Proceedings of CHT-17
ICHMT International Symposium on Advances in Computational Heat Transfer

May 28-June 1, 2017, Napoli, Italy

CHT-17-004

FINITE ELEMENT ANALYSIS OF THERMAL AND MATERIAL FLOW BEHAVIOR DURING FRICTION STIR SPOT WELDING

Ashu Garg and Anirban Bhattacharya*
Measurement and Process Analysis Laboratory, Department of Mechanical Engineering, Indian Institute of Technology Patna, Bihta-801103, Bihar, India
*Correspondence author. Email: abhatta@iitp.ac.in

ABSTRACT Friction stir spot welding (FSSW), a modified approach of solid-state welding process, is gaining importance due to its capability to join sheets that are difficult-to-weld by conventional methods like resistance welding process. In the present work, effects of tool rotational speed (1000, 1500, 2000 rpm), coefficient of friction (0.2, 0.3, 0.4) and tool pin profile (circular, square and triangular) are investigated on the heat generation and material flow behavior during FSSW process through finite element (FE) analysis. FE results indicate that higher heat is generated for circular tool pin profile which further increases with tool rotational speed but decreases the width of bonded region. Temperature in the workpiece rises sharply as severe plastic deformation occurs during plunging of pin into the workpiece followed by a gradual rise with further penetration of tool pin. Another notable rise in temperature is observed as the shoulder region touches and deforms the workpiece wherein friction in radial surface starts contributing along with circumferential tool pin surface. Moderate increase in temperature is noticed with increase in the value of coefficient of friction for different tool pin geometries. The circular tool pin also shows the efficient symmetric mixing of material as compared to other tool pin profiles. Higher strain is generated for square tool pin due to more plastic deformation of metal and width of bonded region formed is also larger as compared to circular or triangular tool pin and thus improved the strength of welded joints formed by square pin tool. The FE predicted temperature is validated with reported literatures and observed to be in fair agreement.