage. [3] The modern sizing machines are available with higher speed with optimized sizing parameters which give desired quality beams for satisfactory running on loom with improved efficiency. [4]

Table.4 Impact of sizing machine speed on beam performance at loom

Sizing Machine Parameters	**40^S Ne**		**60^S Ne**	
	Trial 1	**Trial 2**	**Trial 1**	**Trial 2**
Sizing machine speed (MPM)	62	65	65	75
Efficiency %	80.74	89	76.36	90

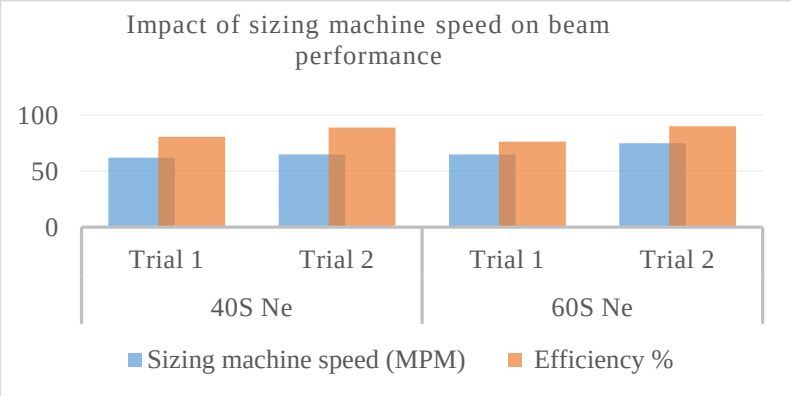

Figure 2. Comparative analysis of impact of sizing machine speed on beam performance

Above graph indicates that if sizing machine speed increases it reduces the residence of warp sheet in the saw box causes less penetration and increased size pick up with optimum squeezing pressure for 16 KN for 40 Ne count. The prepared beam shows good performance on loom during experimentation & increased efficiency to 89%. Whereas higher sizing speed for 60^S Ne, 75 MPM speed with 18 KN squeezing pressure shown best performance of weavers beam on loom with improved efficiency from 76.36% to 90%.

3.4 Impact of Yarn stretch on beam performance at loom

There are various zone in sizing process prone to permanent stretch in yarn these zones are creel zone, wet zone and drying zone. This property have direct impact on the elongation and elasticity property of the size yarn. Certain elastic property of yarn is very much useful during shedding or shed formation during shedding continuous movement of heald shaft considerable stress is imposed on yarn. High penetration or over drying of yarn during sizing, the yarn become stiff & brittle hence immovable gives frequent stoppages at weaving resulted in to loss of efficiency and production. [5, 6, 7]

Table.5 Impact of sizing machine size yarn stretch on beam performance at loom

Sizing Machine Parameters	**40^S Ne**		**60^S Ne**	
	Trial 1	**Trial 2**	**Trial 1**	**Trial 2**
Total Stretch %	1	0.8	0.9	0.7
Efficiency %	80.74	89	76.36	90

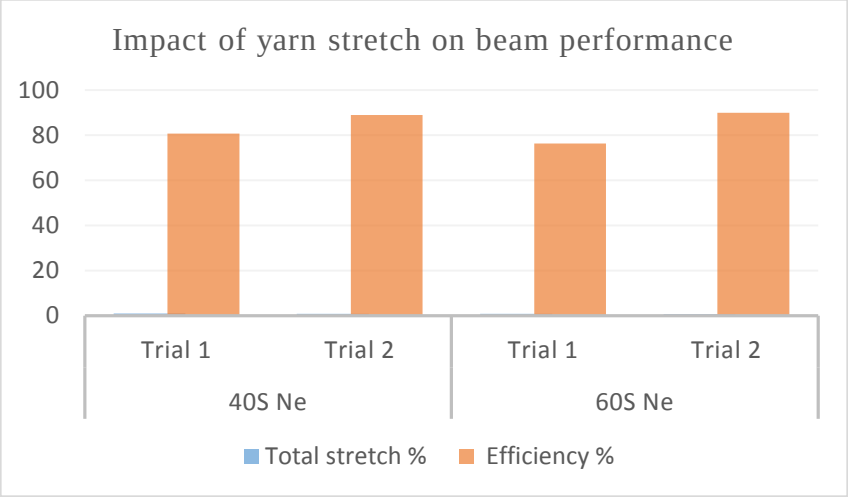

Figure 3. Comparative analysis of impact of yarn stretch on beam performance

High tension incurred in various zones responsible for stretching of fibes, size film and yarn. The strength is reduces by optimizing process parameters during sizing. Care taken to reduce stretch in different zones i) Used PIV gears to unwind the warp sheet from back beams, ii) The gears speed is equal to the squeeze roller speed to enter the warp sheet in to saw box in a relaxed state to avoid unnecessary stretch, iii) initial drying of warp sheet is done, before it passing to the fist drying to reduce wet stretch. [8, 9]
Table.5 shows for 40^S & 60^S Ne count for higher stretch maximum loss in elongation results higher warp breakages. The total stretch was considerable reduced in both cases with improved loom efficiency as the yarn stretch at sizing increases, the size pickup of the yarn reduces due to increase in yarn tension during sizing causes loss of productivity. [10, 11]

IV. Conclusion

Sizing practices and beam quality is entirely responsible for the efficiency of the weaving machine. The efficiency of loom was checked by using various parameters which gave detailed information about the process followed in the sizing machine in the textile industry. This research work briefed about the optimization of sizing parameters to increase beam so that we can get a higher efficiency. A small increase in the optimization of size machine parameters will lead to giving increased productivity to higher profitability. In this research work, we have changed the process parameters and come out with a better result in both cases. It was found that for both counts the efficiency of the loom was increased by 10% and 17% respectively.

References

[1]. Goswami, Bhuvenesh C., Rajesh D. Anandjiwala, and David Hall., Textile sizing, CRC Press, 2004.
[2]. Kovacevic, Stana,, and Zeljko Penava., Impact of sizing on physico-mechanical properties of yarn, Fibres & Textiles in Eastern Europe, Vol.48(4), 2004, 32-36.
[3]. Mogahzy, Yehia E. El, and Warren S. Perkins., Effect of creep-related over drying in sizing on warp characteristics and weaving performance., Textile research journal, Vol.62(6), 1992, 317-324.
[4]. Patil V.A., Gulhane S. S., Turukmane R. N., and Patil R., Productivity Improvement of Loom Shed by Optimizing Relative Humidity., International Journal of Textile Engineering and Processes,Vol.3(1), 2017, 36-40.
[5]. Devare M.D., Turukmane R.N, Gulhane S.S., & Patil L.M., Effect of yarn stretch in sizing on loom performance, International Journal of Textile Engineering and Processes, Vol.2(4), 2016, 19-23.
[6]. Sengupta A. K., Pratihar P., Kimothi P D., Vernekar S., and Sayeed M M Alamgiret., Influence of yarn structure, sizing ingredients and type of sizing on properties and performance of sized yarns: Part III-A study of attrition during weaving for air-jet, ring and rotor yarns on a modern high speed weaving machine, International Journal of Fibre & Textile Research, Vol.27(2), 2002, 149-155.
[7]. Behera B. K., Rashi Gupta., and Rajesh Mishra., Comparative analysis of mechanical properties of size film. I. Performance of individual size materials, Fibers and Polymers, Vol.9 (4), 2008, 481-488.
[8]. Behera B. K., Rajesh Mishra., and Sanjay Nakum., Comparative analysis of size materials and their weaving potential, International Journal of Fibre & Textile Research, Vol.33(2), 2008, 132-138.
[9]. Yao Guifen., Jiansheng Guo., and Yongyuan Zhou., Predicting the warp breakage rate in weaving by neural network techniques, Textile Research Journal, Vol.75(3), 2005, 274-278.

[10]. Maatoug Samah., Néji Ladhari., and Faouzi Sakli., Evaluation of the weavability of sized cotton warps, AUTEX Research Journal, Vol.8(4), 2007, 239-244.
[11]. Sharma, I. C., and R. C. D. Kaushik., Effect of Preparatory Process Parameters and Machine Conditions on Weaving Performance, International Journal of Fibre & Textile Research, Vol.7(4), 1982, 121-125.
[12]. Ren, Xin., Development of environmental performance indicators for textile process and product, Journal of Cleaner Production, Vol. 8(6), 2000, 473-481.
[13]. Hari P. K., and A. Tewary., Role of moisture in the performance of sized yarn, Textile Research Journal, Vol.55(9), 1985, 567-571.
[14]. Gulhane S, Turukmane R, Effect of Make in India on Textile Sector, Journal of Textile Engineering and Fashion Technology, Vol. 3(1), 2017, 1-6.
[15]. Vigneswaran C., N. Anbumani, M. Ananthasubramanian., and R. Rajendran., Prediction of optimum process parameters to achieve eco-friendly desizing of organic cotton fabrics with indigenously produced alpha-amylase and their enzyme kinetics, Journal of the Textile Institute, Vol.103(4), 2012, 422-433.
[16]. Sawhney A. P. S., J. B. Price, and T. A. Calamari., A successful weaving trial with a size-free cotton warp, International Journal of Fibre & Textile Research, Vol.29(2), 2004, 117-121.
[17]. Kovacevic, Stana, and Dubravka Gordos., Impact of the level of yarn twist on sized yarn properties, Fibres & Textiles in Eastern Europe 2009, Vol. 17(6), 44-49.
[18]. KR Patil, Kulabhaskar Sing, P.P.Kolte, A.M.Daberao, Effect of Twist on Yarn Properties, International Journal on Textile Engineering and Processes, Vol. 3(1), 2017, 19-23.
[19]. Vidyarthi S. P., P. K. Hari, and V. K. Aggarwal., Analysis of Size Droppings and Their Correlation with Warp Breakages, Textile Research Journal, Vol.53(6), 1983, 334-340.
[20]. Montes-Moran., Miguel A., Amelia Martinez-Alonso., and Juan MD Tascon., Effect of sizing on the surface properties of carbon fibres., Journal of Materials Chemistry, Vol.12(12), 2002, 3843-3850.
[21]. Turukmane, R.N., Borse, D.S., Parsi, R.D. and Dey, S.K., Methods to control waste in multiplying process. Indian Textile Journal. Vol. 128(3), 2017, 102-103.