CHAPTER 5

CONCLUSION

The effects of fillers on the mechanical properties of high density polyethylene (HDPE) were studied. Calcium carbonate ($CaCO_3$) and carbon black were used as fillers. The filled HDPE samples at various percentages of filler were prepared by a two roll mixing mill and a compression molding. Tensile properties, impact strength and hardness were measured. The results are summarized as, that because the average particle size of carbon black (0.05 μm) was lower than the $CaCO_3$ (average particle size was 6.0 μm for 1939-type and 15.8 μm for 039-type, details shown in the figures 4.1, 4.2 a, b, and c), and the distribution of $CaCO_3$ 1939 was better than $CaCO_3$ 039 (from figures 4.13 to 4.18). Therefore some mechanical properties of these compounds, eg. modulus, hardness and tensile strength (in case of HDPE-$CaCO_3$ 1939 compound) were increased with increasing in fillers content but the other properties such as elongation, Izod impact strength (and tensile strength in case of HDPE-$CaCO_3$ 039) were decreased from the original values. The results also exhibited that the higher percentages of the fillers content increase the values of tensile strength (except HDPE-$CaCO_3$ 039). For the modulus and the hardness the HDPE-carbon black compound also gave the higher values than the HDPE-$CaCO_3$ compound. Comparing the aspect of value

added by using fillers, with positive improvements in mechanical properties such as tensile strength, modulus, and hardness properties and negative improvements in elongation, and impact strength properties. It could be concluded that $CaCO_3$ was considered to the more effective filler than carbon black. The reasons were that the use of carbon black 10% given the higher in modulus equivalent to the use of $CaCO_3$ 20% ($CaCO_3$ 1939) or 30% ($CaCO_3$ 039). For the 100 kg of HDPE resin, 10% of carbon black cost approximately 210-220 Baht, 20%-30% of $CaCO_3$ (untreated grade) cost approximately 80-120 Baht. An equal magnitude of modulus gained by adding $CaCO_3$ costs lower than that adding the carbon black. The research result revealed that the addition of carbon black in HDPE more than 10% would decrease sharply in elongation and impact strength than the HDPE-$CaCO_3$ compound, while the HDPE-$CaCO_3$ compound gave a slow decrease in these properties (as shown in figures 4.9 and 4.11).

Because of the limitation of the machine used in this research, the two roll-mixing cannot completely mix the HDPE with untreated filler at higher loading, especially more than 40%. In order to get the best mixing, the mixing time was extended. The temperature of mixing was also rised up to the point the polymer would not degrade.

The obtained results bring us into the new research scheme for the compounding of polymer. It could be studied further to develop the information for industrial uses. There are:

1. The utillization of the other local fillers, classified by size, shape, and distribution and the other specification required as in the theory. This aspect includes the efficiency of the filler in term of economic consideration, the availabilities of filler, and the fabrication techniques.

2. The utillzation of various treated fillers with many types and methods of treatments, to search out for the most compatibility of treating agents with each type of fillers.

3. The effect of fabrication technique on the distribution of fillers in the compound considered, and also the compatibility of fillers and substrates were studied.

4. The effect of the processing aids for polymer compound, eg. the dispersing agenst, coupling agents could be studied in term of the changes in the mechanical properties of the polymer compound.