

CHAPTER V

CONCLUSION

In this study, the compounded sheets of natural rubber product containing carbon black were prepared by direct mixing the concentrated natural rubber latex with the additives. The additives used in each compounded sheets were carbon black (as filler), sulfur (as a vulcanizing agent), 2-mercaptobenzothiazole (MBT) (as an accelerator), zinc oxide (as an accelerator activator), stearic acid (as a fatty acid), and a surfactant (to stabilize the aqueous dispersions). Normally, zinc oxide and stearic acid were used together. The time for preparing aqueous dispersions of the additives was 3 hours and the ball mill was used at a speed of 130 rpm. Then, the rubber latex was added into the aqueous dispersions and mixed for 0.5 hours. The rubber latex was coagulated by 5% formic acid (by volume). The compounded sheets obtained from this method were used to prepare the vulcanized sheets to study the properties. The dispersion of carbon black of vulcanized sheets was studied by optical and scanning electron microscopic techniques. The formulations of compounded sheets showing the best properties in this experiment are concentrated natural rubber latex 100 parts by dry weight, carbon black type N330 25 phr, sulfur 2 phr, zinc oxide 5 phr, stearic acid 2 phr, 2-mercaptobenzothiazole 1 phr, and Tergitol NP10 3 phr.

The properties of vulcanized sheets are acceptable, for example, tensile strength is 16.49 MPa, elongation is 1538%, hardness (shore A) is 60.4, and tear strength is 57.15 kN/m. The degree of carbon black dispersion is 5.0.

These properties of vulcanized sheets are compared to the properties of some rubber products. Thai Industrial Standards Institute (TISI) set several standards for rubber products. The standard mechanical properties for motorcycle rubber inner tubes, tubes of automobile tyres, weather strips for automobile and automotive rubber mats are shown in Table 5.1. Their properties were chosen to compare specifically the tensile strength, elongation, hardness and tear strength. The other properties were specific for each rubber products such as permanent set and size of rubber products.

Table 5.1 The standard mechanical properties of rubber products

Properties	Motorcycle rubber inner tubes	Tubes of automobile tyres	Weather strips for automobile (type 60 IRHD)	Automotive rubber mats (5 th quality)
Tensile strength (MPa), not less than	11.77	15.00	7.00	10.40
Elongation (%), not less than	500	500	300	250
Hardness (IRHD)	-*	-*	60±5	65±5
Tear strength (kN/m), not less than	-*	-*	15	52.50

* this product was not tested.

The mechanical properties of vulcanized sheets were higher than that of the standard mechanical properties of rubber products. The unit of hardness of rubber products is the International Rubber Hardness Degrees (IRHD) scale. IRHD scale corresponds approximately to the shore A scale. These compounds can be used to produce rubber products. But the specific properties for each rubber products must be tested after they are produced.

The advantages of this method are as follows:

1. This method is convenient because it uses simple instruments to prepare the rubber compounds.
2. Raw rubbers (concentrated natural rubber latex) were cheaper than smoked sheet rubbers which are industrially used in rubber compounding.
3. This method can reduce the fumes of carbon black and other chemicals in the rubber factory. This method can also reduce the time for producing the rubber products if the rubber compound used as raw rubber.

Suggestions for Future Work

1. Studying the properties of vulcanized sheets, which were obtained from this method, can be prepared by using the natural rubber latex (DRC = 30%) as the starting rubber. The protein content in natural rubber latex is more than concentrated natural rubber latex. These proteins may have some effect on the properties of natural rubbers[27].
2. The final products should be prepared from the compounded sheets and their properties should be tested.