Chapter 8
Summary

A comprehensive literature related to tencel fibre’s history, production route, properties and application has been reviewed. The literature highlighting the principle of yarn formation, yarn structure, yarn characteristics and comparison of the properties of blended yarns produced on ring, rotor and air-jet spinning system along with theory highlighting the prediction of blended yarn properties have also been presented.

In the first part of the study, the properties of tencel-polyester and tencel-cotton ring-spun yarns produced with different blend ratios and twist factors have been studied. The study revealed that tencel-polyester yarns are stronger, more extensible, more even, rigid, less hairy, have fewer imperfections and possess higher work of rupture than their tencel-cotton counterparts. A higher level of twist produces a yarn with higher extension, higher unevenness and imperfection, higher flexural rigidity and lower hairiness. The yarn strength and work of rupture, on the other hand, increase initially but decrease thereafter as the yarn twist is further increased beyond that level. The optimum tex twist factor for maximum tenacity of 100% tencel, polyester and cotton yarns are observed to be at 28.71, 33.50 and 43.07 respectively and the blended yarns show optimum twist factor in between their respective optimum twist factors in pure state. An increase in proportion of tencel fibre in the mix enhances the tensile and regularity characteristics of tencel-cotton yarns. However, for tencel-polyester yarns, both these characteristics deteriorate with increase in tencel content in the mix. Blending of tencel fibre either with polyester or cotton substantially increases the yarn flexural rigidity and hairiness.

In the second part of the study, the physical characteristics of tencel-polyester and tencel-cotton yarns spun on ring, rotor and air-jet spinning machines in relation to different blend ratios have been investigated. Amongst ring-, rotor- and MJS yarns, the former are found stronger, less rigid and possess higher work of rupture, whereas rotor yarns are more even, have fewer imperfection and less hairy regardless of the fibre-mix. Rotor spun yarns are more extensible than ring and MJS yarns for tencel-cotton mix, whereas in the case of tencel-polyester mix, ring yarn possesses higher extensibility than rotor and MJS yarns. In comparison with rotor-spun yarns, MJS
yarns display higher strength, less extensibility and lower work of rupture, except for 100% cotton and tencel-cotton mix, where former supersedes the latter in respect of yarn tenacity. Amongst all yarns, the MJS yarns have least breaking extension. Further, tencel-polyester yarns yield more satisfactory results than the tencel-cotton yarns in terms of strength, breaking extension, evenness, imperfections and work of rupture. For all types of yarns, increasing tencel content both in tencel-polyester and tencel-cotton fibre-mix makes the yarns rigid and more hairy.

In the third part of this study, the low-stress and recovery properties of tencel blended ring, rotor and MJS yarns have been compared. In comparison with ring- and MJS yarns, rotor-spun yarns are more bulky, possess low tensile energy and resilience, lower immediate elastic recovery and have higher delayed elastic recovery and permanent deformation. The abrasion resistance of MJS yarns is found best for tencel-polyester mix. In case of tencel-cotton mix, the rotor- spun yarns give the highest abrasion resistance followed by ring and MJS yarns. Ring spun yarns, on the other hand, possess least decay but behave poorly during abrasion test for 200 cycles. The resistance to abrasion of 100% cotton yarn is superior to 100% polyester yarn upto 1000 cycles, and thereafter polyester registers very higher resistance. An increase in tencel content in both tencel-polyester and tencel-cotton mixes produces a compact yarn with reduced abrasion resistance, decreased structural integrity and reduced tensile resilience with poor recovery properties and require higher tensile energy. Generally, tencel-polyester yarns display better low stress characteristics, except the abrasion resistance. All recovery parameters significantly deteriorate with the increase in amplitude of extension regardless of yarn structure.

The last part of this research is devoted to study the hybrid effect for mechanical properties of tencel blended ring-, rotor- and MJS yarns. The measured values of tensile strength, breaking elongation, flexural rigidity and abrasion resistance of tencel-polyester and tencel-cotton blended yarns are compared with the values predicted using linear and quadratic rule of mixture (ROM). No significant hybrid effect is observed for abrasion resistance of tencel-polyester yarns and tenacity and breaking extension of tencel-cotton yarns, and a linear ROM is found better in predicting the yarn properties. However, for all yarn types, a significant hybrid effect is present for tenacity and flexural rigidity of tencel-polyester mix and for flexural rigidity and abrasion resistance of tencel-cotton mix and hence a quadratic ROM model suits well for all these yarn. For breaking extension, a pronounced negative
hybrid effect is present for tencel-polyester ring- and rotor- spun yarns and a positive effect for tencel-cotton MJS yarns only. In general, a negative hybrid effect exists for tenacity and breaking extension, and a positive hybrid effect for flexural rigidity irrespective of fibre and yarn structure. The abrasion resistance shows a mixed trend.