



Characteristics of cracks in heat affected zone of ductile cast iron in powder welding process

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ARTICLE INFO

Article history:

Received 9 March 2010

Accepted 3 August 2010

Available online 7 August 2010

Keywords:

Powder welding

Ductile cast iron

HAZ

Crack

Weld zone

ABSTRACT

Cracking can occur in the HAZ of ductile cast iron hardfaced with nickel base self-fluxing alloy using oxyacetylene powder welding. Since there is no partially melted zone and almost no dissolution of graphite nodules, the cracking has metallurgical characteristics, which differentiate it from the cracks reported in the case of arc welding processes. The cracks initiate within the graphite nodules and propagate through the martensitic matrix. It is shown that the cracking process is predominantly controlled by the residual stresses.

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1. Introduction

Ductile iron has many applications in form of casting in large forming dies industry. Dies for automobile body forming need to have both high strength and smooth surface. During the sheet metal forming, the surface of the die may seldom damage because of entrapment of foreign objects between the surface of die and the metal sheet. These defects should be repaired as soon as possible. Powder welding, due to the unique nature of the process in terms of thermal cycle and the metallurgy of surfacing consumables, can be used for the repair of surface defects of the dies. There are many investigations on the welding of cast iron with arc welding processes, especially manual arc welding (SMAW) [1–5]. Arc welding due to the formation of weld pool and dilution with base metal is quite different with powder welding. There are three zones associated with arc welding: fusion zone (FZ) partially fusion zone and heat affected zone (HAZ) [6]. Formation of carbides during solidification and very hard ledeburite in PMZ are some problems associated with the formation of cracks in FZ and PMZ in arc welding of ductile cast iron [7].

Powder welding process employs oxyacetylene torch in which the welding alloy in form of a finely divided powder is fed through a metering device into the oxygen stream passing through the torch [5]. The nickel base self-fluxing alloys in the form of powders are used which are naturally immune to hot cracks and have good abrasive properties [8,9]. Moreover, powder welding has almost no spatter (compared to arc welding) and can be used to deposit delicately and with more control as the powder feed is independent from heat source.

Apart from the above, because the melting point of the nickel base self-fluxing alloy is significantly lower than the base metal, in powder welding there is very little dilution and effectively there is no partially fusion zone. Generally, due to the lower cooling rates involved in oxyacetylene welding, this process is considered less susceptible to cold cracking in the HAZ and no reference to HAZ cracking with oxyacetylene or powder welding processes could be found in the literature. However,

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