EFFICIENCY ANALYSIS IN RAPIER LOOM.

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ABSTRACT

The study was carried out to find out the effects of various parameters on efficiency in rapier looms. To do so, the efficiency is analyzed by various parameters such as weaver's skillness, loom speed, weave structure, pick density and R.H%, loom allocation per weaver, size take up %, tension on warp etc. The main objective of this study is to increase the efficiency and through that increase the productivity and profitability. Unlike in winding, warping and sizing where the emphasis is on the quality of preparation, in the loom shed, control of fabric quality as well as of productivity assumes significant importance. The weaving operation contributes by far the largest proportion to the cost of conversion of yarn into fabric. Surveys shown that the cost of actual weaving operation in mills with modern preparatory machines and automatic looms about 60%- 65% of the total cost for conversion of yarn into fabric. This means that a small increase in loom shed efficiency via productivity will result in considerable reduction of manufacturing cost. More importantly an increase in efficiency will bring in additional realization on the extra fabric available. For a medium size average mill, an increase of 2% in loom shed productivity can increase the annual cash flow by about Tk. Ten lakhs. Consequently, in evolving a satisfactory process control programmed for the loom shed, considerable weight age should be given to efficiency.

Key words: Rapier loom, Weaving, productivity, fabric construction, weave type and efficiency losses.

1. INTRODUCTION

Generally, loom shed efficiency is calculated for each shift on the basis of production. In loom shed, the production is measured in terms of either pieces booked, meters woven or picks inserted. This method of calculation only gives an idea of the efficiency achieved. It does not indicate the performance index of a mill in relation to an expected optimum. In order to know exactly what a mill can achieve, it is necessary to have standards for efficiency losses due to various causes and a method of estimating the expected efficiency under a given set of circumstances.

The causes for efficiency losses in looms can be divided into two broad categories as frequency dependent and miscellaneous. Warp and weft breaks, beam gaiting belongs to first category, where as healds broken, doffing, loom repairs, weave away, etc. are termed as miscellaneous causes. Interference is, yet another cause of stoppage.

Its extent depends upon the number of looms assigned to a weaver and frequency of warp and weft breaks. Miscellaneous causes are those occurring at random. Further, such causes cannot be ascribed any definite frequency. Whenever an operator is in charge of more than one machine, there is loss due to interference. On looms, this loss is observed to be essentially a function of such stoppages as warp breaks, weft breaks and hence for all practical purposes, it may be expressed as a percentage of the total loss on account of these causes.

The efficiency losses arising from loom stoppages in looms are generally of two types such as those requiring the weavers' attention and those not requiring weavers attention. The former category includes causes like warp breaks, weft breaks and interference. Losses due to warp and weft breaks are in proportion to the frequencies. The interference loss is depend upon the loom assignment to weavers, frequency of warp and weft breaks, average distance required to be walked per stoppage and other miscellaneous jobs performed by a weaver. Losses due to stoppages not requiring weavers' attention arise from loom repairs, cleaning and oiling, beam gaiting and others. Efficiency loss on account of

beam change varies according to its frequency, while other losses depend upon the organizational setup, frequency of breakdowns, types of looms, sorts woven and level of maintenance. [1][2].
As stated earlier, efficiency losses due to warp and weft breaks and beam gaiting of frequency dependent and hence they vary from mill to mill and also sort to sort within the same mill. On the other hand, efficiency losses, ascribable to loom repairs, cleaning and oiling, doffing and other stoppages are observed to be of more or less the same order between mills. For all practical purposes, it would be quite in order to provide an overall allowance for the losses arising from these causes.

2. MATERIALS AND METHOD

2.1 Loom specifications

No. of looms used: 20
Weft insertion type: Rapier
Loom type: Flexible rapier.
Loom maker: PROMATECH S.P.A, ITALY.
Loom model: THEMA SUPER EXCEL.
Loom speed: 450-575 r.p.m
Reed width: 66"-67"
Reed space: 64"-65"

Weft Selection	8 colors pick with programmable microprocessor.
Shed Formation	Electronic dobby (STAUBLI).
Weft Stop Motion	Electronic 8 hole weft slide sensor.
Warp Detection	Electric dropper pin type with 6 rows.
Let-Off	Electronic let-off system ensuring uniform warp beam tension.
Take Up system	Electronically controlled.

Weave type: Plain, Twill, and Satin.
Count of yarn: 16 Ne, 20 Ne, 40Ne and 50 Ne combed yarn.

2.2 Method

Loom efficiency can be measured by the following formulae:

$$\text{Loom Efficiency (\%)} = \frac{\text{Actual Production}}{\text{Calculated Production}} \times 100$$

The efficiency can be calculated quickly and expeditiously from computers. The use of computers enables the parameters to be continuously assessed so that better accuracy can be obtained. [2]
After calibration of the computer software along with the parameters efficiency was taken after one shift production.

3. DATA ANALYSIS

3.1 Analysis of Efficiency by Speed

The production of a loom mainly depends on the speed of the loom. Higher speed does not mean higher production because, if it exceeds certain limit, loom stoppages due to excessive warp breakages occurring as a result of higher speed may even reduce the production to a considerable extent. [3]
So an almost care is necessary for the analysis of the speed of the looms and their influence on the field.

Table:-1
Construction: 40x40/110x74
Weave type: Plain

Speed (R.P.M)	Efficiency (%)
400	95
415	97.8
420	98.9
440	88.7
450	80.4

Table:-2
Construction: 40x40/120x80
Weave type: Plain

Speed (R.P.M)	Efficiency (%)
422	91.2
432	90.5
442	88.7
450	85
475	80.1

Table:-3
Construction: 40x40/130x90
Weave type: Plain

Speed (R.P.M)	Efficiency (%)
408	88.4
417	90.1
432	93.5
440	88.7

Table:-4
Construction: 50x50/144x76
Weave type: Plain

Speed (R.P.M)	Efficiency (%)
408	81
425	90.8
430	93.2
440	87.5
444	84.2

Table:-5
Construction: 40x40/130x90
Weave type: Twill (2/2)

Speed (R.P.M)	Efficiency (%)
420	86.5
430	83
440	78.5
465	73.2

From the above table it is found whenever there is higher loom speed it leads to higher end breakages. This will reduce the efficiency. But when we run a loom at lower speed then the productivity decreases. Higher production also plays an important role in the industries improvement. So it is recommended to run the looms at optimum speed.

3.2 Warp tension Vs Efficiency

Table: 6
Construction: 40x40/110x74
Weave type: Plain

Speed (R.P.M)	Warp tension(Kg)	Efficiency (%)
420	120	86.5
420	130	88.6
420	145	93
420	152	98.9
420	160	90.5
420	170	86
420	185	84.5
420	190	78.2

Table: 7
Construction: 40x40/130x90
Weave type: Twill (2/2)

Speed (R.P.M)	Warp tension(Kg)	Efficiency (%)
423	140	78.5
423	150	80.5
423	160	82
423	180	84.8
423	185	85
423	190	82.3
423	210	79.5

More tension on warp yarn causes more breakage, but low tension makes the yarn entangled with each other. So, appropriate tension should be applied to get better quality fabric and optimum efficiency.

3.3 Weave type Vs Efficiency

Table: 8
Construction: 40x40/110x74

Weave type	Speed (R.P.M)	Efficiency (%)
Plain	420	98.9
Twill(2/2)	420	86.5
Plain+Twill(2/2)	420	82.1
Plain+Satin(4E)	420	78.9

Table: 9
Construction: 40x40/120x80

Weave Type	Speed (R.P.M)	Efficiency (%)
Plain	430	91.2
Twill(2/2)	430	83
Plain+Twill(2/2)	430	79.3
Plain+Satin(4E)	430	77.2

Table: 10
Construction: 40x40/130x90

Weave type	Speed (R.P.M)	Efficiency (%)
Plain	440	88.7
Twill(2/2)	440	78.4
Plain+Twill(2/2)	440	73.5
Plain+Satin(4E)	440	70.7

Since a fabric with high number of interlacing in the design or a high end density (epi) and pick density (ppi) tends to have a large number of breaks. Plain weave gives the highest efficiency than other weaves for a particular condition. For complex design warp breaks more because of uneven tension on warp yarn. The more critical design the weaver takes more time for repair the warp breaks because of different sort of drawing. So, for complex design efficiency becomes low.

3.4 Analysis of Efficiency by Weavers

Here the efficiency of different weavers was analyzed. By analyzing the inefficient weavers as well as the idle weavers can be identified. It will help to take corrective measures on the inefficient and the guilty.

Table:-11

Weaver	Efficiency (%)
1	96.1
2	93.2
3	90.2
4	89.5
5	85

Table:-12

Weaver	Efficiency (%)
1	92.3
2	88.5
3	84.4
4	83.6
5	80.7

Many reasons contribute to the lower weaver's efficiency. If one of the allocated loom stops and at the same time another allocated loom also stops then the weaver cannot able to attend both. This will decrease the loom efficiency, to reduce this, labour cooperation is needed. That is the weaver who is idle can attend the other loom.

Other causes are, if a multiple breakage occurs and at the same time another allocated loom stops, then the weaver should first attend the loom which can be restarted first. By doing this the idle time of one of the loom is reduced and efficiency is increased. The other causes following the inefficient weavers and talking with neighbors.

3.5 Analysis of Efficiency by Loom Allocation

To decide 'How many looms per weaver' one has to take into account several aspects. These aspects relate to the production efficiency, labors workload and productivity, and finally cost and profitability. As these factors have mutual effects on each other while deciding the allocation, the management must decide about the objectives to be pursued. The optimum loom allocation may be the allocation which gives maximum profits, or it may be that one which will give maximum productivity or one which will give minimum cost of production. For instance, maximum machine efficiency may be obtained when less number of looms are assigned to a weaver, whereas the loom efficiency may be lost by increasing number of looms per weaver. In the first case the worker is considerably underutilized while in the later case the labour utilization is more. In both the cases, either operator has to wait for the machine or the machine has to wait for the operator. The loss in machine efficiency due to more loom assignment results in lower production and lower revenue and vice versa. However cost varies at different loom assignments and the total profits also vary depending upon cost and the production at respective assignments. Thus, when an allotment of machines is thought of, a proper balance of these factors is very essential. [1]

Here loom allocation of the weavers was analyzed. Loom allocation plays an important role in the loom efficiency. Care should be taken here because; when more looms are allocated then there will be a problem of efficiency. When less looms are allocated then there will be a problem of wages.

Table:-13
Weave type: Plain

No. of looms/weaver	Efficiency (%) Avg.
5	82.3
4	89.6
3	80.2

Table:-14
Weave type: Plain

No. of looms/weaver	Efficiency (%) Avg.
5	80.7
4	91.1
3	86.4

Table:-15 and Table:-16
Weave type: - Miscellaneous (Plain,Twill,Plain+twill,Plain+satin)

No. of looms/weaver	Efficiency (%) Avg.
5	75.3
4	80.4
3	78.6

No. of looms/weaver	Efficiency (%) Avg
5	72.8
4	82.5
3	77.5

This above chart shows that when lower looms are allocated the efficiency drops and when more looms are allocated the efficiency increases. While analyzing the reason this is because of the labours mischievous behaviors. When there are more labours in a place it will lead them to be more talkative and thus not attending the looms properly. To recover from this type of lower efficiency it is better recommended to keep a supervisor.

3.6 Analysis of Efficiency by Relative Humidity

Here the temp. and relative humidity in the industry was measured and analyzed how they affect the efficiency.

Table 17

Temp.(°C)	R.H (%)	Efficiency (%)
30.6	59.4	89.6
31.4	54.6	85.4
27	65.8	96.1
28.5	63.5	94.4
29.5	61.3	92.6

The above chart shows the relation between Temp., R.H and Efficiency, and the international standards also say that for cotton weaving the efficiency is higher at (65±5) % relative humidity and temperature of (26-27)◦C. So this should be controlled for better performance.

3.7 Size take- up% Vs Efficiency

For better performance following size take up % should be maintained.

Table 18

Count(Ne)	Size take-up (%)
16	9
20	10
40	11-12.5
50	12.5-14

For a particular count, if size take-up % is more than required amount, than yarn becomes sticky and friction occurs more between yarn to yarn and yarn to reed. Problem also arises when knot passes into the reed. Again if size take up % is less than required amount than yarn becomes weak, can't tolerate much stretch during weaving, hairiness causes entangled with each other. So, it is recommended for better performance of weaving appropriate size take up should be maintained strictly.

4. DISCUSSION

Various stops should be controlled and the stoppage rate should be low.

The various stops can be classified as

1. Stops due to warp breaks and warp faults.
2. Stops due to weft breaks.
3. Stops due to mechanical failures.
4. Miscelleneous stops.

Machine maintenance also plays an important role in the efficiency of the machine. Proper lubrication and cleaning should be done frequently. The preventive maintenance is advised for better performance of the loom.

A supervisor should be present for all eight hours of the shift. It will considerably increase the efficiency. It is also very useful if rotating cameras are fixed all around the loom shed so that the efficiency will increase.

It is proven that in mills where there is a consistently low warp breakage rate, the yarn CSP is higher and also the number of thin places is less than the certain minimum level. A weak, fuzzy yarn will break very often whereas a strong smooth uniform yarn will withstand the weaving conditions better. When there is poor raw material, then the efficiency of the loom as well as the quality of the fabric decreases.

Sizing plays a vital role on efficiency. So appropriate size take up should be maintained strictly.

Skilled weavers can repair broken yarns very quickly compared to unskilled weavers. Also the work load of the weaver has a very important effect on the weaving efficiency, since it affects the time a loom is stopped awaiting attendance. The weaver should be trained so that he takes the minimum possible time for clearing a stop. Loom allocation should be optimum.

The weaver's room atmosphere plays an important role in loom efficiency. The relative humidity and the temperature should be maintained properly and constantly to get a maximum efficiency. Whenever there is a change in these two parameters then there will be a chance for drop in the efficiency

Motivation is another major thing to be considered. If a weaver is able to produce higher efficiency he should be encouraged by higher percentage of wages or in some other way. At the same time if a weaver produces lower efficiency he should be punished by reducing the percentage of wage or by some other way. [4]

5. CONCLUSION

The efficiency is analyzed by various parameters. This gives a detailed idea of how the efficiency is dropped. While taking corrective action from the results analyzed, we can get a higher efficiency. A small increase in efficiency will give higher productivity and profitability and that has been obtained. From the results the various factors affecting the efficiency is found and by concentrating in those areas the efficiency of the loom shed is increased.

6. REFERENCES

[1]. Talukdar, M.K, Sriramulu, P.K and Ajgaonkar, D.B (1998) Weaving Machines, Mechanism, Management, Mahajan publishers Ltd. , ISBN 81-85401-16-0, Ahmedabad, India.

[2]. Lord, P.R and Mohamed, M.H (1982) Weaving: Conversion of Yarn to Fabric, Merrow Publishing Ltd.,ISBN 0 904095 38 X, Durham, England.

[3]. Sen Gupta, R., (1971) Weaving Calculations, D.B.Taraporevala Sons & Co. Ltd.,Bombay,India.

[4]. My textilenotes.blogspot.com/.../maximising-loom-efficiency-at-loom-shed.html.