Productivity Improvement of Loom Shed by Optimizing Relative Humidity

Vicky Ashok Patil*, Sujit Shrikrushnarao Gulhane*, Ranjit N Turukmane* & #Rajendra Patil
* Centre for Textile Functions, Mukesh Patel School of Technology Management and Engineering, SVKM'S NMIMS, Shirpur Campus, Dist. Dhule, Maharashtra, India
# Production Manager, Alok Industry Weaving Division, Silvassa, Dadra Nagar Haveli, India
Email:- patilvicky0303@gmail.com, sujitgulhane.iitd@gmail.com

Abstract

The fabric manufacturing industries moves from shuttle weaving to shuttle less weaving in order to secure higher production rates in with good quality fabric. The productivity of the loom is govern by the speed, efficiency and quality of the fabric produced. Loom stoppages during the weaving process not only reduces the productivity but also affect the fabric quality as startup marks and differential dye take up are appeared on the fabric as defects. In the woven fabric manufacturing, warps ends are generally sized so that they can withstand various stresses encountered in weaving process. Prime object of the sizing is to improve the weave ability of the warp and make them sustainable for weaving. The breakage rate of cotton sized warp yarn is highly sensitive to the relative humidity and shows large difference with change in relative humidity. In weaving industry it is a challenging task to find out optimum level of relative humidity to get minimum warp breakage rate. The present study was done to analyze the effect of relative humidity to warp breakages in weaving and to optimize relative humidity with minimum warp breakage rate.

Key Words*: Relative humidity, Warp breakage rate and efficiency.*

I. Introduction

In the every manufacturing industry it is always emphasized to increase production and maintain quality of the product, so the industry can meet the demands of both national and international consumers and markets in terms of cost and quality of the product. Textile industry is the second largest industry in the world and every textile industry is facing the challenge improving productivity to meet the competitiveness in the market [1]. Majority of textile industries are producing similar type of yarns and fabrics [2]. Thus industries need to produce quality product with low cost at high production. In woven fabric manufacturing lower the production costs per meter of woven fabric depends up on the loom stoppages due to yarn breakages [3]. These breakages are essential to be reduced by controlling manufacturing process and atmospheric conditions at every stage of manufacturing the woven fabric. In weaving industry one of the most important and considerable problem is breakages of both warps and weft yarns [4]. These breakages not only reduce the production rate but also deteriorate the quality of the produced fabric, thus affects the productivity of the loom shed. These breakages on the preparatory processes like warping and sizing also creates lots of problems and effects productivity of loom shed. Lesser is the number of yarn breakages results in better quality fabric [5]. The reduction breakages of both warp and weft yarns not only increase the production and quality of the warping, sizing and weaving processes but also reduces wastages of yarn[6]. This reduces the overall cost of the fabric manufactured and improves the profitability of the fabric.

The efficiency of weaving is the most important factor considered in terms of productivity. The loom efficiency is mainly decided by the speed as well as the down time of the machine [7]. Efficiency of the loom can be improved by effective control on the breakage of warp or weft yarn. The mechanical condition of the machine, poor quality yarn of the weft or warp, atmospheric conditions in the weaving shed were identified as main reasons for the weft and warp breakages during the weaving process [8]. By carrying out proper maintenance, use of optimal settings of mechanical and technological parameters yarn breakages due to mechanical problems can be almost eliminated. With the use of appropriate technology in modern yarn preparation machines, the required properties of the yarns can be acquired and thereby yarn breakages due to inferior properties can be minimized [9].The change in relative humidity causes a change in the moisture content of the fibers [10].The fiber strength and elasticity proportionately change with humidity[11]. The surrounding temperature and the relative humidity have a great impact on the physical proper ties of yarns [12]. Higher relative humidity than specified, fibers tends to stickiness' on the warp yarns which disrupt the production process[13]. The standard relative humidity in a textile mill producing cotton fabrics is required to be maintained at 80% to 85% in contrast to general relative humidity condition of a room is around 65%. High humidity in a weaving shed also helps to increase the abrasion resistance of the warp [14]. Many studies are available which provides the relationship between humidity and warp breakage rate in a weaving shed. As the fabrics are produced on different looms with different construction using different warp yarns of various counts, twist and fibre type, requirement of relative humidity for all fabrics varies from one another [15].

Effect of Relative Humidity % and temperature in a textile mill

- Dry air causes lower regain and this contributes to poor quality and lower productivity.

- Yarns with low moisture content are weaker, thinner, more brittle, and less elastic, create more friction and are more prone to static electrification.
- Materials at optimum regain are less prone to breakage, heating and friction effects the handle better, have fewer imperfections are more uniform and feel better.
- Textile weights are standardized at 60% RH and 20°C. Low humidity causes lower material weights and lowered profits.
- Low humidity causes fabric shrinkage. Maintained humidity permits greater reliability in cutting and fitting during garment creation and contributes to the maintenance of specifications where dimensions are important, such as in the carpet industry.
- Humidification reduces fly and micro dust, giving a healthier and more comfortable working environment [11, 16].

The present study was conducted at Alok Industries limited weaving division Silvasa, to find correct value of relative humidity in loom shed for minimum warp breakage for weaving a fabric of sort number- S10700 with 100% cotton warp of 60 Ne, yarn on Picanol Omni plus 800 Air Jet Looms, running with 650 rmp.

II. Problem

The production efficiency is basically depending on the weft and warp breakage rates and the time taken to restore and restart the loom. In addition to the mechanical problems of the loom, the warps and wefts can be broken due to many reasons [9]. The warp breakage rate is highly affected by the relative humidity of the loom shed [9, 10].Therefore productivity of a weaving machine significantly depends on humidity of the loom shed. Higher warp breakage rate causes frequent loom stoppages. Such stoppages and subsequent starts lead to variation in tension of the warp sheet and also in the fabric is being woven. As a result fabric parameters such as pick density and fabric cover factor are subjected to vary [12, 14]. Intermittent variation in pick density of the fabric lead to different dye take up in dying process and it appears as different shades in the fabric[16].

Thus efficiency losses due to warp and weft breaks and beam gaiting of frequency dependent on fabric structure, condition of loom and hence they vary from mill to mill and also sort to sort within the same loom shed. The present study focuses on the finding out level of relative humidity at which minimum warp breakage are occurred. This level of relative humidity will be referred for same sort of fabric to achieve minimum warp breakages.

III. Experimentation

In this study 10 looms running with sort number S10700 was selected. Every day at 08.00 am, 04.00 pm and 11.00 pm relative humidity of the plant is noted average of these three is considered as the RH value for a day. The efficiency and warp breakages of average of 10 looms are noted as shown in table No. 2. This study was conducted for one month and collected data was studied for effect of relative humidity of warp stoppages and loom efficiency.

Table No. 1: Loom and Fabric Specifications:

Sort no	S10700
No. of looms used	10
Weft insertion type:	Airjet
Loom maker, Model	Picanol, Omni Plus 800
Loom speed	650 r.p.m
Reed width, Fabric Width	220 cm, 165 cm
Warp count , Weft count	60Ne ,60Ne
Total ends	6364

Table. No. 2. RH% and Temperature Efficiency study

Sr. no.	Date	R.H.%	Efficiency%	Warp Stops Per loom per day
1	13/06/16	81.5%	75.2%	10
2	14/06/16	81.0%	68.5%	12

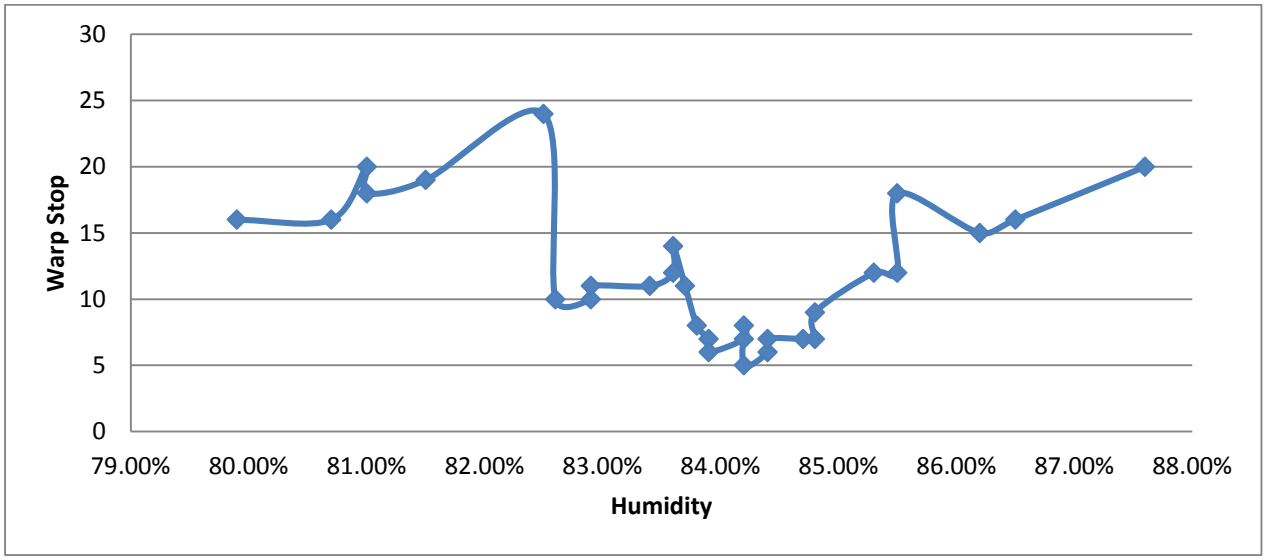
3	15/06/16	81.0%	72.6%	12
4	16/06/16	79.9%	75.54%	10
5	17/06/16	80.7%	79.9%	8
6	18/06/16	83.8%	83.4%	7
7	19/06/16	82.9%	80.0%	7
8	20/06/16	84.4%	83.4%	7
9	21/06/16	82.9%	70.6%	7
10	22/06/16	82.5%	68.1%	9
11	23/06/16	83.4%	82.2%	7
12	24/06/16	84.8%	86.4%	9
13	25/06/16	83.6%	79.50%	11
14	26/06/16	84.2%	86.9%	6
15	27/06/16	83.7%	75.9%	7
16	28/06/16	84.4%	79.8%	6
17	29/06/16	86.2%	78.59%	11
18	30/06/16	86.5%	59.2%	12
19	01/07/16	87.6%	77.6%	20
20	02/07/16	83.9%	84.0%	14
21	03/07/16	83.6%	86.7%	20
22	04/07/16	84.2%	78.3%	18
23	05/07/16	85.3%	55.6%	15
24	06/07/16	84.8%	82.1%	16
25	07/07/16	85.5%	77.0%	18
26	08/07/16	84.2%	83.3%	18
27	09/07/16	84.7%	88.9%	16
28	10/07/16	85.5%	56.6%	16
29	11/07/16	82.6%	80.9%	19
30	12/07/16	83.9%	79.9%	20

IV. Results and Discussion

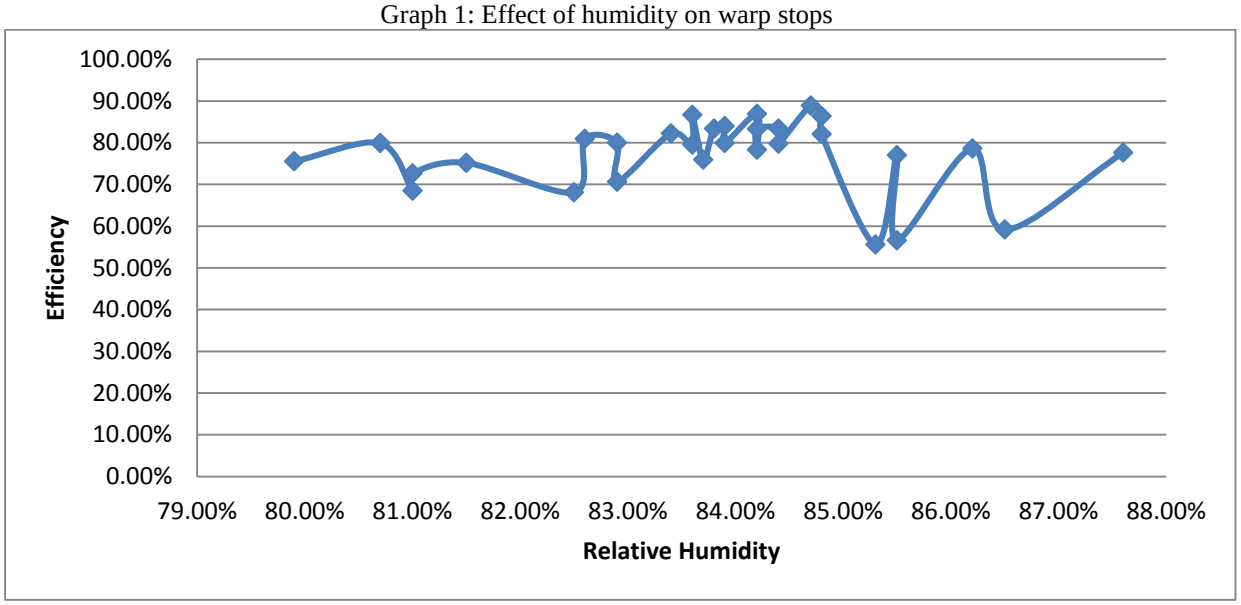
Data Analysis: The collected data analyze by the scatter chart. In first chart warp breakage rate was plotted against the relative humidity and in second chart efficiency of the loom was plotted against the relative humidity.

The data collected in above table no. 2 are plotted as show in following scatter line graphs 1 and graph 2. Form the graph 1 it is observed that warp breakage rate is above 15 for the RH value 80%-82% and 86%-88%, whereas in between 83.5%- 85% it is below 10. Thus warp breakage can be minimizing by achieving RH value in between 83.5% to 85% in the loom.

From the graph 2 it is observed that the efficiency of the loom ranges from 55% to 91 %. The efficiency of the loom is highest at 85% RH. The efficiency of the loom lies in the range of 79% to 91% for the 84- 85 % RH. The efficiency of the loom is on lower side in the range RH 80%-83% this is due to cracking of size film at low RH and causing to warp breakages whereas above 85% RH drastic increase in wap breakages results in reduction in efficiency highly, this is due to higher humidity makes the size coating soft and scrubbed off from the yarn while rubbing with several parts of the loom such as heald reed etc. This bare yarn does not withstand wear during weaving and breaks.



Graph 1: Effect of humidity on warp stops



Graph 2: Effect of Humidity on Efficiency of loom

V. Conclusion

The present study concludes that moisture level in the yarn directly affects the efficiency of loom shed. The RH % play very important role in weaving department. The RH value mainly effects warp breakage rate and consequently loom efficiency. The results indicate that, given fabric with sort no.- S10700 it better to weave at a RH of 84% -85% for minimum warp breakages and highest efficiency of the loom. This will improve the quality and production of the loom shed. It is recommended that similar studies should be conducted to find out correct level of relative humidity and achieve maximum production and quality fabric production. The effectiveness control on the loom shed efficiency leads to control on warp breakage rate. This innovative methodology reduces the ideal time of the loom while improving the productivity and fabric quality. The present methodology of research, its findings have strong industrial application.

VI. Reference

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