CHAPTER 7

SUMMARY AND CONCLUSIONS

Currently the leather industry is facing tremendous pressure from the environmental regulatory bodies because of huge solid wastes generated in various stages of leather processing. Solid wastes not only increase high biological and chemical oxygen demand but also pollute the environment seriously. It is the primary concern of the tanners to develop a suitable technology from the solid wastes for the elimination of solid wastes problem.

Among the solid wastes, fleshing is a major solid waste that contributes to nearly 65% of the total wastes. The nature of the waste is highly complex because of harmful nature of the chemicals used in liming process for the separation of hair and fleshings. If these fleshings are not utilised properly, it will increase high BOD and COD in the resultant effluent. On the other hand, fleshing is one of the protein rich solid waste and hence it can be easily utilised for many purposes. Keeping in mind, it has been used for the development of a RP. The RP has been applied in various stages of leather processing and the effect on tanning was studied. The interaction of RP with delimed pelt and subsequent combination studies with chromium and wattle extract (vegetable tannin) were compared with control. The following conclusions were drawn from the studies.
Limed fleshing has been used for the development of RP. Fleshing was hydrolysed to the level of peptides by using proteolytic enzyme at 1%. The hydrolysed peptide fractions show the particle size of 600 nm and molecular weight of 15000 D. The peptides were further broken down into the level of amino acids by using 6N Hydrochloric acid at 110°C.

The observations of hydrolysed fleshing from Circular Dichroism spectrum showed the presence of random coil at the level of 95-97%, β-sheet of 2-5%.

High Pressure Liquid Chromatography (HPLC) spectrum analysis of the compound present in the fleshing hydrolysate showed the presence of two types of compounds. Polar compounds gave the yield of 62% and non-polar compounds a yield of 37%.

HPLC analysis of amino acids using Ortho Pthalaldehyde as a derivative showed the presence of different amino acids. Glycine (22.8%) was the major amino acid present in the hydrolysate. Next to Glycine, Aspartic acid (7.90%) and Glutamic acid 10.99% were present. Other amino acids such as Lysine (2.13%), Arginine (8.62%), Histidine (2.13%), Phenyl alanine (2.50%) etc were also present.

Only few amino acids undergo chemical treatment in the development of RP. Aspartic acid and Glutamic acid will undergo reduction reaction with sodium Borohydride, Dimethyl Sulfate and oxidation reaction with Pyridinium Chloro Chromate resulting in the formation of aldehyde.
Lysine and Arginine favour oxidation reaction with Pyridinium Chloro Chromate resulting in the formation of aldehyde. The other amino acids don’t exhibit remarkable reactive potential as compared to Aspartic acid and Glutamic acid. The active aldehyde content present in the RP was 28%

- The average particle size of RP measured was in the range 50-200 nm.

- The interaction of RP with delimed pelt at various levels of 5%, 10%, 15% and 20% were studied. Based on the shrinkage temperature, DSC analysis and Hydroxy Proline loss, the RP at the level of 5%, 10%, 15% show minimum tanning action in preserving the pelt. On the other hand RP at 20% level exhibited tanning property and showed shrinkage temperature of 74°C without any degradation in for 5 days.

- The tanning system using RP at 20% level was optimised for further study. Tanning experiments showed the presence of 3.90% aldehyde in the leather. $^1$HNMR analysis of spent liquor shows the presence of alkyl, aromatic and $\alpha$ proton in the experimental sample. Similarly FT-IR analysis showed C-H stretching and bending of methyl and methylene and C=O stretching frequencies of aldehyde in the experimental sample carried out for the application of RP at 5%, 10%, 15% and 20% levels. C-H stretching and bending of methyl and methylene compound was not present in the formaldehyde control sample.
The bio-degradability studies of the experimental sample (RP 20%) showed degradation level of 72% in comparison with 64% after 120 hrs.

The results of the color matching studies showed decrease trend in reflectance measurements for the experimental sample because of more uptake of dye. The shade becomes darker when compared to the control sample.

Scanning Electron Microscopic (SEM) studies of the crust leather showed that there was no surface deposition of the tannin or much difference in the fibre orientation and fibre structure of the experimental sample. The physical strength properties of the crust leather were comparable to the control sample.

The interaction of RP (in the optimised system) with chrome at various levels of 2%, 4%, 6% and 8% gave the following conclusions. The exhaustion level of chromium in experiment was 94.4% in comparison with 69.4% for the application of BCS 8%. Tanning experiments showed the presence of 1.32% aldehyde in the leather. The shrinkage temperature of the experimental leather for the application of BCS 8% showed 118°C in comparison with control sample. The DSC analysis confirmed the shrinkage temperature data. $^1$HNMR analysis of spent liquor shows the presence of alkyl protons, aromatic and $\alpha$ proton in the experimental sample. Similarly FT-IR analysis showed C-H stretching and bending of methyl and methylene and C=O stretching frequencies of aldehyde in the leather.
experimental sample carried out for the application of BCS at 2%, 4%, 6% and 8% levels.

♦ The bio-degradability studies of the experimental sample (BCS 8%) showed degradation level of 75% in comparison with 68% after 120 hrs. The reduction of TDS to the level of 67.05% and 2.18% in comparison with conventional chrome tanning process and pickle-less tanning process was achieved in the experimental process.

♦ The results of the color matching studies showed decrease trend in reflectance measurements for the experimental sample because of more uptake of dye. The shade becomes darker when compared to the control sample.

♦ Scanning Electron Microscopic (SEM) studies of the crust leather showed that there was no surface deposition of the tannin or much difference in the fibre orientation and fibre structure of the experimental sample. The physical strength properties of the crust leather were better than the control sample.

♦ The interaction of RP (in the optimised system) with wattle extract at various levels of 2%, 4%, 6% and 8% led to the following conclusions. The exhaustion level of wattle extract in the experiment showed 90.2% in comparison with control sample of 80.5%. Tanning experiments showed the presence of 1.41% aldehyde in the leather. The shrinkage temperature of the experimental leather showed 70°C for 2% wattle treatment and 88°C for 8% wattle treatment. DSC analysis
confirmed the shrinkage temperature data. $^1$HNMR analysis of spent liquor shows the presence of alkyl protons, aromatic and $\alpha$ proton in the experimental sample. Similarly FT-IR analysis showed C-H stretching and bending of methyl and methylene and C=O stretching frequencies of aldehyde in the experimental sample carried out by using wattle extract at 2%, 4%, 6% and 8% levels. The bio-degradability studies of the experimental sample (Wattle extract 8%) showed degradation level of 86.63% in comparison with 77.7% after 120 hrs. The reduction of TDS to the level of 65.05% and 1.60% in comparison with conventional vegetable tanning process and pickle-less tanning process was achieved in the experimental process.

♦ The results of the color matching studies showed decrease trend in reflectance measurements for the experimental sample because of more uptake of dye. The shade becomes darker when compared to the control sample.

♦ Scanning Electron Microscopic (SEM) studies of the crust leather showed that there was no surface deposition of the tannin or much difference in the fibre orientation and fibre structure of the experimental sample. The physical strength properties of the crust leather were better than the control sample.

♦ High exhaust chrome and vegetable tanning systems for the application of RP at various levels of 1%, 2% and 3% in tanning process (after basification) showed chrome exhaustion
level of 82.5%, 92.8% and 93.0% in chrome tanning process and 90.0%, 94.1% and 94.9% for vegetable tanning process. The shrinkage temperature of the leather showed 128°C for chrome tanned and 86°C for vegetable tanned leather. The results indicated that 2% RP was sufficient to achieve maximum exhaustion in both chrome tanning and vegetable tanning. The dye exhaustion level was increased remarkably up to the level of 94.5% for the experiment (RP treated after basification) and pollution load of BOD and COD was reduced to 40-48%, 20-25% respectively.

- Retanning effects on the leather were studied in the post-tanning processes using RP. The properties of leather such as grain tightness, softness, fullness, dyeing property and physical strength properties were studied. The results showed that there was an improved uptake of dye to a level of 95.2%, better properties such as softness, dyeing uniformity in comparison with control sample. SEM results showed that there was no surface deposition or fibre orientation of the experimental sample. The physical strength properties of crust leather were better than the control sample.