Chapter 6

CONCLUSIONS

The important conclusions from the study are the following

1. CNSL, phenol and formaldehyde can be co-condensed to get a CNSL-phenol- formaldehyde resole resin with a typical $M_n = 835$ and $M_w = 3345$. Melting point is in the range of 70 to 80°C and a typical decomposition temperature is 500°C.

2. Of the two methods for preparation of resin investigated, the method involving a condensation step followed by air-drying for 4 days is more acceptable because it gives a shorter cure time subsequently.

3. Useful adhesive systems based on neoprene and CNSL-phenol-hexa copolymer can be formulated. Such adhesives are more suitable for Al-Al bonding rather than IIR-Al or IIR-IIR bonding.

4. Cure time of 2.5 hours and a cure temperature 140°C are found to give the best results for these adhesives.

5. The resin used for adhesive formulation is found to give the best performance at 45 to 55 phr of the resin and a total phenol: formaldehyde ratio of 1:2.9. Total solid content of the formulation is optimum at 38 %

6. A coupling agent 3-aminopropyl triethoxy silane is found to improve the performance of Al-Al adhesive bonds.

7. The best results are obtained for the resin resulting from condensation of pure phenol with formaldehyde. However inclusion of upto 25% CNSL gives an almost equivalent performance.

8. The copolymer obtained by condensation of CNSL and phenol with hexa when added at the rate of 15 phr improves the ageing characteristics of NBR, SBR and IIR with respect to retention in tensile strength, modulus, tear strength and elongation at break. All these rubbers behave in a similar fashion in this respect.
9. Vulcanizates containing resin with P: F ratio 1:2.9 shows the least change in properties on ageing.

10. Although resin based on pure phenol gives the greatest improvement in ageing characteristics of NBR, addition of CNSL upto 25% still resulted in substantial improvement.

11. Based on studies of SBR, CNSL by itself at 15 phr has the ability to improve the ageing characteristics.

12. Ageing studies on EPDM and NR show no positive effect on addition of CNSL- phenol- hexa resin. In the case of CR which has inherent resistance to ageing no effect is noticeable.

13. The mould design and moulding procedure adopted for particleboard moulding are found to be effective. This can be a starting point for a moulding process to make larger mouldings.

14. When a binder consisting of a reactive mixture of CNSL and hexa is employed a minimum resin content of 15% is needed for optimum performance of particleboard.

15. For particleboard based on rosewood sawdust and CNSL based resin, the optimum cure temperature is 150°C and cure time, 15 minutes.

16. When a reactive mixture of CNSL and hexa is used as the binder a high formaldehyde content (P: F ratio 1:2.9) is needed. But when the powdered resin is used as the binder even low formaldehyde content typically 1:1.1 gives adequate bonding strength. In both cases replacement of phenol to the extent of 50% by CNSL gives an equivalent performance by the particleboard.

17. When a powdered resin resulting from the condensation of CNSL, phenol and hexa is used as binder 10% resin concentration gives the accepted values of bonding strength for the board.

18. The study amply demonstrates the utility of CNSL for three important applications in polymer processing.