Study of Reed on High Speed Weaving Machines

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Abstract - *This paper is focused on the life of the reed. Life of reed is decreasing because of* ***Groove's formation*** *of reed on a* ***high-speed weaving machine****. Groove formation of the reed is one of the disturbing elements in decreasing weaving performance and life of the reed. It happens at an early stage of running (Approx 500 Hrs). The main objective of this paper is to know how to increase the life of reed on the high-speed weaving machine. These factors are the construction of Fabric, Type of Yarn, Loom Settings, Sizing recipe, Reed Construction plays an important role to reduce the life of the reed. The life of reed needs to be increased because of its cost and productivity of looms.*

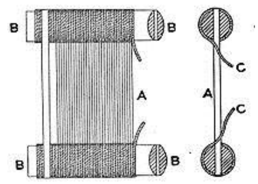
Key Words: **Life of reed, Groove formation, Weaving performance, High speed weaving machine, cost and productivity.**

1. INTRODUCTION

Nowadays the air-jet machine is running at 1100 rpm, the life of reed is only 4 to 5 month after that creates groove on reed but earlier air-jet machine is running at 600 to 800 rpm, the life of reed is 2 to 3 years. Now the life of reed has decreased drastically because of the increase in the speed of the machine. Groove formation in reed happens especially in the area where selvedge ends are present in the reed dents. This damage to the reed dents takes place where selvedge ends have more abrasion with the dents. The warp sheet normally contracts from 2 to 15 percent in width from reed to the cloth due to the interlacement of warp and weft. This creates high tension on selvedge ends & abrasion with the reed dents. When this contraction between reed ends & fell of cloth is very high the warp ends start to cut the dents of reed due to very high tension.

Groove formation in reed can deteriorate fabric quality as well as decrease the loom productivity. So to avoid this formation of groove it is very important to understand the area of concern & root cause. With permutation & combination of possible solutions such as better sizing, proper loom settings, reed specifications, temple selection, a wax application can reduce the groove formed in the reed.

1.1 Reed



A: wires or dents
B: wooden ribs
C: tarred cord

A **reed** is part of a weaving loom and resembles a comb. It is used to separate and space the warp threads, to guide the shuttle's motion across the loom, and to push the weft threads into place.[1][2] The reed is securely held by the beater and consists of a frame with many vertical slits.[2]

Modern reeds are made by placing flattened strips of wire (made of carbon or stainless steel [3]) between two half-round ribs of wood and binding the whole together with tarred string.[2]

1.2 Dents

Both the wires and the slots in the reed are known as dents [6] (namely, teeth).[4] The warp threads pass through the dents after going through the needles and before becoming woven cloth.[2] The number of dents per inch (or per cm or 10 cm) indicates the number of gaps in the reed per linear width. The number of warp thread ends by weaving width determines the fineness of the cloth.[1] One or more warp threads may pass through each dent. The number of warp threads that go through each dent depends on the warp and the desired characteristics of the final fabric,

Putting more than one thread through each dent reduces friction and the number of reeds that one weaver needs, and is used in weaving mills.[7] If too many threads are put through one dent there may be reed marks left in the fabric, especially in linen and cotton.[8]

For cotton fabrics, reeds typically have between 6 and 90 dents per inch.[4] When the reed has a very high number of dents per inch, it may contain two offset rows of wires. This minimizes friction between the dents and warp threads and prevents loose fibers from twisting and blocking the shed.[4]

1.3 Reed count

Reed Count is generally calculated in the stock port system. The number of dents in 2 inches is called as Reed Count.

1.4 Types of reed

Type of reed is depends on:-

1. Type of weaving machine.
    - Reeds for rapier machine,
    - Reeds for water jet machine,
    - Reeds for Sulzer machine,
    - Reeds for air jet machine with special profile dents rear side dent (Rucksack reed),
    - Reeds for shuttle less looms (flat reed)
2. Type of fabric wants to produce.
    - Reeds for metallic cloth,
    - Reeds for Narrow fabrics and label weaving,
    - Reeds for bolting clothes,
    - Reeds for terry towel and special fabric,
    - Reeds for carpets and velvets,
    - Reeds for ribbons
3. Reed for weaving preparations.
    - Reeds for sizing machines:
      Combs for expansion device, open/closed
      Simple and double hook reeds
    - Reeds for warping and leasing machine:
      Front reeds
      Leasing reeds on 2, 4, 6 levels
      "V" reeds, with or without support

1.5 Materials used for reed manufacturing

Normally material used for dent is Mild Steel, High Carbon Steel and Stainless Steel

1.6 Bonding

- Chemical bonded / Tin Soldered
- Cold welded by special resin for maximum resistance
- Epoxy welding by special resin

1.7 Type of coating / Treatment given to reed

- Hard Chrome plated
- Diamond like carbon(DLC)
- Super polish treatment for delicate fabric

2 Problems associated with reed

In high speed weaving machine Groove formation in the reed at early stage of running (Approx 500 Hrs)

Groove formation:

Groove formation is the phenomenon of cutting the dents of reeds in horizontal direction at both ends of the reed. Due to cutting of dents in horizontal direction a groove is formed in the reed.

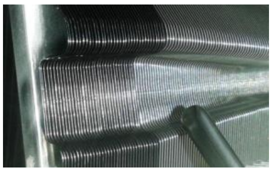


Figure (1)

Figure (1) shows groove formation of the reed

A groove formation in the reed will take place especially at the both end of the reed especially in fabric selvedge area. From the both ends of reed approximately 25 to 60 mm length in horizontal direction this damage happens.

Frequency of groove formation:

The warp sheet normally contract from 2 to 15 percent in width from reed to the cloth. This contraction is due to the interlacement of warp and weft. This creates high tension on selvedge ends & abrasion with the reed dents. When this contraction between reed ends & fell of cloth is very high the warp ends start to cut the dents of reed to very high tension.

2.1 Reasons of groove formation are as bellow

Sr. No	Area of Concern	Reason
1	Construction Of Fabric	A square construction of fabric produces high contraction between reed end & fell of the cloth. A square construction normally has the same yarn count & density in both warp & weft direction This causes more abrasion of selvedge ends to the dents & starts cutting the dents leading to groove formation
2	Type of Yarn Material	Yarn material of high coefficient of friction like glass, tirecord, polyester, nylon etc will cut the dents very early. As this type of yarn material is having very high tensile strength & rough surface in nature they will form a groove in reed easily due to friction with reed dents. Yarn material of cotton or any other natural fiber which

		has less coefficient of friction & smooth surface will create less damage to reed dents.
3	Loom Settings	Following wrong loom settings will create a groove in the reed. 1. Wrong reed alignment in sley. 2. Excessive tightening of reed in sley. 3. Wrong temple setting. 4. Wrong selection of Temple specification. 5. Wrong selection of emery cloth roller. 6. Improper width settings on loom All above setting problems will create a high contraction of cloth selvedge between reed & fell of the cloth. This creates the high tension on selvedge ends & abrasion with the reed dents at both ends of reed leading to groove formation.
4	Sizing recipe	1. Excessive size pick up % will lead to a very harsh & rough surface of the yarn. This reduces the friction resistance of yarn & starts to cut the dent during abrasion. 2. Less moisture % in yarn itself also leads to high abrasion property of yarn & starts cutting dents 3. Less moisture % in sizing chemical also imparts high friction properties to yarn
5	Reed Construc tion	1. Improper selection reed construction in terms of wrong airspace % or dent thickness can lead to such problem of groove formation. 2. Less hardness property of dent can also lead to early dent cutting in the reed. 3. Less airspace % & high denting order can also lead to groove formation. 4. Wrong selvedge construction in terms of weave, denting order, the width can easily cut dents at both ends of the reed.

2.2 Problems due to Groove formation are as follows:

Following are major impacts on loom efficiency & fabric quality due to groove formation.

Sr. No	Impact Area	Description
1	Warp Breakages	Due to groove formation, sharp edges will develop to dents which will break warp yarn frequently
2	Weft Cuts	The sharp edges formed due to cutting of reeds can cut the weft while beat up.
3	Floats in warp & weft	Groove formation can lead to improper opening of shed causing warp float or weft float in fabric.
4	Weft buckling in air jet looms	Groove formation also resists smoothing weft insertion in the shed in air-jet looms cause in weft buckling problem.
5	Loom Efficiency	A Frequent warp of weft breakages due to groove formation can increase loom stoppages & reduce the efficiency.
6	Loom Productivity	To avoid breakages, we have to scarify the loom speed & hence productivity.
7	Fabric quality like Appearance	All kind of stoppages & above impacts will deteriorate the fabric quality drastically i.e. because of abrasion of warp threads increase yarn hairiness and further affect the fabric hairiness.

2.3 Prevention of groove formation:

Some technical solution to avoid groove formation

1. Dent specification = Selection proper dent thickness & hardness is kept on prime importance while reed making.

2. Dent tensions = we impart the highest tensions to the dents at both ends of the reed to have good resistance to abrasion with selvedge yarn.

3. Selection of Reed specification = It is very important to select reed specification according to fabric design, construction, material of warp/weft & denting order. E.g. For same reed count & end density, the dent thickness, airspace % can be different for different yarn count & denting order (Weave).

4. Reed cleaning = For Efficient operation of a weaving machine, it is very necessary to keep the reeds clean. The machine is very easy to use and operate. During weaving operation, a lot of fly, fluff, wax, dust, dirt, oil etc. accumulate on the surface or in the dents of the reed which may result in frequent warp thread breakages. After specific period reed is needed to be cleaned. Before cleaning and after cleaned reed is shown in figure(a)

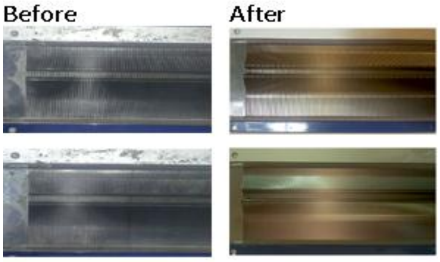


Figure (a)

5. Selection of Temple = The temples are used to hold fast the width of the woven cloth as equal to as possible to the width of the warp against reed width.
    1. In case of very high contraction (Especially for square construction of fabric) between reed & fell of cloth proper selection of temple can avoid less abrasion of selvedge ends with reed dent. So that groove formation can be reduced. E.g. Temple of at least 5 to 6 rings with 4 no of rows of pins & pin size of 0.75 mm is recommended in case of high contraction of selvedge. This can help to hold the fabric more parallel to the temple.

    2. It is also recommended to use more no of such rings (e.g.approx.8 to 10) so that the selvedge can be held straight between reed & fell of the cloth. This can reduce the abrasion of selvedge ends with reed & reduces the cutting effect, hence groove formation, shown in figure (b)

Figure (b)

6. Temple Setting / Cleaning = Proper temple settings & cleaning are required to hold the cloth selvedge straight between reed end & fell of cloth. This will reduce the abrasion of ends with reed dent.

7. Selvedge construction = for high selvedge construction it is recommended to use wider selvedge with less denting order & asymmetric weave. This will help to held selvedge in straight direction between reed & fell of cloth and reduces the contraction between them. Thus this will have less abrasion with dents. The figure (c) shows heavy shrinkage of fabric at selvedge area on almost all looms where the selvedge of the cloth is not straight near temple area.

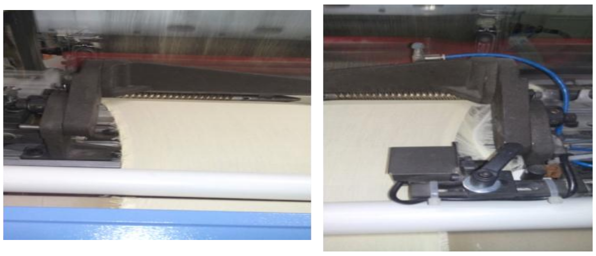


Figure (c)

- The selvedge width is also less around 7 to 8 mm which is not holding fabric straight near temple area and loom speed is around 1000 RPM to 1100 RPM on all machines shown in figure (2)

Figure (2)

8. Sizing =
The primary purpose of sizing is to produce warp yarns that will weave satisfactorily without suffering any consequential damage due to abrasion with the moving parts of the loom. During the process of weaving, warp yarns are subjected to considerable tension together with an abrasive action. A warp yarn, during its passage from the weaver's beam to the fell of the cloth, is subjected to intensive abrasion against the whip roll, drop wires, heddle eyes, adjacent heddles, reed wires, and the picking element [9], as shown in figure (d)

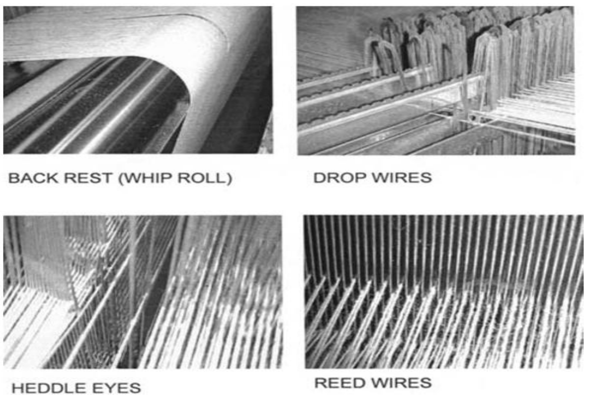


Figure - (d): Parts of the loom and major abrasion points.

- The intensity of the abrasive action is especially high for heavy sett fabrics. The warp yarns may break during the process of weaving due to the complex mechanical actions consisting of cyclic extension, abrasion, and bending. To prevent warp yarns from excessive breakage under such weaving conditions, the threads are sized to impart better abrasion resistance and to improve yarn strength. The purpose of sizing is to increase the strength and abrasion resistance of the yarn by encapsulating the yarn with a smooth but tough size film. In the size paste softeners/lubricants are used to reduce the friction between neighbouring warp thread in the loom during shed formation and the reed. The softeners thus perform the dual function making the yarn flexible and smooth. In other words, it also acts as a lubricant. Lubricants used are the oils and fats, mutton tallow, oils and emulsions, stearic acid emulsions, vegetable tallow, soaps, sulphated oils and fats, mineral oils, paraffin wax, plasticizers etc. The coating of the size film around the yarn improves the abrasion resistance and protects the weak places in the yarns from the rigorous actions of the moving loom parts. The functions of the sizing operation are

  a. To lay in the protruding fibres in the body of the yarn and to cover weak places by encapsulating the yarn by a protective coating of the size film. The thickness of the size film coating should be optimized. Too thick a coating will be susceptible to easy size shed-off on the loom.
  b. To increase the strength of the spun warp yarn without affecting its extensibility. This is achieved by allowing the penetration of the size into the yarn. The size in the yarn matrix will tend to bind all the fibres together, as shown in figure(e)

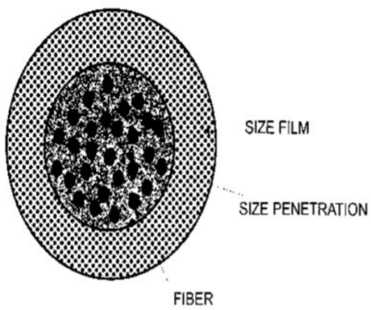


Figure- (e): Fiber-size binding in a yarn (not to scale). (Ref 10.)

1. The increase in strength due to sizing is normally expected to be about 10 to 15% concerning the strength of the unsized yarn. Excessive penetration of the size liquid into the core of the yarn is not desirable because it affects the flexibility of the yarn.

2. To make a weaver's beam with the exact number of warp threads ready for weaving.

Sizing–Weaving Curve

A typical sizing–weaving curve is as shown in Fig. (f)

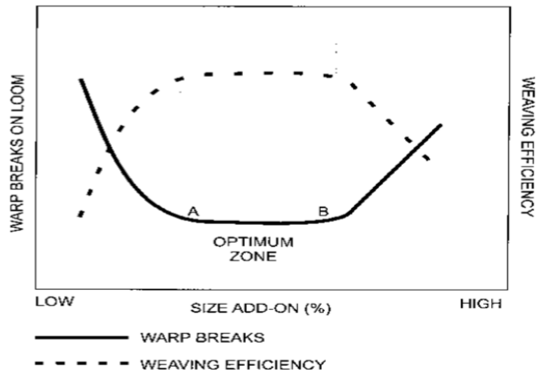


Figure (f): A typical sizing-weaving curve.(Ref 11.)

Initially, the warp breaks decrease with the increase in size add-on level. This is due to the associated increase in yarn strength and reduction in yarn hairiness. The coating of the protective size film around the yarn provides improved resistance to abrasion and also affords adequate protection to the weak places in the yarn. The reduction in warp breakage rate with an increase in size add-on reaches a point beyond which further size add-on will not show any significant improvement in yarn performance on the loom. The weaving efficiency, which is inversely proportional to warp yarn end breakage rate, reaches its peak when the warp breakage rate is at its minimum. The optimal range of size add-on is usually between points A and B as shown in the typical curve in Fig. (f). Increasing the size add-on beyond the optimum, in fact, has a detrimental effect on weaving performance since the warp breaks increase. Excessive size add-on leads to an increased penetration of the size, which makes the yarn inflexible. Also, higher size add-on may tend to coat the yarn with a very thick film of the size which is not sufficiently anchored to the fibres. Such a thick coating of size film may have a lower extensibility compared to the extensibility of the warp yarn itself. Inflexibility of the yarn and a size film not bound securely warp breakage rate. The best weaving efficiency region consistent with optimal size add-on is usually achieved in practice by trial and error.

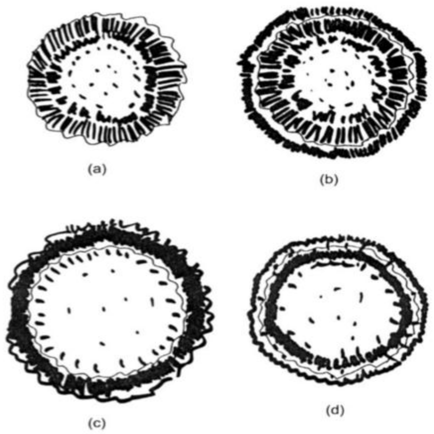


Figure (g): showing size distribution; (a) too much penetration, no surface coating; (b) too much penetration, more size added to provide surface coating; (c) too little penetration, no anchoring of yarn structure; (d) optimal distribution. (From Ref. 10.)

Use of sizing chemical with higher moisture % (Approx 12 to 15%) will reduce abrasion property of yarn & can lead to less abrasion with dents. Optimum size pick % can also give less harshness & stiffness to yarn. Such yarn will not cut dents in reeds. Good moisture content % in the yarn itself (Approx 7 to 8%) will also have less abrasion with reed dents which can reduce groove formation. Use of after waxing device with optimum wax % on sizing machine impart smooth surface to yarn (especially yarns like glass, synthetic, nylon etc) which will avoid cutting of dents in reed.

9. Weaving Machine =
   1. Proper settings of reed, temple, and emery cloth roller can reduce the contraction of selvedge between reed & fell of cloth. This will avoid dent cutting due to abrasion of ends with dent & hence groove formation.
   2. Use of wax bars or waxing device for selvedge ends on loom can reduce the abrasion of selvedge ends with dent & hence groove formation can be avoided.
   3. The staggering of warp sheet & change in beat up point in case of symmetric weave will also help to reduce the abrasion of ends with reed dents.

3. Trials or Test can be taken.

In case of groove formation problem to have some indication or guideline for attacking the root cause following tests / checkpoints can be done.

1. Fabric construction = Square construction fabric where density & count of yarn in warp & weft is same, is having highest probability of creating groove formation.

2. Yarn Material = Yarn material of highest coefficient of friction fibers like glass, nylon, synthetic leads to frequent groove formation problems.

3. Sizing parameters = Sizing parameters like Size pick up%, moisture % in chemical, which has impact on abrasion properties of yarn leading to dent cutting.

4. Yarn parameters = Tensile strength, abrasion properties, elongation %, moisture % can be checked to have idea about friction of yarn with reed.

5. Reed parameters = Dent thickness, dent hardness, airspace%, denting order.

4. CONCLUSION

All above solutions is only to prolong the life of reed against groove formation. The problem cannot be eliminated permanently.

REFERENCES

[1] Jump up to:[a] [b] Curtis, H P (1921). Glossary of Textile Terms. Arthur Roberts Black Book. Manchester: Marsden & Company, Ltd. 1921. Archived from the original on 2011-10-06. Retrieved 2009-06-23.
[2] Jump up to:[a] [b] [c] [d] 1911 Encyclopedia Britannica
[3] Cartwright, *Wendy (2007). Weave. Murdoch Books. p. 10.* ISBN 1-74045-978-4. *Retrieved* July6, 2009*.*
[4] Jump up to:[a] [b] [c] [d] [e] *Fox, Thomas William (1894).* The mechanism of weaving*. London: MacMillan and Company. p. 349*. Retrieved June 27, 2009*.*
[5] Jump up to:[a] [b] [c] *International Correspondence Schools, International Textbook Company (1906).* Ring Frames ; Cotton Mules ; Twisters ; Spoolers ; Beam Warpers ; Slashers; Chain Warping*. International Textbook Co. pp. 54–55*. Retrieved July 3, 2009*.*
[6] "Dent." The Oxford English Dictionary. 2nd ed. 1989.
[7] Jump up to:[a] [b] *Simpson, L. E.; M. Weir (1963). The Weaver's Craft. Leicester: The Dryad Press. p. 71.*
[8] Jump up to:[a] [b] [c] *The Weaver's Companion. Handwoven Magazine, Interweave Press. 2001. p. 14.*
[9] Zolotarvskii, L.T.Effect of the mechanical action in weaving on the technological properties of the warp yarn, Technol. Text. Ind. USSR; 1963, no.6, 99–105.
[10] Heap, V. Development of new synthetic sizes for polyester/cotton blends, Third International Sizing Symposium; Shirley Institute: Manchester, England, 1978, 117–144.
[11] Schutz, R.A. Theoretical and practical aspects of the sizing process, Chapter 2, A Symposium of Warp Sizing. Smith J. B., Ed.; Columbine Press: Manchester, England, 1963.