

Effect of Taper Pin Ratio on Microstructure and Mechanical Property of Friction Stir Welded AZ31 Magnesium Alloy

Authors : N. H. Othman, N. Udin, M. Ishak, L. H. Shah

Abstract : This study focuses on the effect of pin taper tool ratio on friction stir welding of magnesium alloy AZ31. Two pieces of AZ31 alloy with thickness of 6 mm were friction stir welded by using the conventional milling machine. The shoulder diameter used in this experiment is fixed at 18 mm. The taper pin ratio used are varied at 6:6, 6:5, 6:4, 6:3, 6:2 and 6:1. The rotational speeds that were used in this study were 500 rpm, 1000 rpm and 1500 rpm, respectively. The welding speeds used are 150 mm/min, 200 mm/min and 250 mm/min. Microstructure observation of welded area was studied by using optical microscope. Equiaxed grains were observed at the TMAZ and stir zone indicating fully plastic deformation. Tool pin diameter ratio 6/1 causes low heat input to the material because of small contact surface between tool surface and stirred materials compared to other tool pin diameter ratio. The grain size of stir zone increased with increasing of ratio of rotational speed to transverse speed due to higher heat input. It is observed that worm hole is produced when excessive heat input is applied. To evaluate the mechanical properties of this specimen, tensile test was used in this study. Welded specimens using taper pin ratio 6:1 shows higher tensile strength compared to other taper pin ratio up to 204 MPa. Moreover, specimens using taper pin ratio 6:1 showed better tensile strength with 500 rpm of rotational speed and 150mm/min welding speed.

Keywords : friction stir welding, magnesium AZ31, cylindrical taper tool, taper pin ratio

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