CHAPTER V

CONCLUSIONS AND FURTHER WORK

5.1 Conclusions

5.1.1 Functionalization of HNR with Thioacetate and Mercapto Groups

It was possible to functionalize thioacetate and mercapto groups onto HNR structure. The functionalization of HNR involved a two steps reaction. The first one consisted of a free radical addition of thioacetic acid onto the carbon-carbon double bond of HNR. The extent of reaction was dependent on the contentration of thioacetic acid and initiator including reaction time. However, the results from the kinetic study indicated that the extent of reaction was limited by a steric hindrance of the functional groups that applied onto HNR structure. Under similar condition, the conversion of thioacetate for HNR with 80% hydrogenation was also lower than that with 90%hydrogenation. It might be due to the effect of steric hindrance from the higher content of thioacetate groups in HNR with 80% hydrogenation. The methanolysis of HNRTA in a NaOH-methanolic solution resulting in HNRSH. Both NaOH concentration and reaction time affected the level of methanolysis of the acetylthio group. Nevertheless, an increase in NaOH concentration increased the gel content. In addition, the modification by using thioacetate- or mercapto-functionalization of HNR could not enhance the decomposition temperature, and it did not affect the glass transition temperature of HNR.

The optimum condition to functionalize HNR (90 %hydrogenation) with thioacetate was 1/1/0.1 of [C=C]/[TAA]/[initiator] at 80°C for 48 h to obtain 0.966 mmol/g of thioacetate functional group on the HNR structure. The HNRTA was subjected methanolysis using 5 %w/v NaOH in methanol for 2 h to achieve 100% conversion. At these conditions, an amount of thioacetate or mercapto group in HNR structure corresponding to 0.966 mmol/g was used as compatibilizer for HNR/NR blends.

5.1.2 The Effect of HNRTA and HNRSH as Compatibilizer for Rubber Blends

HNR samples functionalized with thioacetate or mercapto groups were employed as the compatibilizers for HNR/NR (50:50 %wt) blends. Both HNRTA and HNRSH acted as accelerator agents in the curing process, as indicated by the decrease in scorch time and cure time of vulcanization. The presence of functionalized HNRs resulted in an increase in the tensile strength of HNR/NR vulcanizates, but the best performance was achieved with HNRSH, probably due to the increase in the crosslink density associated to the reactive compatibilition promoted by the reaction between mercapto group and rubber matrix. The HNRTA was also considered to be reactive compatibilizer because the dicumyl peroxide (DCP) used as the co-crosslinking agent in EPV system might react with the thioacetate groups on the HNR structure to give the mercapto radical species that was responsible for the crosslinking formation. Dynamic mechanical analysis of rubber vulcanizes confirmed the increase in the crosslink density of functionalized HNRs by decreasing the damping values. The compatibility with functionalized HNRs showed a co-continuous morphology as attested to by scanning electron micrographs. The presence of HNRTA and HNRSH also increased the thermal stability, as indicated by an improvement of the retention of the mechanical properties after ageing in an air-circulating oven. Moreover, an improvement ozone resistance was also observed. It was possible that thioacetate and mercapto groups could promote the crosslink formation during the aging process to improve the aging resistance of the blends.

For EPDM/NR blends, the addition of HNRTA and HNRSH showed the lower improvement of their blends mechanical properties when compared to HNR/NR blends. It was possible that both HNRTA and HNRSH were more compatible to HNR than EPDM phase.

5.2 Further Works

A further study of HNR should be concerned with the following aspects:

1. Modification of HNR

To modify HNR should be studied as a function of both thiol and initiator type and reaction temperature in order to get more information about the effect of the reaction parameters on the reaction conversion.

2. Application of thioacetate- and mercapto-HNR as compatibilizer

To study the effect of employed HNRTA and HNRSH as a compatibilizer for HNR/NBR and EPDM/NBR blends to improve the mechanical properties of these blends containing highly different polar properties.