CHAPTER 1

INTRODUCTION

Growing industrial activities create a continual demand for improved materials that satisfy more stringent requirements, such as higher tensile strength, modulus, thermal conductivity, heat distortion temperature, and lower thermal expansion and cost. These requirements, which often involve a combination of many difficulties to attian properties, can often be satisfied by utilizing a composite material, whose constituents act synnergistically to solve the needs of the application. As we cross the threshold into the "Composite Materials Age," it becomes increasingly important to understand the properties, performance, costs, and potential of the available composite materials.

Fillers and reinforcements have always played an important role in the plastics industry. The early growth of the phenolic plastics industry would not have been possible without the enhancement of properties by the use of fillers and reinforcements. The later commodity resins, such as poly(vinyl chloride), polystyrene, polyethylene, and polypropylene, have properties that meet the requirements of high volume end uses; thus they have been sold and used as essentially pure resins. However, recent price escalations, combined with the sporadic and projected shortages of resins and petroleum feed stocks, have established the urgent need for efficient and widespread utilization of fillers and reinforcements.

The composite systems afford a means of extending the available volume of resins while improving many properties. These improvements in properties are often associated with economic advantages such as lower raw material cost, faster molding cycles as a result of increased thermal conductivity, and fewer rejects due to warpage.

At present, most molded products do not contain any filler or reinforcement, in spite of the fact that the judicious choice of a filler or reinforcement can result in a lower cost product with equivalent or improved properties. Recent technological advances, such as improved dispersion and the often-neglected factor of filler and reinforcement packing, have not been widely applied, and as a consequence, much current information on filler or reinforced plastics indicate poorer properties than the true potential of these composites. Also there have been recent advances in the equipment and procedures for compounding and molding highly filled polymers. Currently, there are few valid technical justifications for the use of an unfilled resin in most molded products, from a consideration of either properties or moldability. Moreover, as this technology advances, there will be increase benefits from the use of fillers and reinforcements.

Resin production statistics for 1975-76 are shown in table 1.1. These figures indicate an annual production of about 13,300,000 metric tons or 30 billion lb. Table 1.2 lists the annual usage of most major fillers and reinforcements, from this table, plastics will use 15 million tons of fillers in the year 2000, a 117% increase from 1990. This estimate does not include glass fibers, carbon-graphite filaments, and a number of other reinforcements. Even with these items added, the figures would indicate that the usage of fillers and reinforcements is less than their potential usage. For example, current fiber glass reinforced injection molding compounds contain up to 40 wt % in PVC pipe extrustion compounds. Moreover, the improvements in coupling agents, compounding procedures and, molding are leading to the effective use of higher filler concentrations. Good molding compounds that contain 75 parts of filler per hundred parts resin may be common in the near future.

All the above has been shown the importance and very interesting point in polymer composite based on the use of filler. Therefore, this preliminary study was then conducted, starting with the effect of calcium carbonate and carbon black on the mechanical properties of high density polyethylene. Because the calcium carbonate not only acts as an extender but provides some reinforcement, besides its other advantages. Carbon black, usually acts as an UV absorpber for plastics or as a reinforcement for rubber. Therefore, current study of carbon black on polyethylene plastics will also indicate other applications of carbon blacks as well.

Table 1.1. Production statistics for 1975 - 1976(1)

Material	1,000 METRIC TONS	
	1975	1976
Polyethylenes	3,196	4,042
LDPE and copolymers	2,148	2,625
HDPE	1,048	1,417
Vinyls	1,700	2,103
other	320	390
Polystyrene and copolymers	1,875	2,285
Polypropylene and copolymers	861	1,178
Phenolics	465	600
Polyesters	350	430
Aminoplastics (UF and MF)	369	450
Acrylics	193	222
Alkyd resins	280	330
Coumarone and petroleum resins	113	136
Cellulosics	56	70
Epoxies	85	110
Polyamides	65	95
Polyurethanes (excluding foam and elastomers)	614	738
Engineering plastics	130	170
Total	10,672	13,353

Table 1.2. The annual usage of most major fillers and reinforcements(1)

Matrerial	CONSUMPTION, 1,000 METRIC TONS			
	1975	1980	1990	2000
Alumina trihydrate	50	200	800	1,600
Asbestos	180	350	800	1,700
Carbonates	700	1,500	3,500	9,000
Cellulosic types	40	90	300	500
Glass	5	15	50	200
Silicas	25	80	300	500
Silicates	6	15	50	100
Talc minerals	40	200	900	1,800
Miscellaneous	14	50	200	500
Total	1,060	2,500	6,900	15,000

SOURCE: *Modern Plastics* and industry estimates.