

Polycarbonate Engineering Thermoplastic from the Industrial Point of View

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Introduction

It is well known that the aromatic polycarbonate of bisphenol A (hereafter BPA polycarbonate) possesses superior transparency, exceptional toughness, high heat resistance and mechanical properties, which allow it to be diversely used for automotive, electrical, electronic, appliance and optical industries. BPA polycarbonate has been first commercialized in the early 1950's, and its market has rapidly grown to approximately three million tons per year.

The development history of BPA polycarbonate can be divided by four distinct periods^[1]. (i) In the early years of commercialization, most of work was focused on developing efficient process. (ii) During 1970's and 1980's, research was carried out in order to investigate its properties, and much of research work was involved in blending and compounding of polycarbonates by utilizing additives, fillers, and other polymers such as poly (butylenes terephthalate) and ABS, resulting in commercialization of PC/PBT and PC/ABS alloys. (iii) From the late 1980's to the mid 1990's, a great deal of work was conducted in order to optimize and control manufacturing processes: implementation of melt processes, the preparation of oligomeric cyclics and their conversion into very high molecular weight polycarbonates,^[2] and solid state polymerization.^[3] (iv) Over the past ten years, in order to enhance ductility at low temperatures, heat distortion temperature, chemical resistance, new monomers have been designed to synthesis random or block copolymers.

On the market point of view, the application of polycarbonate has been begun with sheet extrusion. In early 1980's, the commercial success of polycarbonate continued to be a major item in the field of automotive lightings as an unbreakable glass-replacement materials. With the advent of the digital recording industry, polycarbonate has been used as a base material for compact discs, opening a new major market. Over past several years, digital electronic devices industry has grown at a tremendous speed, and consequently high performance materials has been strongly needed in the consumer electronics markets such as mobile phones, digital cameras, computers, flat panel displays. Polycarbonate is the best choice of flexible design and style for smaller and thinner applications due to its combined properties of toughness and rigidity. Since polycarbonate has long been used as an unbreakable window glass-replacement material, a major effort of polycarbonate will be centered on developing automotive glazing with the aid of injection molding technology.

Applications

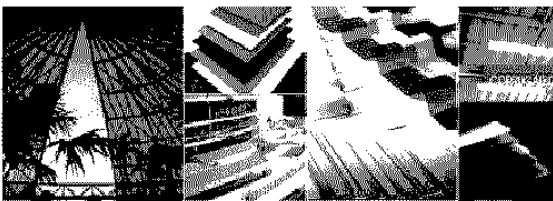


Figure 1. constructual sheets



Figure 2. automotive lightings

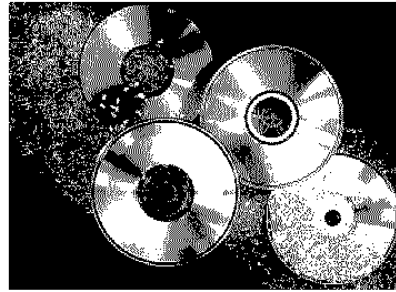


Figure 3. compact discs

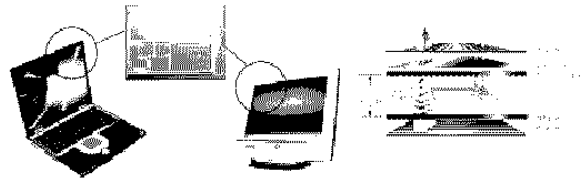


Figure 4. consumer electronics

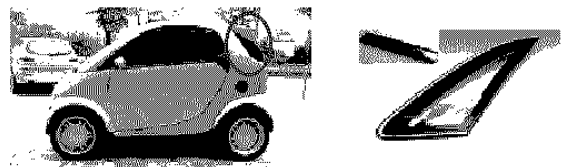


Figure 5. polycarbonate glazing

Market Trends

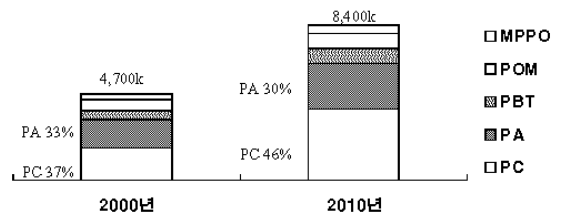


Figure 6. Consumption of General Purpose Engineering Plastics

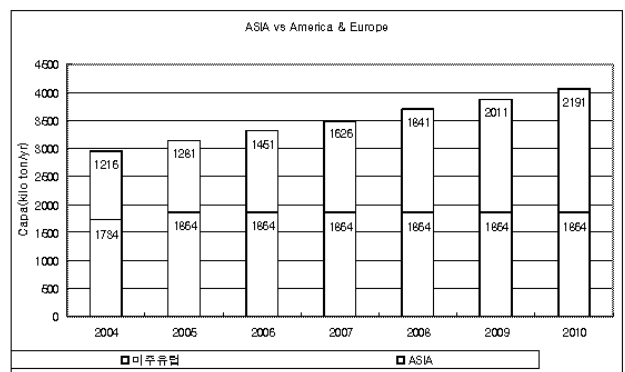


Figure 7. Capacity of Asia versus America and Europe

Table 1. Establishment and Extension in Asia

Unit: thousand tons

| area | 2006 | 2007 | 2008 | 2009 | 2010 | total |
|----------------|-------|-------|-------|-------|-------|-------|
| Korea | | 65 | 170 | | 30 | 265 |
| China | 150 | 50 | 275 | 315 | 140 | 930 |
| total | 150 | 115 | 445 | 315 | 170 | 1,195 |
| world capacity | 3,513 | 3,772 | 4,152 | 4,597 | 4,762 | |

References

- [1] *Advances in Polycarbonates*, Edited by D. J. Brunelle and M. R. Korn. (American Chemical Society, 2003)
- [2] D. J. Brunelle and T. G. Shannon, *Macromolecules*, 1991, 24, 3033-3044
- [3] J. M. Schulz and S. Fakirov, *Solid state Behavior of Linear Polyester and polyamides*, Prentice Hall 1990.