Multiwall Polycarbonate: Application and Development

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The intent of this paper is to inform designers and end users on the advanced qualities of multiwall polycarbonate. While polycarbonate has been around since the 1950's, its use in architectural applications has been limited in the United States. Past products lacking new technologies have given a bad name to polycarbonate, specifically with regards to weathering and yellowing. For many, the idea of using a plastic for exterior glazing is still difficult to accept. The following information will help define the unique qualities of polycarbonate and the improvements that address many of these common concerns. These advancements and qualities make polycarbonate ideal for glazing and daylighting applications.

Polycarbonate is a thermoplastic polymer. Polymer meaning it is constructed of repeating structural units. Thermoplastic refers to its ability to be heated and formed to a variety of shapes. Thermoplastics are different from thermosetting plastics in that they can be melted and remolded. Polycarbonate is flexible giving it the ability to be cold formed. (Kopeliovich, 2012) Polycarbonate can withstand an impact of 240 inch-pounds, over 40 times that of glass or acrylic (Sabic IP, 2008). Lexan* Polycarbonate was invented in 1953 by Dr. Daniel W. Fox. Since its invention, a variety of uses for polycarbonate have been found. These include specialty applications such as NASA space helmets and fighter cockpits. Uses also include everyday products like cellphones and eyeglasses (Sabic IP, 2012). Polycarbonate's extreme strength and flexibility give it an advantage over other plastics such as acrylic or PVC.

Solid sheet and injection molded components remain the most common forms of polycarbonate but a variety of multiwall sheets are available. Starting in the 1970's, multiwall polycarbonate began to see use in architectural and horticultural projects. High light transmittance makes it ideal for use in green-houses. Multiwall polycarbonate's light weight is advantageous in covered stadiums where added weight means added structure and cost. The possible uses of multiwall polycarbonate are almost limitless inside and outside of buildings.

Multiwall sheets are produced through an extrusion process. A screw driven extruder heats and pushes the polycarbonate material through dyes. These dyes vary in size and shape offering a variety of finished products (Wikipedia, 2012).The result is a sheet with a hollow fluted profile that is light weight, high strength, and has high light transmittance. The addition of the flutes increases the thermal resistance of the panel and decreases sound transmittance. The sheet structure also diffuses light. This light diffusion can be increased by using various colors or tints. Because of these qualities multiwall polycarbonate has seen increasing use in architectural and building applications.

While advantages of multiwall polycarbonate have been inherent in the product for decades, early applications were tarnished by weathering issues. Polycarbonate naturally absorbs ultra-violet (UV) radiation. This causes the polycarbonate to be degraded by sunlight. The result is a yellowing of the sheets and a reduction in strength. To address this issue protective layers are added to one or both sides of the sheet. The most common method of adding this protective layer is through co-extrusion, where the protective layer is added as part of the extrusion process (Wikipedia, 2012). These UV protected sheets come with warranties against weathering for up to 10 years.

Other processes involve applying a protective coating to the sheet after extrusion while the material is still hot. This coating process was developed by GE Plastics (now Sabic Innovative Plastics) and can provide up to 15 year warranty (Sabic IP, 2003). These new advancements in UV protection make multiwall polycarbonate a long-term building solution.

Having addressed yellowing issues, multiwall polycarbonate is now seeing extensive use in glazing and daylighting applications. Its high light transmittance, low U-Values, light diffusion properties and affordable cost make it an excellent material for skylights and vertical glazing. Polycarbonate is ideally suited to daylighting applications. A 25mm sheet with a .26 U-Value has the thermal properties of many insulated glass units. This same 25mm sheet has a 57% light transmittance and will provide more diffused light than other translucent daylighting products, such as fiberglass (Sabic IP, 2008). The addition of Lumira®aerogel to the sheets greatly increases light diffusion and more than doubles thermal performance (Architectrual Testing, 2012). Multiwall polycarbonate sheets are available in a variety of colors, sizes and profiles. This increases the design options and allows for the product to address specific project needs.

Multiwall polycarbonate provides distinct safety advantages over other glazing options. Panels can be made using formulas of polycarbonate that do not support their own combustion. These products have achieved Class A ratings for smoke development and Class CC1 for flame spread (ICC Evaluation Service, Inc, 2002). The strength of polycarbonate makes it a very safe product. In addition to being stronger than glass or acrylic, there is no risk from broken pieces as it does not shatter in failure. Sheets are resistant to breakage from hail, vandalism or accident. Many sheets are Miami-Dade County accepted and are often used as storm shutters (Miami-Dade County, 2008).

The ability to be extruded into almost any form has led to the development of specialty products such as Lexan* Thermoclick*. These panels click together creating a continuous wall system of multiwall polycarbonate. This system offers the same advantages of other multiwall products with the added design flexibility of a continuous system. Continuous skylight applications are achieved through standing seam products such as Lexapanel*. Standing seam panels are held in place with clips and battens. Using an ultrasonic welding process, Lexapanel* can be constructed in a variety of shapes and sizes to fit the project's needs.

Polycarbonate is a high-performing product that far exceeds the average expectation for a plastic. It has proven its value in everyday and highly advanced applications. The development of multiwall systems utilize these qualities to provide a truly uniqe building material. The resulting performance of these panels secures their place in the building and construction world far into the future.

*Trademark of Sabic Innovative Plastics IP B.V.

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