Automotive Headlamp Lens Technology from Covestro

Annealing of Molded Makrolon® Polycarbonate Parts

Annealing or heating a molded Makrolon® polycarbonate part to just below the glass transition temperature reduces inherent stresses introduced in a molded part during the molding and cooling processes. Stress reduction can provide an extra measure of safety from aggressive chemical environments that may come in contact with the molded part. High stress levels generally make molded Makrolon® polycarbonate parts more susceptible to stress cracking. Stress cracking failure can be critical in automotive lighting applications.

The three common methods of annealing used in the plastics industry are Batch, Conveyorized Forced Hot Air (CFHA) and conveyorized Infrared (IR) annealing.

Batch Annealing consists of placing parts, typically on racks, in a hot air convection oven that is set at a certain temperature for a specific time period. This is a fairly simple annealing method that has been used for many years. However, it does have its drawbacks.

Annealing cycles last from 30 minutes to as long as 2 hours or more at temperatures commonly ranging from 230°F to 270°F. These long cycles are sometimes necessary, due to restricted airflow caused by parts being packed on top of or placed very close to one another. Assuming the oven provides uniform air flow around all of the parts, annealing is typically done at 260°F for 15 minutes per 1/16" of wall thickness. For example, a 1/8"- thick part would be annealed for approximately 30 minutes. Annealing time is normally adjusted to the minimum time required for parts to pass the 1:3 TnP solvent stress test and then adding 5-10 minutes.

CFHA Annealing uses forced hot air set at a certain velocity and temperature. Unlike the batch process, CFHA is conveyorized and is well suited to be implemented as an in-line annealing process. Parts can be set on the conveyor belt immediately after molding. This works especially well with robotic part pickers.
This method allows for each part to be heated identically, which yields consistent annealing results. Typical annealing times using CFHA can range from as little as 4 minutes to as long as 15 minutes. Temperatures can range from 250°F to 275°F, depending on the part design, size and thickness. CFHA can also be implemented as an off-line process where parts could be annealed sometime after molding.

Infrared Annealing is a process that is best suited for in-line implementation. It is a continuous annealing process, much like CFHA. However, unlike CFHA, heat is generated in the molded part by absorption of infrared radiant energy transmitted from IR emitters. Direct energy absorbed by the molded part generates the required heat for annealing.
This method is a very fast and efficient way of generating heat. Comparatively, the hot air annealing methods generate part heat by first heating the surrounding air which, in turn, heats the molded part.

Typical in-line IR annealing cycles range from approximately 60 seconds to as long as 6 minutes, depending on the size and wall thickness of the part. Although IR annealing is generally the fastest of the three methods, it also has a few drawbacks. Off-line implementation is possible, but not generally recommended. Also, part orientation is sometimes critical for successful IR annealing.

Covestro LLC
1 Covestro Circle
Pittsburgh, PA 15205 USA
412-413-2000

www.plastics.covestro.com
plastics@covestro.com