

Ahimsa silk union fabrics—A novel enterprise for handloom sector

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India, the only country which produces all four varieties of silk, *i.e.*, Mulberry, Tasar, Muga and Eri and Karnataka is famous for mulberry silk production. The silk spun from mulberry pierced cocoons without killing pupae for silk extraction considered as "*Ahimsa silk*" is also called as "Peace silk". *Ahimsa silk* was spun on CSTRI (Central Silk Technological Research Institute, Bangalore) Motorized Spinning-cum-Twisting Machine and yarn shows unequal distribution of slubs and snarls, an added advantage that gives a fancy appearance and texture for the yarn. The courser and uneven *Ahimsa silk* yarn is most suitable for handloom sector and appropriately used as shot weft. It is new enterprise in this sector, since *Ahimsa silk* is compatible to interweave with cotton, art silk, terrycot, polyester and filature silk to produce designer's fabrics. Keeping *Ahimsa silk* as weft, the dress materials and shirting were woven in cotton, art silk, terrycot and filature silk on pit looms and furnishing in cotton and polyester on Hardakar jacquard loom. These union made-ups exhibited greater tensile strength with better elongation, resistance to abrasion, excellent hand- feel properties and moderate pilling. The production cost of *Ahimsa silk* union made ups were found to be inexpensive compared to cent per cent filature silk. Considering the increased awareness of animal protection around the world, *Ahimsa silk* union made-ups definitely have better market potential and can create new horizon in the fashion world.

Keywords: *Ahimsa silk*, Union made-ups, Tensile strength, Abrasion resistance, Drapability

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Silk, the queen of textiles spells luxury, elegance, luster and comfort. Mankind has always loved this shimmering fibre of unparalleled grandeur from the moment Chinese Empress Shi-Ling Chi discovered it in her tea cup. India enjoys the world monopoly of producing all four varieties of silk, *viz.*, Mulberry, Tassar, Eri and Muga of which Mulberry- the best known among the silks is the product of *Bombyx mori* L. Karnataka is the premier mulberry silk producing state in India contributing yearly sixty per cent of the country's total production. The main objective of the silk industry is to reel silk from cocoons and to weave silk fabric. The traditional process of silk production involves killing thousands of pupae by boiling cocoons. Majority of the consumers who enjoys glory of the lustrous silk are not aware of boiling cocoons to unwind the silk from the cocoon. But there involves another technique of extracting silk filaments by giving life to pupae to emerge as moth by piercing through. Alas! life for the pupae.

Ahimsa Silk is obtained from pierced cocoons without killing pupa for silk extraction considered as "Peace silk" is widely accepted by Jain community, *yogis* and environmentalists. Silk obtained from pierced cocoons is spun, yielding the yarn evenly distributed with slubs and snarls, giving an added advantage of fancy appearance and texture^{1,2}. This coarser and uneven *Ahimsa silk* is most suitable for handloom sector and appropriately used as shot. This is a new venture in the silk sector since *Ahimsa silk* is compatible to interweave with natural as well as manmade yarns to produce designer fabrics at a reasonable price.

Therefore, the present study was undertaken with the aim of producing variegated dress materials, shirting and furnishings using *Ahimsa silk* yarn as weft and assess, the mechanical and functional properties, along with cost of production.

Materials and methods

The Bivoltine (Cocoons built by a silkworm race with two generation in a year) and multivoltine (Cocoons built by a silkworm race with more than two generation in a year) pierced cocoons

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(Fig.1) were softened in a solution of soap + soda (3 and 1.5 gpl, respectively) and spun on CSTR, Mysore motorized spinning machine developed by Central Silk Technological Research Institute, Bangalore. The *Ahimsa silk* union made-ups were woven at different handloom weaving centers of Karnataka (Fig. 2). Keeping *Ahimsa silk* as weft, the dress materials were woven in cotton, art silk and filature silk as warp, shirting with cotton, terrycot and filature silk as warp on pit loom and furnishing with cotton and polyester as warp on Hardekar jacquard loom. These newly designed union textile materials were tested for mechanical and functional properties based on the standard test methods listed in the Table 1.

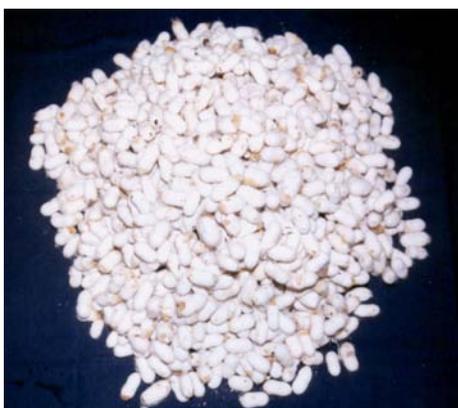


Fig.1- Pirced cocoons



Fig.2- Handloom weaving

Economics of newly designed union textile materials

The fixed cost and variable cost of the newly designed made-ups were calculated for cost comparison. Depreciation was worked out at the rate of 10 % on the fixed costs and interest on working capital was calculated at the rate of 9 % per annum.

Results and discussion

Utilization of *Ahimsa silk* in the handloom sector

The handloom industry in fact is the largest economic activity next to agriculture providing employment to about 124 lakh weavers in India either directly or indirectly. *Ahimsa silk* is specially suited for handloom sector because of its coarseness and unevenness. The *Ahimsa silk* union fabrics were woven at different handloom weaving centers of Karnataka. The handloom industry of Karnataka is the largest cottage industry in terms of magnitude of employment and is next only to agriculture. Therefore, occupies an important place in the development of the state by catering to the needs of economically weaker sections of the society.

Assessment of mechanical properties of newly designed union fabrics

It is clear from the Table 2 that among the union fabrics, Filature silk x *Ahimsa silk* dress material and Shirting (D_F 20/22denier, 35S) were woven with finer warp and weft. It may be due to the filature silk being inherently fine, more regular and uniform than the cotton, art silk, terry cot and polyester shot woven union fabrics. All the newly designed fabrics were densely woven with greater ends and picks per inch than the control sample (24 ends, 20 picks) which may be because of the yarn type, basically hand spun yarn was relatively coarser and uneven because of slubs and snarls. The cloth thickness was noticeably high with furnishing materials (Fc-0.93mm) compared to other union fabrics. Among the fabric samples Cotton x *Ahimsa silk* (Dc-1.22 and 1.20, Sc-1.40 and 1.10, Fc-1.00 and 1.10 exhibited higher

Table 1-Physical testing of *Ahimsa silk* union Textile materials for selected properties

SINo	Property	Instrument	Standard method
1.	Cloth count (Numerical expression)	Pick glass	-
2.	Mass per unit area (GSM)	Electronic weighting balance	-
3.	Cloth thickness (mm)	Shirleys thickness tester	ASTM 1777-1975
4.	Cloth stiffness (cm)	Shirleys stiffness tester	BS: 3356-1961
5.	Cloth crease recovery (degree)	Ureka crease recovery tester	AATCC: 66-1975
6.	Cloth drapability (%)	BTRA drape meter	IS: 8357-77
7.	Cloth tensile strength	Hounsfield Universal testing Machine	IS: 12676 - 1989
8.	Cloth abrasion resistance	Martindale abrasion tester	-
9.	Cloth pilling	Heal's Pilling tester	IS : 10971 - 1984

bending path which inturn depicted its stiffness, due to sizing material present in the cotton during preloom process that contributed to cloth stiffness. Among the samples, Filature silk x *Ahimsa*. Silk dress material (D_F-112.33) and shirting (S_F-107 degree) showed highest crease recovery angle both in warp way and weft way than the rest as silk possess soft and pliable handle exhibited greater recovery angle. The recovery or resistance towards creasing largely depends on the fibre content, resiliency and presence of sizing material (starch) which makes the fabric stiff, thereby reducing the pliability. The stiffness in turn influences the recovery resistance; soft and pliable fabrics however exhibit greater recovery angle. In other words the cloth stiffness is inversely proportional to crease recovery angle³.

Assessment of functional properties of newly designed union fabrics

The main elements contributing to the tensile strength of a fabric are fibre content, yarn type & count, yarn extensibility, weave type, fabric sett and amount of starch in the cloth. The Table 3 reflects on the functional properties of control and union fabrics. The weft way tensile strength was higher than the warp way may be due to fiber content and coarser yarn. *Ahimsa* silk which was hand spun (mean warp 40.99 kgf and weft 46.48 kgf) considered to be stronger than the cotton (16.24 kgf), art silk (22.53kgf), terrycot (49.68 skgf) and filature silk (32.86 kgf). In general the weft way elongation was lesser (ranging from 12.41 to 16.80 %) than warp way may be due to its fiber content, *i.e.*, silk which is

Table 2-Mechanical properties of newly designed *ahimsa* silk union fabrics

Sl. No.	Name of the material	Yarn count (Ne)		Cloth count (Numerical expression)		Cloth Thickness (mm)	Crease recovery (degree)	Cloth Stiffness (cm)	
		Warp	Weft	Ends	Picks			Warp	Weft
I	Control (<i>Ahimsa silk</i> x <i>Ahimsa silk</i>)	35	35	24	20	0.50	111.00	0.99	1.00
II. Dress material									
1	Cotton x <i>Ahimsa silk</i> (D _C)	60	33	72	58	0.46	88.91	1.22	1.20
2	Art silk x <i>Ahimsa silk</i> (D _A)	120d	34	72	62	0.36	99.42	1.00	1.10
3	Filature x <i>Ahimsa silk</i> (D _F)	20/22d	35	74	57	0.31	112.33	0.68	1.00
III. Shirting									
1	Cotton x <i>Ahimsa silk</i> (S _C)	42	35	52	48	0.46	94.53	1.40	1.10
2	Tericot x <i>Ahimsa silk</i> (S _T)	60	33	54	44	0.38	103.00	1.07	1.20
3	Filature silk x <i>Ahimsa silk</i> (S _F)	20/22d	34	120	76	0.29	113.30	1.00	1.00
IV. Furnishing									
1	Cotton x <i>Ahimsa silk</i> (F _C)	40	33	60	40	0.93	102.00	1.10	1.10
2	Polyester x <i>Ahimsa silk</i> (F _P)	35 (155d)	35	48	68	0.51	107.00	1.25	1.20

Table 3-Functional properties of newly designed *Ahimsa* silk union fabrics

Sl. No.	Name of the material	Tensile Strength (kgf)		Elongation (%)		Cloth abrasion resistance (cycles)	Drape coefficient (%)	Cloth pilling (ratings)
		Warp	Weft	Warp	Weft			
I	Control (<i>Ahimsa silk</i> x <i>Ahimsa silk</i>)	40.99	46.68	14.87	13.81	272	79.58	3
II Dress material								
1	Cotton x <i>Ahimsa silk</i> (D _C)	16.24	61.12	19.63	13.52	31	108.00	3
2	Art silk x <i>Ahimsa silk</i> (D _A)	22.53	63.23	25.23	13.26	28	86.78	3
3	Filature x <i>Ahimsa silk</i> (D _F)	10.50	52.75	11.98	13.70	25	80.68	2
III Shirting								
1	Cotton x <i>Ahimsa silk</i> (S _C)	41.71	51.94	18.93	14.70	30	92.67	3
2	Tericot x <i>Ahimsa silk</i> (S _T)	49.68	66.90	26.94	12.41	26	88.91	3
3	Filature silk x <i>Ahimsa silk</i> (S _F)	32.86	57.52	28.78	15.70	23	75.23	2
IV Furnishing								
1	Cotton x <i>Ahimsa silk</i> (F _C)	73.57	50.57	17.86	12.45	127	81.62	2
2	Polyester x <i>Ahimsa silk</i> (F _P)	106.80	67.54	17.07	16.80	100	98.01	3

Table 4-Economics of newly designed *Ahimsa* silk union fabrics
Amount in rupees/meter

Sl. No.	Particulars	Control	Dress materials			Shirtings			Furnishings	
			D _C	D _A	D _F	S _C	S _C	S _F	F _C	F _P
I	Variable cost									
a)	Raw material	62.00	51.00	51.00	59.00	33.50	30.00	53.00	66.50	52.00
b)	Preparatory process	12.00	12.00	15.00	15.00	10.00	10.00	10.00	12.00	15.00
c)	Weaving charges	20.00	20.00	25.00	20.00	15.00	15.00	20.00	20.00	20.00
d)	Interest on variable cost	10.00	9.22	8.77	10.44	6.50	6.11	9.22	10.88	9.66
	TOTAL	104.00	92.22	94.77	104.44	65.00	61.11	92.22	109.38	96.66
II	Fixed cost (Loom depreciation)	2.14	2.14	2.85	2.14	2.14	2.14	2.14	10.88	8.92
III	Total production cost	106.14	94.36	97.62	106.58	67.14	63.25	94.36	120.26	105.58



Fig. 3- Art silk X Ahimsa silk dress material



Fig.4 - Cotton X Ahimsa silk dress material

considered to be more plastic than elastic because its very crystalline polymer system does not resist the polymer movement, which on the contrary is possible in an amorphous system. Hence when silk is stretched additionally, the polymers, which are already in stretched state may not elongate further⁵. The control sample exhibited higher resistance to abrasion (272 cycles) than the newly designed union fabrics may be due to the coarser *Ahimsa silk* yarn, in turn increased the cloth thickness, resulting into better abrasion resistance. Whereas newly designed union fabrics possessed low resistance to abrasion attributed to its finer yarn count, low thickness value and pliable texture. During abrasion, the fibrous substance in the form of dust is raised from the fabric surface and gradually reflects into fuzz, nap, pile and finally yarn breakage. In other words the components that contribute to loss in cloth thickness (%) do influence

loss in mass (%). The continuous surface abrasion resulted into decrease in fabric weight and thickness^{3,4}. The drape co-efficient (%) was least in Filature silk X *Ahimsa silk* dress materials (D_F – 80.68%), shirting's (S_F – 75.23%) and Cotton X *Ahimsa silk* furnishing (F_C 71.15%), which in turn exhibited soft and more pliable texture than the rest. All the newly designed made-ups exhibited slight to moderate pilling owing to their fibre content and yarn type.

Economics of newly designed *Ahimsa silk* union fabrics

The economics of *Ahimsa silk* union made ups is presented in Table 4. It is clear from this Table that Salwar suit woven in Filature silk x *Ahimsa silk* (D_F) was reasonably expensive compared to Cotton x *Ahimsa silk* (D_C) and Art silk x *Ahimsa silk* (D_A). Further, it is interesting to note that the total cost of control sample

and Filature silk x *Ahimsa silk* shirting (S_F) was maximum (Rs. 106.14 and Rs. 106.58) followed by Cotton x *Ahimsa silk* (S_C -Rs. 94.36) and terrycot x *Ahimsa silk* (S_T -Rs. 102.62), which may be due the cost of raw materials that accounted to about 59.21 and 56.16 % of the total production cost. Moreover, the cost per kg of Filature and *Ahimsa silks* were exorbitantly higher than the cotton and terrycot yarns.

It is evident from the Table 4 that among the newly designed furnishing materials the total cost of Cotton x *Ahimsa silk* furnishings (F_C - floral) is maximum (Rs. 120.26) compared to control (Rs. 106.14) and Polyester x *Ahimsa silk* (F_P) material (Rs. 105.58), which may be due to the utilization of greater amount of weft, *i.e.*, *Ahimsa silk*. It is essential to mention here that cost/kg of *Ahimsa silk* yarn was higher than cotton and polyester. On the whole it may be inferred that the cost of union fabrics was found to be inexpensive than the cent per cent pure silks⁶.

Conclusion

The hand spun *Ahimsa silk* yarn being highly versatile with fancy effect, can be interweave with natural and man-made fibers to produce designer fabrics at more reasonable prices. It creates unique

products that appeal to the demand of consumer, believes in non-violent and eco-friendly production processes. A luxurious feel and incredibly soft hand woven *Ahimsa silk* union fabrics would go long way not only to meet the needs of the Indian buyers but also a boon for the Indian exporters. The production cost of *Ahimsa silk* union fabrics were inexpensive than the pure silks, will be an encouraging enterprise for handloom weavers and designers.

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