

Polyethylene Terephthalate/Polbutylene Terephthalate Alloy

Vibration Welding

GE Plastics: Valox HV7065 (material composition: 65% mineral filler)

The process phenomenology for the welding of particulate and glass-filled PBT is clearly similar to that for neat resins: the penetration-time curves exhibit the four phases that are typical for neat resins. In all cases, with all other parameters held constant, the cycle time decreases with an increase in pressure.

For the same base resin, the filler content has a remarkably small effect on the steady-state penetration rate. Even the effect on the cycle time appears to be small for the same filler type; for the same filler loading, the cycle times are lower for the glass-filled materials, however.

For the same base resin, increasing filler content reduces the attainable relative weld strength. Although the base strengths of 30-PF-PBT and 30-GF-PBT are very different (52.7 and 90.6 MPa, respectively), their maximum relative weld strengths are remarkably the same, on the order of 0.6. Increase in filler content does decrease the ductility of the weld, i.e., the relative strain at which failure occurs in the weld, decreases.

One way of assessing the effect of fillers is to compare the maximum weld strength with that of the base resin. This is not easily done because, in addition to the main filler, filled materials may contain additives that can affect the mechanical behavior of the base resin - and this information is not available for commercial materials. In the absence of more information, the strength of straight PBT may be used as a reference. The strength of this semicrystalline resin can depend on the processing conditions and the location on the plaque from which the test specimen is cut; for PBT (Valox 310) four bars had strengths of 65.2, 60.1, 61.8, and 58.7 MPa giving a mean strength of 61.5 MPa. The five filled grades, 10-PF-PBT, 30-PF-PBT, 65-PEB, 15-GF-PBT, and 30-GF-PBT, exhibited maximum weld strengths of 59.2, 32.5, 39.8, 59.3, and 54.4 MPa, respectively. Using the strength (61.5 MPa) of PBT as a measure of the strength of the base resin, the strengths of the welds of the filled materials relative to that of the base resin, are given, respectively, by 0.96, 0.53, 0.65, 0.96, and 0.88. Of these, the result for 65-PF-PEB is the least reliable because the polymer matrix of this material is a blend, so that using the base strength of PBT may not be appropriate. Welds of the 30 wt% mineral-filled PBT are only able to attain about 50% of the strength of the base resin. The relative strengths of the remaining three mineral- and glass-filled grades are remarkably high - on the order of 90-95%. Even the 30 wt% glass-filled grade can attain about 90% of the strength of the base (filled) resin.

Reference: Stokes, V.K., *The Effect of Fillers on the Vibration Welding of Poly(butylene Terephthalate)*, ANTEC 1993, conference proceedings - Society of Plastics Engineers, 1993.