KERF GEOMETRY BY ABRASIVE WATER JET CUTTING

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Extended Abstract: Abrasive Waterjet (AWJ) cutting is an emerging technology for material processing with the distinct advantages of no thermal distortion, high machining versatility, high flexibility and small cutting forces. Although this cutting technology includes many advantages, there are some drawbacks. For instance, abrasive water jet cutting can produce tapered edges on the kerf of workpiece being cut. This can limit the potential applications of abrasive water jet cutting, if further machining of the edges is needed to achieve the engineering tolerance required for the part.

Kerf geometry is a characteristic of major interest in abrasive waterjet process. Cutting using AWJ can create tapered edges on the kerf, especially when cutting at high feed rates (nozzle traverse rates).

The kerf geometry of a through cut generated by abrasive waterjets is characterized by a small rounded corner at the top edge due to the plastic deformation of material caused by jet bombardment. As the kerf is wider at the top than at the bottom due to the decrease in water pressure, a taper is produced. The primary interests in sheet processing are the kerf shape (kerf widths). These characteristics will be considered in the present study.

Effects of feed rate on the kerf geometry were experimentally investigated. The aim of this study is to investigate experimentally the profiles of machined surfaces and kerf geometries of the machined surfaces in terms of feed rate in AWJ-machined aluminium alloy (EN AW-6060). A series of water jet cutting experiments were conducted using a Bystronic abrasive water jet cutting system. It is equipped with a dual intensifier high output pump and a five axis robot positioning system, to cut 50 mm long slots on 700×300 mm test specimens of 10 mm thick. The main process parameter varied in the cutting operation is the feed rate. In this initial study the feed rate and abrasive flow rate was varied. For each level of the abrasive flow rate, six levels of feed rates (200, 300, 400, 500, 800 and 1000 mm/min) were used at a single level of water pressures of 400 MPa and a single level of impact angle of 90°. The other parameters were kept constant using the system standard configuration, that is, the orifice diameter was 0.27 mm, the mixing tube diameter was 1.08 mm, the length of mixing tube was 80 mm, and stand-off distance of 2 mm. The abrasive used was garnet sand with a mesh number of 80.

The kerf geometry (top and bottom kerf widths) was measured from the optical microscope images. The measurements are accurate to 0.01 mm. These measurements were taken for each cut away from the ends of the slots to eliminate any effect of the cutting process at the jet entry and exit. The standard establishes a zone of significance for the measurements of widths at the top and bottom edge by a distance, related to material thickness as specified in the standard.

Summarizing the main features of the results, the following conclusions may be drawn:

1. As the feed rate increases, the AWJ cuts narrower kerf. This is because the feed rate of abrasive waterjet allows fewer abrasives to strike on the jet target and hence generates a narrower slot.

2. Higher abrasive flow rate produce greater kerf width, especially bottom kerf width, because the larger number of abrasive particles share in machining process which has positive effect on kerf geometry.

Bibliography

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