# CHAPTER V

## CONCLUSION

A reflection on the relevance of this study to the science of chemical modification of liquid natural rubber and on the direction of possible endeavors germinated by this study is perhaps a useful conclusion for this thesis. The major contributions of this thesis can be divided into three parts. The first part involves preparation of liquid natural rubbers with different average molecular weight. The second part deals with the examination of the parameters that affect percentage of grafting of 2-EEMA onto LNR with viscosity average molecular weight of $3.3 \times 10^4$. These parameters include the effects of reaction time, reaction temperature, monomer concentration, type and concentration of cupric salts, concentration of DMA, acid concentration and type of solvent. The third part deals with the testing of adhesive property of grafted LNR.

In the preparation of liquid natural rubber, a phenylhydrazine/oxygen redox system was employed to depolymerize natural rubber. It was found that the

average molecular weight of LNR obtained was dependent upon depolymerization time. Other parameters that were reported previously to affect $\bar{M}v$ of LNR were phenylhydrazine concentration and depolymerization temperature [5]. By varying the depolymerization time from 1 to 30 hours we can prepare LNR with $\bar{M}v$ ranging from $7.8 \times 10^4$ to $1.1 \times 10^4$.

In the examination of the parameters that affect the percentage of grafting of 2-EEMA onto LNR with $\bar{M}v$ of $3.3 \times 10^4$, gel formation can be a major problem if the proper solvent is not employed. For example, we have observed that an insoluble gel is found when chloroform is used as the reaction medium. The proper solvent for the graft copolymerization of 2-EEMA on LNR is carbon tetrachloride. Type and amount of cupric salts are also important to the graft yield. The order of the catalytic activity of cupric salt is as follows: $CuSO_4 > CuBr_2 > CuCl_2 > Cu(acac)_2 > Cu(OAc)_2.H_2O$. Other parameters also play important roles in controlling the percentage of grafting. The results of our investigation have indicated that optimum conditions for graft copolymerization of 2-EEMA on LNR are: [LNR] = 0.5 mol/L, [2-EEMA] = $7.5 \times 10^{-1}$ mol/L, [DMA] = $2.0 \times 10^{-3}$ mol/L, $[CuSO_4] = 2.0 \times 10^{-3}$ mol/L, $[H_2SO_4] = 7.5 \times 10^{-4}$ mol/L, reaction temperature = 80°C, and reaction time = 30 h.

The other parameter that should be investigated in the graft copolymerization of a monomer onto LNR is stirring speed since we have observed a variation of percentage of grafting when the speed control knob of a magnetic stirrer is changed to other position. However, we do not have equipment to measure the stirring speed accurately enough so we set the speed control knob of the magnetic stirrer at the same position for every reaction that we have carried out.

The adhesive property of the grafted product was measured by using TIS 521 - 2527 (1984) Method. It was found that the higher percentage of grafting the lower adhesive property of the grafted product. Although the grafted product has good tact property, the polymer is too soft to hold a surface of an alumimum sheet and cotton-duck strongly enough. So in order to improve the adhesion strength of the grafted LNR, a monomer such as methyl methacrylate or styrene which will provide hardness and rigidity to the grafted product, should be used for this purpose.