Development of Three Layered Technical Textiles in a Shuttless Loom

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ABSTRACT

In this research work an attempt has been made to develop the Three Layered Technical Textiles using Rapier Shuttless Loom with necessary alterations in loom settings and modifications in the essential components of the existingShuttless loom. For the development of Three layered Technical Textiles, threedifferent types of Sized Yarns have been used in a weaver's beam containing Lyocell micro fibre spun yarn, Cotton Yarn and Polyester spun yarn for the three layered Technical textiles as inner, middle and outer layers respectively with suitable modification in the primary and secondary motion of the loom, such asShedding, Let-off and Take-up motions.The three layered technical textiles has been sucessfully developed in existing Rapier Looms.

The modification in the shed geometry and shed crossing angle of the respective layers such as inner layer, middle layer and outer layer have been done. In let-off motion theposition and the load cell of the back restwere altered. Heavier load springs in oscillating bars has been changed. The warp weight has been maintained at the higher side. Inthe take-up motion three modification has been done which are the pressure roller diameter has been increased for better holding of fabric.Secondly cramming take-up has been adopted for the pick variation.Andthirdly bigger spikes inthe temple rings have been used for the better grip at fell of the fabric. With abovemodifications the development of three layered technical textile has been successfully carried out.

Keywords: *Lyocell, Cotton, Polyester, Rapier Looms, Temples, Multilayered Fabrics.*

1. INTRODUCTION

The recent R&D work reveals that multi-layered fabrics with different materials areperformingbetter than single layer conventional fabrics. Based on the specified applications, the selectios of different materials in the different layers have been used to get therequired properties.In this work, the Three Layered Technical Textileswas developed for the specific use of sports and active wear. During sports activity, tremendous heat energy is developed whichliberates sweat from body and the inner layer is directly contact with skin which should provide more comfort by way of absorbing the sweat and keeping the skin dry &cool. Middle layer has act as bridge inbetween inner and outer layer as a transporterand tactile, it act as a temperature regulator to maintain the body in a cool condition. From middle layer, the sweat and moisture were transfered to atmosphere through the outer layer and the outer layer also used to protectthe body from the environment conditions.

The sports activity has mainly divided into two categories such as, in-door and out-doors activities. Sport wear, Sport equipments and Sport foot wear are the three major fields where Multi-layered TechnicalTextiles have a very good scope. While designing the sportswear the shape, fit and comfort are the three major areas which play a vital role. The Sport wear is intact with the human body and it needs comfort. The reinforced composite materials of multilayered technical textiles are mainly used to develop the various sports equipments because of its strength and durability. The constructionalgeometry, packing density, structure and constitute of materials are the important aspects which decides the comfortproperties of the sportswear. Thesportswear should withstand the environmental abnormal conditions such as heat, cold, rainand it should also have the required mechanical properties such as strength, drape, comfort and fit. Weaving, Knitting and NonwovenTechnologies have been adopted to develop the Three Layered Technical Textiles.

In this present work, theThree Layered Technical Textiles have been produced usingthe Shuttlesslooms with fewmodifications, alterations and adjustments in the settings. Since the warp constituteneeds more number of shafts and different crossing points, the dobby attachments for shedding

motion is very essential. While weaving technical textiles heavy beat-up is required.Hence the "beat-up cam"and"slay gears" are directlydriven by the main motor. As like in terry mechanism, the take-up motion is controlled by servo motor.

Based on the above three concepts and necessary modifications with adjusting the settings,the Three Layered Technical Textiles was developed in the existingShuttlesslooms.

2. MATERIALS AND METHODS

The detail about the materials and the specifications to develop the Three Layer TechnicalTextilesare givenin Table 2.1.

Table 2.1 Material and specification for the Three Layered Technical Textiles

SL	Layers	Materials	Specifications			Woven structure
			Fibre	Yarn Count	Fabric weight	
1	Inner	Lyocell	0.7 Dtex	60.30 Ne	40 gsm	Backed Fabric Structure
2	Middle	Cotton	3.9 Mic	61.70 Ne	40gsm	3/2 Satin Structure
3	Outer	Polyester	0.7 Dtex	59.70 Ne	40gsm	Backed Fabricd Structure

The inner layeris Lyocell Microfibre of 0.7 dtex and yarn count of Ne 60.30^{s} was used. The middle layer isCotton yarn count of Ne$61.70^{S}$was used. The outer layer is polyester Micro fibre of 0.7 dtex and yarn of count Ne59.70^{s} was used.Cotton yarn count of Ne 61.70^{s} has been used for the weft. Thethree layeredfabricswere constructed with two different fabrics structure. For the inner & outer layer the "Backed Fabric Design" structure has been selected.For the middle layer "2/3 SatinWeave" Structure has been selected. The weight of the three layered fabrics is 120GSM with 185 X 96 ends x picks per inch.

During warping the Lyocell, Cotton and Polyester yarns are separately warped in the six wraper's beam with 616 ends per beam. So that six warper's beam contains the 3696 ends. Then the three sets of wraper's beam have to be sized and to be wound on the weaver's beam. The"Double Sow Box" sizing was used in which one is for cotton sizing and another one is for Lyocell / Polyester synthetic sizing.Both the sow box temperature has been maintained at 110^{o} C for better penetration of the size.

The drying zones have 11 cylinders, out of which six cylindersare having Teflon coating. 120^{o}C temperature has been maintained for the first two cylinders and gradually reduced from 120^{o} C to 70^{o} C inthe subsequentcylindersthe details in Table 2.2

Table 2.2 Parameters for three constituted warp sizing

SL	Layer	Materials	Ends	Sow Box Temp		Add On %	RF %	Viscocity	Drying temp in c	Waxing
				I	I					
1	Inner	Loycel	3696	110^{C}		14	14	14 Sec	120 / 70	Y
2	Middle	Cotton	3696		110^{C}	16	15	14 Sec	110 / 70	Y
3	Outer	Polyester	3696	110^{C}		14	14	14 Sec	120 / 70	Y

The size recipe for cotton yarn and Lyocell / Polyester yarns are different and the viscosity of the size add on %and solid content refractor meter % should maintained at 15 and 14 respectively. The details of size recipe for the cotton and Lyocell/ Polyester Synthetic are shown in Table 2.3

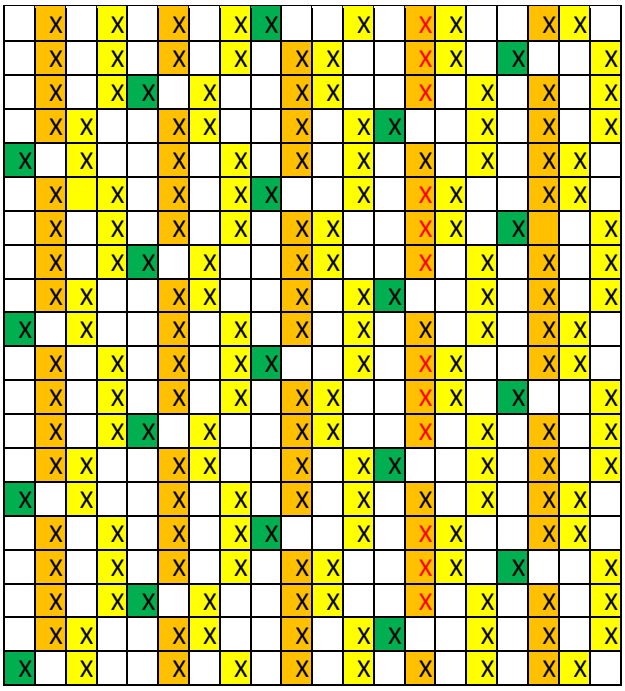
Table 2.3 Sizing Recipe for Cotton and Synthetic Warps

SL	Materials	Cotton	Synthetics
1	One sort Item	-	75.00 Kgs
2	Modified Starch	30.00Kgs	50.00 Kgs
3	Maize	30.00 Kgs	-
4	Thin Boiling Starch	50.00 Kgs	-
5	PVA	7.00 Kgs	10.00 Kgs
6	Softener	6.00 Kgs	7.00 Kgs
7	Acryrilic	10.00 Kgs	-
8	Antistatic Agent	-	1.00 Kgs
9	Wax	1.00 Kgs	-
10	Water	600 Liters	600 Liters
11	Refractor meter Readings	15%	14%

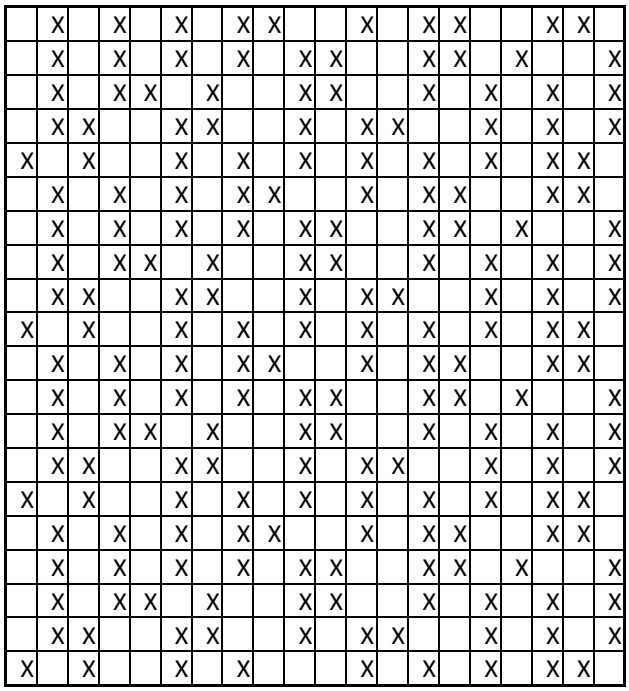
After drying the sized yarns the liquid wax has been coated. There are 18 lease rods are used to separate the sized yarns. Atthe head stock, the denting was carried out. The winding tension of the sized yarn during winding on the weaver's beam should be maintainedat230KP. All the three constituted yarns were equally spreaded over the entrie weaver's beam.

In drawing-in process, the drawing of ends has taken in the sequence of inner layer fabric threads then middle layer fabric threads and outer layer fabric threads. The 72/3 reed count was used to guide the warp during weaving and to maintain 185 EPI in the fabrics. The design and peg plan for the three layered technical textiles was shown inFig 2.1

Fig 2.1. Design and Peg Plan for Three Layered Technical Textiles.



DESIGN



PEG PLAN

3. RESULTS AND DISCUSSION

As per the design and peg plan mention earlier the three layeredtechnical textiles has been developed with the fabric structure of "Backed Fabric Design" for the inner & outer layer and "2/3 Satin Weave Structure" for the middle layer.

For the development of three layer fabrics in the shuttless loom, the following modifications and setting changes have been carried out in the loom.

i) Changes in primary motion of the shed geomentry and shed crossing.

ii) Modifications and adjustments in secondary motion of Let-off and Take-up.

The details of the above changes and modification are disscussed below.

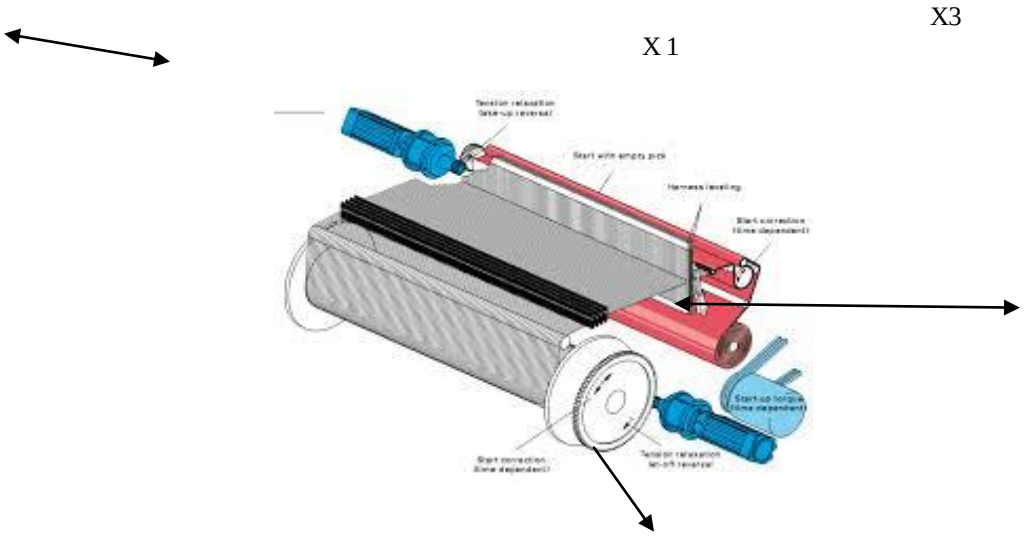
i) Changes in primary motion of the shed geomentry and shed crossing.

The shed opening and shed height of the heald frames influence the following factors.

The Cover of the fabrics, Warp and Weft breakage, Quality issues of warp & weft and bumping.In three layer fabrics there are twenty heald shaft are employed to distingue the layers. The first five shafts are usedfor inner layer of the fabricand the last five shafts are used for the outer layer of the fabric. The ten shafts which are in between above mensioned two sets are used for middle layer of the fabric. At 180 degree the open shed position has performed. The bottom shed should lowerthan the curvature of the guidehooks. And top shed should be above 3mm than the guide hooks. The staggered shed opening is used which has clear seperation of warp threads. The first heald frame starts from 90mm from reference point and incrementally increased 1 mm until last heald frame. Shed staggering plays a vital role in clear warp separation. For the better cover of the fabric the late shedding has been used. The timing cycles has set in such way that the shed crossing of inner and outer layer should be occurred at 305degreeand the shed crossing of middle layers occurred at 300 degree.

ii) Modifications and adjustments in secondary motion of Let-off and Take-up.

The back rest height has a vital role in fabric forming. Since the basic weave structure is 2/3 satin the back rest position has been kept at + 20 mm above the mean line. The back rest bar should be made in oscillating manner so as to keep the sufficient space for the warp threads.The heavier springwereemployed to maintain for uniform warp tension. The Let-off tension on machine wasmaintained at 180kgs. The Back Rest should be set at "Inner Position". Warp Stop Motion bars should be set at "Rear End"..More than 8 mm distance has been maintained between the fell of the clothto avoid "Bumping".And also"Heavy Duty Full Width Temples" were used to reduce the cloth bumping. The pressure roller diameter hasbeen increased by 20 percent to maintain the sufficient fabric holding pressure. 60 grains emery roller has been used for the better grip of the fabric while take-up.The following figure shows the schematic diagrame of material passage and Primary and secondary motion of shutless loom.



X 1. Shows the necessary modifications carried out in Let-off motions such as attachments of Load cell to maintain warp tension and heavier spring at oscillating bar to have better warp threads separation

X2. Shows the necessary modifications carried out in Take-up motions such as attachments of servo drive for cramming pick variation and heavy duty full width temples to have heavier beat-up

X3. Shows the necessary settings to carried out in Shed Geometry such as different shed crossing for three layered fabric and increased shed opening / height for better shed formation for three layered fabrics.

4. CONCLUSION

Using Rapier Shuttless loom with nessary alterations and modifications three layered technical textiles has been developed.Lyocell Micro Fibre Spun Yarn was used for the inner layer, Cotton yarnwas used in the middle layer and Polyester spun yarn was used in outer layer.The necessory modifications in the shed geomentry and shed crossing angle that place a vital role to produce Three Layered Technical Textiles in the shuttless loom.The shed crossingof inner and outer layer has been set at to occur 305 degree .The shed crossing of middle layer hasbeen set at to occur 300 degree. The Back rest postion has been kept +20 mm above the mean line.The let-off tension on warp maintained at 180 Kgs. More than 8mm distance has been maitained at the fell of the cloth to avoid the cloth bumping. The weight of the developedthree layered fabrics is 120 GSM with 185 X 96 End X picks per inch.

5. REFERENCE

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