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Development of Speciality Embroidery Thread for Application in Stretchable Knitted Fabrics for Body-Fit Garments

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***Abstract*:- The developed embroidery thread is a multilayer structure and inelastic in nature. The elastane filament which is highly elastic is used as core, which is covered by two layers of staple fibers as a sheath. The inner layer of sheath is made by water soluble PVA fiber and the outer layer is having fiber like polyester/viscose. The ultimate three layer structure thus produced is inelastic in nature to facilitate effective embroidery on stretchable fabrics. Subsequently when embroidered fabric/garment is treated in hot water, the water soluble inner layer of sheath of embroidery thread is dissolved. This result in regeneration of stretch-ability in embroidery thread due to void created between highly stretchable core filament and outer sheath. This embroidery thread has such a stretch-ability that the applied embroidery thread can follow the elastic movement of the stretchable fabric/garment.**

Key words: Elastane, poly vinyl alcohol (PVA), polyester fibre, viscose fibre, embroidery, stretch-ability

1.0 INTRODUCTION

Embroidery threads are usually made from long staple combed mercerized cotton, viscose and polyester fibers. All these threads are relatively inelastic in nature and thus can easily and effectively be applied on relatively un-stretchable fabric like woven fabrics. When these embroidery threads are applied on stretchable fabric like knitted fabric, the problem distortion of embroidery structure arises due to differential stretch-ability of embroidery yarn and fabric. The fabric tends to lose its natural stretch-ability due to the presence of inelastic embroidery threads. This also causes uneven stretching at different places of fabric body, i.e. where there is no embroidery stretch-ability will be good, but at places of embroidery there will be no stretch-ability. This results in an odd look of fabric/garment. There are also chances of damage of fabric/garment at the point of embroidery due to difference in stretch-ability of embroidery threads and fabrics. Therefore, it is a need to develop such type of embroidery yarn, which shall have stretch-ability to match the stretch-ability of knitted fabric.

Most of the defects in embroidery are dependent on quality of embroidery yarn. There are various types of defects that influenced quality of embroidery. These defects may be due to various elements used during embroideries like embroidery threads, embroidery materials properties and process parameters. In one of the study (Svetlana RADAVIČIENĖ et al), it was investigated that properties of embroidery threads influence buckling of fabric. The effect of fibre composition, density and structure were also investigated.

Some research work has been done on developing of composite yarn. Different types of composite yarns developed by using combining of fibres as core and sheath. In one of the study a stretch yarn comprised of stretchable core covered by an inelastic fibre sheath was developed. The first fibre was an elastomer (spandex) and the second fibre was a polyester based co-polymer, the amount of the second fibres being in the range of 60-90% of the total fibres of the stretchable yarn. The first and second fibres were connected together by known technique such as open or closed intermingling jet. These stretchable composite yarns were used for making woven fabric. In another study (WO2012062480), a stretch yarn was developed, which comprised a stretchable core covered by an inelastic fibers sheath, the stretchable core comprises first and second fibers that have elastic properties, the first fiber is an elastomer and the second fiber is a polyester based (co)polymer.

In this study, the stretchable multi-component embroidery thread is developed on DREF-3 spinning machine, using elastane filament as primary core, polyvinyl alcohol (PVA) as secondary core and dyed polyester and viscose fibers as sheath, to develop a stretchable embroidery thread.

2.0 MATERIALS & METHODS

2.1 Materials

Elastane filament of 40 denier is taken as primary core and PVA fibre is taken as inner sheath, which is wrapped by polyester and viscose as outer sheath fibers. Elastane was chosen because of its elasticity and Poly vinyl alcohol (PVA), being a hot water soluble synthetic polymer. Polyester & viscose were selected because most of the normal embroidery threads are made of polyester and viscose fibres.

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2.2 Methods

Thread was developed on a modified DREF-3 spinning machine (Friction spinning). A positive feed roller (elastane delivery system) was attached with machine for feeding the elastane as primary core, PVA fibers fed in the drafting unit-I as inner sheath and polyester /viscose sliver fed to drafting unit-II as outer sheath.

The core fibres were fed axially along the yarn direction whereas the sheath fibres were fed vertically. Elastane filament and PVA fibres fed after drafting unit-I enters the nip of the spinning drums (comprised of pair of perforated drums) whereas the polyester/viscose fibres coming from drafting unit-II fall on the surface of the core sliver (being fed after the drafting unit-I and feed roller into the nip of the perforated drums) and wrapped around the core to form a sheath. The sheath fibres were attached to core fibres by false twist generated by the rotating action of the drums.

The twist imparted was determined by the ratio of motion drum speed to delivery rate. After passing through the spinning aggregate, the yarn was drawn off through three outlet rollers and delivered to the winding device.

The developed embroidery thread is a multilayer structure and temporarily inelastic in nature. At the centre of the yarn, there is a highly elastic filament and it is covered by two layers of staple fiber sheaths. The inner layer is hot water soluble PVA fiber and the outer sheath is insoluble fiber like polyester/viscose. The ultimate three layer structure thus produced is inelastic in nature to facilitate effective embroidery on stretchable fabrics. Subsequently when embroidered fabric/garment is treated in hot water, the water soluble inner sheath of embroidery thread is dissolved. This result in regeneration of stretch-ability in embroidery thread due to void created between highly stretchable core filament and outer sheath, which result in elastic mobility. This embroidery thread has such a stretch-ability that the applied embroidery thread can follow the elastic movement of the stretchable fabric/garment.

Hand Embroidery and Machine Embroidery was carried out on stretchable knitted fabric using developed stretchable embroidery thread and normal embroidery thread and the embroidery samples were washed and evaluated for their stretch ability at the embroidery area.

3.0 RESULTS & DISCUSSION

3.1 Comparison of Yarn Properties:

Physical properties of developed embroidery thread and normal embroidery thread were evaluated and are mentioned below in Table-1:

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Table-1 Comparison of Yarn Properties of developed & normal embroidery thread

S. N.	Test Parameters	Developed Embroidery Thread	Normal Embroidery Thread
1.	Yarn Count, Ne Count C.V.%	11.91 0.61	2/23.8 1.03
2.	CSP	1698	3087
3.	Uster %	9.74	6.88
4.	Imperfections/Km Thin Places (-50%) Thick Places (+50%) Neps (+200%)	 5 34 63	 2 13 20
5.	Elongation at Break%	13.09	11.90
6.	Co-efficient of friction against metal surface	0.13	0.10

The quality of developed embroidery thread is slightly poor as compared to normal embroidery thread in terms of lower strength, higher unevenness and imperfections due to the use of friction spinning technology.

3.2 Comparison of stretch-ability of embroidery thread

The developed stretchable thread and normal embroidery purchased from market were evaluated for their stretch properties. Initially threads were tested for stretch-ability before and after washing. It was found that stretchable thread showed more stretch-ability as compared to normal embroidery thread. The results obtained are given in Table-1

Table-2 Stretch % in Developed embroidery thread & Normal embroidery thread

Condition of samples	Developed embroidery thread			Normal embroidery thread		
	Initial length (cm)	Stretch length (cm)	Stretch %	Initial length (cm)	Stretch length (cm)	Stretch %
Before washing	50	52.25	4.5%	50	51.0	2%
After washing	50	57.5	15%	50	51.0	2.2%

3.3 Comparison of stretch-ability at embroidery area in knitted fabrics

Hand Embroidery and Machine Embroidery was carried out on stretchable knitted fabric using developed stretchable embroidery thread and normal embroidery thread and the embroidery samples were washed and evaluated for their stretch ability at the embroidery area.
The stretchable knitted fabric was tested for stretch% in wale-wise and course-wise direction without any embroidery. Then design motif was prepared by hand and machine embroidery using normal embroidery thread and developed embroidery thread.

Table-3 Stretch-ability of knitted fabric & embroidered area for Hand embroidered samples

S. No.	Direction of stretch	Stretch ability of knitted fabric without embroidery	Stretch ability at embroidered area with developed embroidery thread		Stretch ability at embroidered area with normal embroidery thread	
			Before washing	After washing	Before washing	After washing
1	wale-wise	186.54%	107.0%	126.1%	106.1%	106.4%
2	course-wise	120.73%	94.2%	108.4	92.1%	92.3%

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The results show that there is a gain of about 15 - 18% in stretch-ability at embroidery portion, in both directions using developed stretchable embroidery thread as compared to a normal embroidery thread.

Table-4 Stretch-ability of knitted fabric & embroidered area for M/c embroidered samples

S. No.	Direction of stretch	Stretch ability of knitted fabric without embroidery	Stretch ability at embroidered area with developed embroidery thread		Stretch ability at embroidered area with normal embroidery thread	
			Before washing	After washing	Before washing	After washing
1	wale-wise	158.88%	105.2%	122.6%	104.0%	104.8%
2	course-wise	141.67%	102.7%	116.2	95.0%	95.7%

The result shows that there is a gain of about 13% - 16% in both directions using developed stretchable embroidery thread as compared to a normal embroidery thread.

The performance of the developed embroidery thread on high speed embroidery machine was slightly poor as compared to normal embroidery thread because of lower strength and higher unevenness and imperfections due to the use of friction spinning technology. The developed embroidery thread was given surface finish with silicon oil, which slightly reduced the breakage rate on the embroidery machine.

4.0 CONCLUSION

Hand embroidery and Machine embroidery samples were evaluated for their stretch-ability at the embroidery area. There is a gain of about 13 - 18 % in stretch-ability at the portion of embroidery in Wales-wise direction and Course-wise direction using developed embroidery thread as compared to normal embroidery thread.

In case of hand embroidery the performance of developed embroidery thread was satisfactory and almost at par with the normal embroidery thread. However in case of high speed machine embroidery, thread performance was slightly poor as compared to normal embroidery thread.

Therefore, the developed multi-component embroidery thread may be beneficial for embroidering stretchable body-fit garments, especially where the stress and strains are more likely at the embroidery areas.

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