

Polycarbonate/Polyethylene Terephthalate Alloy

Ultrasonic Welding

Bayer: Makroblend UT400

Tensile test bars (12.8 mm width and 3.2 mm thickness) having a molded-in energy director were ultrasonically welded using a Thermosonics welding machine in the following two modes under 18 different conditions: constant energy mode with variable force triggering and time based mode with delay timer triggering. The experimental conditions were set up according to the L18 orthogonal array of Taguchi statistical experimental design. It should be pointed out that the angle of the energy director and delay timer setting have been assigned in the array such that their interaction can be analyzed. After welding, pull strength of the welded test bars was determined using an Instron tester at a pull rate of 50 mm/min.

A few key highlights of the results are that impact modified PC/PET blend can successfully be welded under a broad range of welding conditions; and the constant energy mode has yielded more consistent values than the time based mode. A similar conclusion has also been obtained from PC welding experiments carried out under comparable experimental conditions.

Using all the raw data, the effect of a given welding parameter and level on pull strength was quantitatively analyzed with a computer program, Analysis of Variance using Taguchi Methods. In the constant energy mode, the energy director angle was found to interact strongly with the delay timer setting. For the best pull strength, the 60 degree energy director required a long delay timer setting (0.3 seconds), while the 90 degree energy director required a short delay timer setting (0.1 seconds). Also, it has been found that the higher the energy set value is, the higher the pull strength.

In contrast to the constant energy mode, the interaction of the energy director with the delay timer setting in the time based mode did not provide a simple trend. An interesting result from the time based mode experiment is that the best pull strength was obtained from the longest weld timer setting.

The optimum welding conditions for impact modified PET/PC blend are shown in the Table. There is a significant difference in optimum welding conditions for the constant energy mode and time based mode: the hold pressure setting of the former mode is significantly lower than in the latter mode (62 vs. 104 kPa pressure). This may indicate that the constant energy mode yields a more effective melting of the resin than the time based mode.

Table 77.1: Optimum ultrasonic welding conditions for impact modified polyester PET/ polycarbonate blend.

| Mode | Welding Parameter | Energy Director (degrees) | |
|----------------------|-----------------------|---------------------------|------|
| | | 60 | 90 |
| constant energy mode | energy set value (Ws) | 260 | 260 |
| | delay timer(seconds) | 0.3 | 0.1 |
| | hold timer (seconds) | 0.25 | 0.25 |
| | hold pressure (kPa) | 62 | 62 |
| time based mode | weld timer (seconds) | 0.5 | 0.5 |
| | delay timer (seconds) | 0.2 | 0.3 |
| | hold timer (seconds) | 0.65 | 0.65 |
| | hold pressure (kPa) | 104 | 104 |

Reference: Chung, J.Y., Charles, J.J., *Properties of an Impact Modified Polycarbonate/Polyethylene Terephthalate Blend*, ANTEC 1989, conference proceedings - Society of Plastics Engineers, 1989.