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Thermal analysis on a weld joint of aluminium alloy in gas metal arc welding

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ABSTRACT

In this paper, a three-dimensional finite element model has been developed to simulate dynamically the gas metal arc welding (GMAW) process of aluminium alloy sheets. The numerical simulation was conducted using a non-linear transient thermal analysis by changing the welding parameters: namely arc power and welding speed. A moving Gaussian distributed heat source is implemented. All major physical phenomena associated with the GMAW process, such as thermal conduction and convection heat losses are taken into account in the model development. The developed model can calculate the temperature field and predict the weld geometry profile during the welding process. The measurement of weld bead profile from the GMAW experiments was used to validate the developed finite element model. The numerical study reveals that the arc voltage and welding speed have a significant influence on the temperature distribution, weld pool size and shape, and weld bead geometry. The results show that there are good agreements with the weld bead profile between the experimental observation and finite element simulation.

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Izvirni znanstveni članek

Termična analiza zvarnega spoja aluminijeve zlitine pri plinskem obločnem varjenju kovin

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POVZETEK

Da bi dinamično simulirali postopek plinskega obločnega varjenja kovin (GMAW) smo razvili 3D-model s pomočjo končnih elementov. Varili smo pločevine iz aluminijeve zlitine. Numerična simulacija je bila izvedena s pomočjo nelinearnega prehoda toplote ob spreminjajočih parametrih varjenja, in sicer moči obloka in hitrosti varjenja. Uporabljen je bil premikajoč vir toplote po Gaussovi porazdelitvi. Pri razvoju modela so bili upoštevani vsi glavni fizikalni pojavi, ki so povezani s postopkom GMAW, in sicer prenos toplote in toplotne izgube zaradi konvekcije. Razvit numerični model lahko izračuna temperaturno polje in napove geometrijo profila zvarnega spoja med varjenjem. Da bi potrdili uspešnost modela, smo izvedli tudi meritve profila varka med izvedenimi eksperimenti varjenja po metodi GMAW. Numerična študija je razkrila, da imata napetost obloka in hitrost varjenja pomemben vpliv na porazdelitev temperature, na velikost in obliko bazenčka raztopljene kovine ter na geometrijo varka. Raziskava je pokazala, da smo za geometrijo profila varka dosegli dobro ujemanje eksperimentalnih opažanj z rezultati, dobljenimi s simulacijo.

PODATKI O ČLANKU

Ključne besede:
Plinsko obločno varjenje kovin
Aluminijeva zlitina
Profil varka
Končni elementi
Termična analiza

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