CHAPTER 2

SCOPE AND OBJECTIVES

2.1 POLYMER – LEATHER COMPOSITES : LITERATURE REVIEW

In addition to leather substitutes, polymer composites based on leather wastes as fillers are reported to be useful for many applications. Products from such composites find applications in construction materials, automobile interior moldings, heat and sound insulating boards, shoe soles and flooring materials. Moldings with good antistatic properties, air permeability and good appearances have been prepared from thermosetting resins and powdered leather (Nishibori 1988a). Tanned leather wastes when mixed with PVC, Poly (vinyl acetate), Polystyrene or Polyolefins have been found to produce uniform moldings (Nishibori 1988b). Mixing powdered chrome leather with plasticized PVC increases the porosity and water absorption characteristics of the latter (Rudzka and Szczepaniak 1977).

Wear and water-resistant panels suitable for construction and furniture have been manufactured by pressing waste leather or paper fibers with waste plastics such as LDPE, PS, and PP at 100-200 °C for 15-30 minutes. Powdered gelatin when mixed and press moulded with PP at 200 °C results in moldings with, good moisture sorption-desorption characteristics and good polyurethane coatability. Fire resistant construction materials have been
manufactured by reacting leather scrap materials with polymethylene, polyphenylene isocyanates (Cioca and Fertell 1982). Automobile interior moldings with good appearance and feel have been prepared from a polyurethane composition containing powdered leather. Coating a mould surface with this mixture and filling the mould with the polyurethane forming composition results in curing during moulding.

Wood substitutes containing upto 15 parts of leather shavings when bonded with formaldehyde–urea resins have produced heat and sound insulating boards with lower flammability than the particle boards (Sedlicak and Pivoluska 1990). Ceramic floor tiles and facing bricks, prepared from a mixture containing 1.2% by weight of chrome tanned leather have exhibited greater water uptake due to the porosity developed by the thermal destruction of leather fibers during baking (Orgiles et al 1991). Thermal conductivity, absorption and release of water vapor, coefficient of friction and sound transmission loss of compounds containing rubber formulations with chrome leather fibers are found to be suitable for floorings having special qualities of a sound insulator (Ishihara 1979).

Shoe sole materials with good permeability to water vapor, perspiration and strength after stitching have been manufactured by vulcanizing ground waste rubber filled with waste leather pieces along with other additives (Tivadar 1986). Vulcanizates of butadiene rubber composites with leather fibers have shown improved mechanical properties and abrasion resistance. Processability is found to improve with compounds containing microcrystalline cellulose and chrome leather fibers as fillers.
Vulcanization time for natural rubber compounds with leather fibers are reported to decrease from 3-4 minutes for conventional blends to 2 minutes for the compounds containing leather fibers. Mechanical properties of these vulcanizates, however, are found to be poor but did not deteriorate for about one year (Simoncini et al 1983). Compositions by tyres with good skid resistance on ice and snow have been developed by mixing 30 phr powdered leather with a 70/30 NR/BR rubber blend (Takino et al 1990). Similar non-skid rubber compositions, useful for golf clubs has been prepared by mixing powdered leather with a 30/70 EPDM/NR blend (Hashimoto and Tomita 1989).

Rheological studies of composites based on leather fibers and LDPE or EVA copolymers at various temperatures and shear rates have exhibited two types of flow behaviour which have been interpreted in terms of fiber-matrix interactions (Ayad et al 1986 a). Under certain conditions, one part of the relative viscosity is found to be a curved function of the fiber content and the other part is attributed to the fiber-matrix interaction (Ayad et al 1986 b, Pichon 1984). Similar studies on viscoelastic properties of epoxy resin composites containing leather dust has shown improved relaxation characteristics. Minimum mechanical losses and the corresponding increase in dynamic shear modulus of the filled epoxy composites are attributed to an increase in the conversion of epoxy groups during curing (Bilym et al 1988).

Extensive studies on Polymer-Leather composites involving the deposition of acrylate monomers into chrome tanned hide have been carried out (Jordon et al 1980 a, 1980 b, 1981 a and 1981 b). Vulcanization characteristics and mechanical properties of chrome leather shavings in Nitrile rubber and Nitrile Rubber-PVC blends for shoe sole applications have been reported by

While the presence of chromium in leather wastes complicates their recycling, the recycling problem is entirely different for scrap tyres. Scrap rubber is in a chemically a cross linked network state which is highly resistant to degradation. Therefore, the energy requirements for degrading scrap rubber in such operations as pyrolysis, incineration and catalytic cracking would be higher.

When chrome containing leather wastes are mixed with scrap rubber in a suitable form in presence of small quantities of virgin rubbers and re-vulcanized, useful products such as flooring materials and footwear components could be realized. Once the service life of such a product is over, they may be degraded easily as the energy requirements for the degradation of scrap rubber might be reduced considerably due to the presence of chromium. It is in this context that an integrated approach which would combine both rubber recycling and leather waste management has been envisaged in this work.

2.2 OBJECTIVES OF THE PRESENT WORK

Rubber recycling has become an important aspect in modern Rubber Technology since the growing population of scrap tyres and other waste rubber products are to be disposed off in an environmentally acceptable manner. Traditional recycling techniques such as reclaiming and re-treading could no longer be the solutions for the disposal of billions of scrap tyres. Attempts on alternative recycling techniques including incineration and pyrolysis, scrap tyres-to-energy plants, tyre derived fuel, application in road construction and
ultrasonic de-vulcanization have all been made, but only with limited success. An environmental friendly, energy efficient recycling or disposal technique for the scrap tyres is yet to be realized.

In order to make useful rubber products for non-critical applications and to study their recyclability, an attempt has been made in this work to combine scrap rubber and natural rubber in presence of tanned leather wastes. Keeping in view the increasing interest in rubber recycling on one hand and the stringent environmental regulations on dumping of scrap tyres in landfills on the other, the present work has aimed at developing Rubber–Leather Composites with the following objectives:

- Development of Rubber-Leather composites based on natural rubber and scrap rubber as matrix in presence chromium containing leather wastes
- Understand the vulcanization characteristics of natural rubber-scrap rubber compounds containing leather wastes at different temperatures
- Evaluate the mechanical properties of these composites and identify suitable application areas based on the properties obtained
- Investigate the dispersion of leather in the rubbery phase and study the morphological changes during the fabrication of the composites
• Study the thermal stability and degradation behaviour of the composites to understand the effect of leather on the degradation pattern in the composites

• Study the swelling behaviour of natural rubber-scrap rubber composites containing leather in aqueous and organic media.