Chapter 6

SUMMARY AND CONCLUSIONS
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The primary objective of the study was to develop novel, more efficient and indigenous adhesives to replace expensive, commercial adhesives for wood to wood, leather to leather and rubber to metal bonding. The results of the study may be summarised as follows:

Adhesives for wood to wood joints:

Natural rubber latex based adhesives found to be efficient and cost effective systems for bonding wood. The effect of prevulcanisation of NR latex and the effect of different ingredients on adhesive efficiency were investigated. Natural rubber latex based adhesives were also found to be superior in water resistance compared to the commercially available latex based wood adhesives.

Styrene butadiene vinyl pyridine copolymer latex adhesives were also tried as wood adhesives. VP latex was also found to be an efficient adhesive for wood joints. Adhesion strength could be improved by modifiers such as RF resin, ammonium caseinate and CMC. The efficiency of wood joints employing these adhesives was found to be superior to that compared to commercial latex based adhesives.

Solution based wood adhesives were also prepared from natural rubber and synthetic rubbers and their blends. Chlorinated natural rubber was prepared and characterised and compared with commercial CNR. Solution adhesives were modified by CNR and lap joint strength improved significantly. Wood joint strength employing these adhesives was found to be superior than some of the commercial solution based wood adhesives. Durability of the wood joints when in contact with water, hot water, acid and alkali was also found to be much higher than commercial adhesives. Shelf life of the adhesives prepared was also found to be adequate.

Novel thermoplastic elastomer based adhesives were prepared and tried as wood adhesives. Lap shear strengths using these adhesives were better than that of commercial
adhesives. The effect of solid content and viscosity on lap joint strength were estimated. Optical microscopic investigation of the peeled surfaces was done to investigate the mode of failure.

*Adhesives for leather to leather joints:*

Natural rubber, chloroprene rubber and polyvinyl chloride based solution adhesives were prepared for bonding different components in leather products. The peel and shear strength of the joints using these adhesives were much higher than those of commercial adhesives. Resistance to water, hot water, ageing and flexing etc. were also found to be superior for the test adhesives to those of commercial adhesives.

Leather joints were prepared with latex based adhesives also. NR, VP and XNBR latices were compounded and tried in leather joints. Joint strength under different environments and shelf life were evaluated and compared with commercial adhesive.

Thermoplastic elastomer based solution adhesives were tried for leather joints also. Adhesion strength of the joints were significantly higher than those of commercial adhesives. Ageing resistance of the bonded specimens were also superior. The peeled off surfaces were examined under an Optical microscope to study the mode of failure.

*Adhesives for rubber to metal bonding:*

A low solvent rubber compound strip adhesive system was developed in place of solvent adhesives for rubber to metal bonding. Peel strength of the joints were compared with those of the commercial adhesive polylock and results were comparable. The rubber compound strip used for bonding was modified with different ingredients and also with blends of elastomers. The efficiency of different rubber strips based on different elastomers on different adherends was investigated. Using the results, it may be possible to select a particular rubber strip for obtaining maximum adhesion depending upon the type of substrates.

Adhesion of the bead wire-to-rubber was also investigated by modifying the rubber compounds. The effect of different ingredients in the compound was studied. The SBR
compound which contain CR gave the maximum adhesion to bead wire. The resistance of the specimens to adverse environments were studied and found to be comparable with conventional bead wire compounds.

Adhesion of steel cord to NR compounds was also found to be improved by the addition of chloroprene rubber. Accelerated ageing of the bonded specimens under different service conditions were studied. The adhesion strength was comparable with conventional compounds containing cobalt adhesion promoters.

The pulled off bead wire and steel cord were examined using an optical microscope to study the mode of failure.

The major highlights of the study are:

1. Development of water resistant latex based adhesives for wood to wood bonding.
2. Development of superior strength adhesives based on thermoplastic elastomers for leather to leather bonding.
3. Development of rubber strip adhesion system for rubber to metal bonding. Modification of the matrix using polychloroprene rubber for improving the bead wire and steel cord adhesion to rubber.