CHAPTER V

SUMMARY AND CONCLUSIONS

The new developments in the textile manufacture with various types of blends offer varieties in the market. Consumers seek not only fashionable but also have become conscious of comfort enhancing and fatigue reducing garments. Lycra has been introduced into both woven and knitted fabrics for the optimum performance and aesthetics. The influence of Lycra on fabric properties having different geometry, fabric count, mass, thickness, air permeability, shrinkage and stretch and recovery behavior would be useful to create variations in clothing pattern. This would further be useful for construction of garments to fit the range of sizes with satisfactory fit, style and comfort properties. This property and other related physical properties would lead to develop standards for sizing of bodice blocks for woven and knitted fabrics blended with Lycra to fit a range body sizes.

Woven Lycra blends have additional advantage of allowing sewers to more closely fit a pattern and be very comfortable. It imparts a great level of stretch and dimensional recovery, adding comfort and wrinkle resistance to the garments. Knit Lycra blends would be as comfortable and more of dimensionally stable fabrics. The fibre blend and fabric structure is very important to study for the fit the garments that impart comfort, aesthetic appeal and flexibility to the wearer of various size groups.

The purpose of this research was to study physical properties of woven and knitted Lycra blends with different geometry and use them for garment construction to see the garment fit with stretch and recovery property of Lycra and location of seams with larger body sizes. Importance of seam in garment construction for body contour as aesthetic parameter and stretch and recovery property as performance parameter would be useful for garment designing with Lycra.

To achieve the purpose of the study, the specific objectives thus framed were as follows.

5.1 Objectives of the study

5.2.1. To study the physical properties for Damage tolerance: Pilling and abrasion resistance, Stress-strain properties: Uniaxial extension and Fabric and yarn structure deformation.

5.2.2. To study the comfort parameters of fabrics such as fabric sett and thickness, tightness and air permeability and wear properties: shrinkage.

5.2.3. To develop basic bodice block and adaptation of it on the basis of physical properties of fabrics for range of body sizes.

5.2.4. To test the performance and serviceability of the garments for fit, comfort and appearance and recovery behaviour with wear trials.

5.2 Method of procedure

This was an experimental study to understand impact of Lycra on woven and knitted fabrics. Fabric properties were examined for their relationship to shrinkage behavior, strength and recovery properties, stretch and fit properties to determine whether incorporation of Lycra had its impact on performance properties of fabrics. Two fabrics under each, with three percent Lycra woven and knitted categories with three percent Lycra were selected to study stretch property of Lycra with fabric geometry. This property was finally used for construction of garments.

Phase I consisted of preliminary testing of fabrics to obtain preliminary data of fabrics. Fibre content, thread count of fabrics, cloth cover, tightness factor, thickness, and weight per unit area was done at standard testing conditions maintaining 65% ± 2% R.H. and 20°± 2°C temperature. The samples were conditioned for 24 hours in the dessicator before testing to keep them free from moisture.

Phase II was carried out with physical testing for performance and serviceability of fabrics. Determination of loose fibres that protrude from a fabric surface under the influence of rubbing action was carried out using Pilling tester. Abrasion resistance of fabrics was done on Taber Abraser using ASTM D1175-61 standard. The fabrics were tested for growth and elastic recovery property under constant rate of loading.

The tensile strength and elongation of fabrics were determined on Lloyd Tensile Testing Instrument using ASTM D 5034 standard based on the principle of CRE (Constant rate of Extension). The fabrics were also studied for shrinkage behavior using Launder-o-meter following ASTM D 2724 test method. Two sets of samples were made, one washed without detergent and another with 5% non-ionic detergent, Teepol. The effect of laundry was followed by air permeability test using Matefem Air-permeability tester. Fabric samples before and after laundry were tested for air permeability.

The stress-strain behavior under cyclic loading was carried out for the purpose of studying performance of fabric during wear. The fabric when put in use in form of garment, seam has its importance in wear property. A fabric tensile test on fabrics containing a seam was determined to test seam quality.

Phase III was carried out with construction of garments. The tested fabrics were used for construction of the upper garment for female of 81.0 cm standard bust size. The basic pattern of garment with specified design details taken for pilot study was adapted for length alteration and front opening facility. These garments were tried on models with larger size of 86.0, 91.0 and 96.0 cm to study garment fit and appearance with stretch and recovery property of these fabrics.

Appropriateness of garment fit or looseness was recorded photographically and through visual assessment. The constructed garments were also assessed for garment stretch and recovery property after wear trials. As final application of these fabrics for apparel use, physical properties of fabrics were related to garment properties and statistically analysed.

5.3 Results and Discussion

5.3.1 Preliminary data of the fabrics

- Preliminary data for fibre content, thread count, cloth cover, tightness factor, thickness and weight per unit area of fabric were determined. Confirmation of the content of Lycra in the fabric was done through microscopic analysis and chemical solubility test.

- Thread count (number of warps and wefts) was almost same for woven fabrics Plain (2x2 basket) weave Fabric A(168 x 96) and Twill (2x2) weave fabric B(168 x 92) per square centimeter. Single Knitted jersey knit Fabric C and Rib knit fabric D had number of wales and courses 46 x 64 and 33 x 60 respectively.
- Cloth cover for both woven fabrics A (26.2) and B(26.6) had almost similar values as their thread count was also similar. Fabric C and D had different values for tightness factor as 0.67 and 0.85 respectively.
- Thickness values of both woven fabrics A and B were similar i.e., 0.26 mm as the thread count was same. Fabrics C and D showed different thickness values, 0.69 mm and 0.78 mm respectively.
- The weight per unit area for woven fabric A was 141.31 gm/m^2 & 140.92 gm/m^2 for fabric B. Knitted fabrics C and D had 202.49 and 299.39 gm/m^2 value respectively.

5.3.2 Physical testing for performance and serviceability of fabrics

Results of physical testing for performance and serviceability for all four fabrics gave comparative idea for fabrics as how woven or knitted fabrics perform for their behavior with Lycra incorporated with them.

5.3.2.1 Pilling and abrasion resistance of fabrics

Woven fabrics A and B were with their compact geometry did not show protruding fibres. Similarly knitted fabrics C and D showed no effect of pilling on the surface. Any effect of fussiness, fading or change in colour was also not observed.

The fabrics with their close woven and knitted structure were quite resistance to abrasion showing resistance upto 680 to 1000 abrasion cycles respectively. Rib knit fabric was more resistant than all other fabrics.

5.3.2.2 Growth and elastic recovery properties of fabrics

Woven fabrics did not show recovery in warp direction presenting elastic recovery value 0. Weft direction exhibited better results for fabric A and B with elastic recovery value 0.8 and 0.9 respectively.

5.3.2.3 Strength and elongation properties of fabrics

Woven fabric A showed higher elongation value in both warp and weft direction compare to twill weave fabric B. Bias direction of plain weave showed higher elongation value exhibiting quite flexible behaviour than compact twill weave construction. Fabric C showed higher elongation value in wale wise direction than fabric D. In bias direction, the loops for both the fabrics behaved independently, showing lower elongation value than course wise direction.

5.3.2.4 Shrinkage behavior of fabrics

The shrinkage values for both woven and knitted fabrics were different for all fabrics as per their geometry. Woven fabrics A and B showed extension upto -1.5 percent in warp direction. Weft showed shrinkage ranged from 0.5 to 3.0 percent. Fabric C exhibited progressive shrinkage when washed without detergent in wale as well as in course direction ranging from 3.5 to 5.5 percent and 4.5 to 6.5 percent respectively. Fabric D showed progressive shrinkage in wale direction from 5.5 to 8.0 percent when washed without, and 7.0 to 8.5 percent when washed with detergent solution. Extension from -0.5 to -1.5 percent without detergent wash and 0.5 to -0.5 percent with detergent was observed in course direction.

5.3.2.5 Air permeability of fabrics

Fabrics when washed with water only, due to swelling and contraction of the yarn in the fabrics A and B showed decreased permeability of air(505 and 410 $m^2/m^3/hr$) respectively. While washed with detergent, with removal of surface finish from the fabrics, the air permeability increased to 585 $m^2/m^3/hr$ and 500 $m^2/m^3/hr$ for fabrics A and B respectively.

The treatment with only water made the fabric structure swollen and compact and more resistant to air showing decreased value for fabric C(485 $m^2/m^3/hr$) and 600 $m^2/m^3/hr$ for fabric D also. Further the treatment with detergent gave lower readings of air permeability for knitted fabrics C and D with closeness of loops due to shrinkage in these fabrics.

5.3.2.6 Elastic properties of fabrics

Woven and knitted fabrics under study were first tested for their tensile strength in lengthwise, widthwise and bias direction. On the basis of the tensile graph obtained yield point for maximum recovery at stress was found and the samples in each direction were worked to study recovery below yield point, at yield point and above yield point. It was observed that woven fabrics have minimum recovery at smaller extensions (from 0.8 to 1.12), where knitted fabrics had higher extension (from 7.2 to 7.79) exhibiting 100 percent recovery.

5.3.2.7 Seam strength of fabrics

Seam strength of fabrics was studied with extension and load curves. Lowest seam strength was observed in warp wise direction of both woven fabrics. Fabric B in weft wise direction with Lycra and twill weave exhibited higher strength than fabric A. In the bias direction, similar property was observed.

Both the knitted fabrics had maximum seam strength in course direction followed by bias and wale direction. Looped structure with Lycra in weft knit construction contributed to higher seam strength in course direction.

5.3.3 Garment construction and assessment

5.3.3.1 Visual assessment.

The appropriateness of garment fit or looseness was recorded photographically and through visual assessment. Garments in woven construction had limitation of accommodating larger size figures. Though there was Lycra yarn in the weft direction, with firm woven construction it could fit only one size larger than the standard size.

Knitted garments with their elastic property exhibited very good fit on many body sizes. The style of the garment with princess seam lines in the front and back projected stress on the garment with increased body size by shift in the placement of princess line towards the sides. This suggested that the placement of seam line has its importance designing garments with knits especially when many sizes are expected to fit in one size.

5.3.3.2 Assessment of garment stretch and recovery property

The constructed garments were also assessed for garment stretch and recovery property after wear trials. Woven garments after wear trials showed average recovery of 50 percent when worn by a larger size figure. The wider areas of bust and waist girth showed minimum recovery.

Knitted garments showed 100 percent recovery from size 81.0 to 86.0 and 91.0 cm. Only 96.0 cm size showed about 60 percent recovery at the bust and waist levels. Lycra in rib knit structure exhibited more recovery than single jersey.

5.3.3.3 Analysis of garment stretch and recovery property

As final application of these fabrics for apparel use, physical properties of fabrics were related to garment properties and statistically analysed using paired t-test. While comparing average expansion of woven fabrics with Test value, it was found that t-value was not significant with p-value at 0.005 level of significance showing there was not much difference found between expansion and test value. While comparing t-value for average recovery p-value was found to be significant showing difference between the extension and recovery values indicating less recovery for woven fabrics.

The comparison of average expansion of knitted fabrics with Test value showed that t-value was significant with p-value at 0.005 level of significance showing difference between expansion and test value. While comparing t-value for average recovery p-value was found to be significant showing difference between the extension and recovery values indicating higher recovery for knitted fabrics.

5.4 Conclusions

The fabric geometry has its influence on physical properties. Combination of Lycra yarn in smaller amount of 3 percent gives good results with adequate comfort.[2]

Woven and knitted fabrics in different geometry with 3 percent Lycra were tested for their physical properties. On the basis of that their performance in the garment for stretch and recovery was also analysed. It was concluded from the results that

- Fabrics in woven and knitted construction with Lycra yarn had better wear properties like pilling and abrasion resistance.

- Growth and recovery behavior of woven fabrics was lower than knitted fabrics. Knitted fabrics had very good elasticity property.
- Woven fabrics limited the stretch property of Lycra with strong, compact and firm structure.
- Higher elongation was observed in knitted constructions with Lycra.
- Stability of dimension on laundry washes would give longer wear life to the garments as after initial progressive shrinkage the fabrics stabilized.
- Seam strength of fabrics was higher for knitted fabrics. Knitted fabrics with Lycra and textured polyester sewing thread had good compatibility in contributing better seam strength than woven fabrics.
- Air permeability of woven fabrics was lower than knitted fabrics. Looped structure of knitted fabrics on shrinkage reduces air permeability.
- Elastic recovery under cyclic loading showed that woven fabrics recover less within the limit of smaller extension with rigid structure.
- Knitted fabrics recover maximum exhibiting elastic property with higher extension.
- Garments made out of woven fabrics with standard size (81.0 cm) fitted well to the body of a larger size (86.0 cm), but elastic recovery of garment from larger (expanded) to original (standard) was found to be poor. Woven garments even with three percent Lycra could not be worn by figures of two different sizes.
- Woven fabrics could have the arm scye cut slightly lower and allowance for ease can make the wearer of the larger size comfortable.
- Limited range of stretch with woven construction actually needs to have individual garment size developed with marginal ease for comfortable body activities.
- Knitted garments with higher elastic property can fit the wearers of many larger sizes (86.0, 91.0 and 96.0 cm). Standard size garment (81.0 cm) with three percent Lycra in knit structure can fit the wearers of larger sizes 86.0 and 91.0 cm with total recovery. Further the size of 96.0 cm gave poor recovery from expanded to original size at bust, waist and hip areas.
- Garment style with princess seam lines projected stress on the garment with increased body size shifted princess seam lines towards the sides.
- Placement of seam line has its importance while designing garments with knits

especially when many sizes are expected to fit in one size.

5.5 Recommendation

Based on the results of the study, further work could be carried out for development of size charts separately for woven, knitted and Lycra incorporated garments to facilitate the consumers in buying the garments of correct fit.

The present study of the seam in the vertical direction of fabric was studied. Similar study can be done for behaviour of seams in the horizontal direction of garments with Lycra.