

## **CHAPTER V**

### **CONCLUSIONS AND RECOMMENDATIONS**

#### **5.1 Conclusions**

The intercalation step by surfactant molecules is required for separating the clay lamellae thus facilitating the adsolubilization of isoprene monomers followed by admicellar polymerization. The polar head group of a surfactant molecule is remarkable for its ability to swell silicate layers. The layered clays with polyisoprene ultra-thin film polymerized in cationic bilayer patch show excellent dispersion in NR vulcanizates. However, surface modification of clay by admicellar polymerization using the cationic surfactant mixed with the nonionic surfactant in the ratio of 3:1 in a continuous stirred tank reactor afforded the most promising candidate based on physical properties when compared to those of rubber compound using pure cationic surfactant. While there is too small amount of polymer formed in the case of higher nonionic surfactant loading (1:1 and 1:3) that leads to no significant improvement in mechanical properties of rubber compounds. This is possibly due to low adsorption of nonionic surfactant on layer silicate therefore there is no favorable organic phase for isoprene monomer to adsolubilize in. Interestingly, the presence of co-existing two phases of intercalated structure layered silicate in the case of 3:1 mixed surfactants exhibits concurrent improvement in cure characteristics and physical properties, for only 10 phr loading. Enhanced properties include improved tensile strength, tear strength, hardness, resilience as well as little heat build up at the same time. Moreover, the use of nonionic surfactant can lessen the cost of the modified clay to a third of the modified clay using the pure cationic surfactant.

#### **5.2 Recommendations**

Usually, X-ray diffraction can provide evidence of the ordered layer structure dispersed in NR matrix. By contrast, exfoliation involves extensive polymer penetration and silicate crystallites delamination, and the individual nanometer-thick

silicate platelets are randomly dispersed in the polymer matrix. In order to characterize the exfoliated structure, dispersability of layered silicate in NR matrix and the relative extent of intercalation / exfoliation of modified clay-NR hybrid composites, XRD data should be further confirmed by TEM.