8.1 CELLULASE TREATMENT OF COTTON YARNS

This work was initiated to investigate the effect of cellulase treatments on the regular and compact yarns and the effect of gauge length and strain rate on the properties. Also the mechanical, thermal and morphological properties of cotton/sisal reinforced Polypropylene composites were examined. Weight loss is an indication of extent of hydrolysis which shows an increasing trend with increase in enzyme add on. Pretreatments namely, scouring and bleaching have led to weight losses, the former showing higher values than the latter. However a pre treatment with sodium hydroxide namely, mercerisation clearly increases the weight loss for 60s and 80s compact yarns. This may be attributed to lower twist. This is also due to improved accessibility of fibres for the large enzyme molecule. With the exception of 60R, 80R, 80C weight losses show significant increase following mercerisation. Mercerised and enzyme treated samples show greatest losses due to greater activity. Higher temperature has led to greater weight losses. But maximum weight loss was observed in 60R at 50° C for 2% concentration. Wickability showed substantial increase after the enzyme treatment. Compact yarn showed better wickability in comparison with regular yarns. This is due to the lowest twist given to them (24.01tpi) as against (34.3tpi) given to regular yarns. Wickability of 80 yarn is better as compared to 60s. Enzyme treated yarns following pre treatments with sodium hydroxide show a significant improvement in wickability which is due to
more amorphous nature and greater accessibility. Values of shrinkage of all types of yarns show a significant increase in the case of mercerized and mercerized enzyme treated yarns. Among those, 60R and 80R show increase of shrinkage values. Mercerised treatment has led to higher shrinkage values. Compact yarn shows an increase in shrinkage in bleached, scoured and enzyme treated which is noticed in both the cases. The bending rigidity values of the scoured yarns are greater than those of scoured enzyme treated yarns. The bleached yarns showed higher flexural rigidity than those of bleached enzyme treated yarns. With the exception of mercerised yarns, the compact yarns show highest bending rigidity in comparison with Regular yarns. An interesting observation is that in both 60s and 80s yarns the Regular yarn shows a higher value for mercerised yarns. In the case of 60s yarns, with the exception of mercerisation treatment, values of bending rigidity are higher in compact yarns. The opposite effect is noticed in 80s yarns where compact yarns show an increase. Perhaps enzyme treatment following pre treatments in respect of finer yarns offers the best advantage, as a lower value of bending rigidity would imply better handle of fabric made from them. This may be due to a considerable freedom of movement of fibres during yarn bending. The tenacity of various treated yarns in which the bleached and bleached enzyme treated yarns are included show higher values. It was observed that the elongation of 60R and 80R after mercerization show higher values among all. Maximum values of work of rupture were observed for mercerized 60R and 80R. Since work of rupture and elongation are synonymous, the increase is due to higher elongation of yarn following mercerisation. There was not much difference in minimum twist of cohesion of enzyme treated yarns.
8.2 STATISTICAL VARIABILITY IN THE STRENGTH AND FAILURE OF COTTON YARNS AND WEIBULL MODELLING

While there is a trend in the tensile strength of regular yarns at different gauge lengths in that at higher gauge length the strength shows a drop consistently at 5 mm/min, the strength values at 500mm/min that are found are erratic. Yarn tested at longer gauge length of 254 mm at 500 mm/min strain rate shows higher value in comparison with 5mm/min. Even in treated yarns this trend is noticeable. This may be due to several reasons such as realignment of fibres and increase in broken fibres.

The reduction in tenacity and the extension can be attributed to the well known weak-link effect, the probability of presence of weakest link is greater in a longer specimen. The longer specimen exhibits lower extension.

Another notable feature in 80 Ne yarns is that the strain is highest at a gauge length of 12.7mm irrespective of the treatments given. An increase in strain rate has led to a drop in extension.

The Weibull plots were plotted for all the cotton yarns and the effect of different estimators were studied on Weibull modulus and parameters. It is noticed that estimator 1(Hazen) gave the higher weibull modulus values in comparison with others.

8.3 MECHANICAL BEHAVIOUR OF SURFACE MODIFIED COTTON AND SISAL FIBRE REINFORCED POLYPROPYLENE (PP) COMPOSITES

Short fibre natural fibres such as sisal, jute, banana reinforced thermoplastic composites are increasingly gaining attention for their
emerging applications in the field of aerospace, automotives, construction, textiles, etc. The tensile strength of Cotton/PP composites increased with increase in the fibre content. When Cotton/PP (CFP) and Cotton/Sisal/PP (CSFP) composites were compared 15% CFP, CSFP showed better results. The flexural strength of CFP gets slightly increased by increasing the composition of cotton Fibres. The 15% CFP blend exhibited better flexural strength than the other compositions. From the maximum load at break there is also an increase in load by increasing the PP/Cotton blend. The impact strength of the composites increased gradually at a small rate i.e. upto 5 wt% and on further increase in composition drastically. The decrease impact strength or smaller variation in strength may be due to introduction of micro space between the fibre and the polymer. These results proved that CSFP blend has better properties than those of CFP blend.

8.4 EFFECT OF CLOISITE 25A ON THE MECHANICAL PROPERTIES OF COTTON/SISAL FIBRES REINFORCED POLYPROPYLENE COMPOSITES.

PP-MAPP- nanocomposites were successfully prepared by employing melt intercalation technique. The comparative performance of the nanocomposites were studied. The WAXD patterns showed that the addition of clay improved the clay dispersion in the CSFP matrix in presence of compatibilizer. Among all composition 3% of nanoclays used in this study, have shown better mechanical properties than others. Further good toughness and stiffness were coexistent in the CSFP/clay nanocomposites compatibilized with 2 wt% of MAPP. All the composition of clay has demonstrated the apparent nucleating effect because the crystallization took place at higher temperature upon cooling. The crystallization Temperature (°C) temperature is also affected by the intercalants characteristics. TGA thermographs showed higher thermal stability in case of the nanocomposites.
This is significant as most of the commercial applications of layered silicate nanocomposites will be commercially viable if they are cost competitive with regular additive approaches to modify polymer properties.

8.5 CONCLUSION

- The effect of cellulase enzyme on the mechanical and surface properties of regular and compact cotton yarns were studied.

- As the concentration of enzyme was increased the weight loss, specific flexural rigidity, shrinkage loss, twist liveliness, tenacity, work of rupture, elongation and wicking rate were also found to vary irrespective of the spinning system.

- Tenacity and elongation of yarns show a decrease with an increase in gauge length.

- The strain rate significantly affects the tenacity in that, higher strain rate higher the tenacity.

- The CSFP blend has better properties than CFP blend. It showed an increase with increase in the fibre content.

- The nano clay was used with cotton and sisal fibre reinforced PP composite to increase the strength at lower cost and also to use of natural fibres to make the composite eco-friendly. The tensile and flexural properties of nanocomposites increased upto 3% of nanoclay but decreased on further addition, whereas the opposite trend was shown for water absorbance.

8.6 FUTURE SCOPE OF WORK

- This work was directed towards the determination of impact of enzyme treatment on the handle related property and the hygroscopic behaviour of the yarn.
• It is suggested to study the surface changes that the yarn undergoes when treated with enzyme so that exact change that the surface of the yarn undergoes for the respective change in the above mentioned properties along with other miscellaneous property is understood. Also, it is suggested to study the frictional properties of the yarn to understand the tactile property of the yarn.

• The study of biodegradation of composites can be proposed in future studies.