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PROSPECTING PREFORMED REFRACTORY CERAMIC STRUCTURES AS WELD POOL SUPPORTS FOR WIRE + ARC ADDITIVE MANUFACTURING

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ABSTRACT

Additive Manufacturing (AM) of metallic parts main advantages may be its higher flexibility of additively build components without the need of fluid material containers. Tough, to achieve the final result, post processing is a reality for most cases. Producing near-net shape parts is a great advantage, but not enough to fulfill most projects. Usually, the post processing of metallic components is related do heat treatments and machining. With time the metallic components have gained intricacy, along with the new requirements of the contemporaneous world. High-tech products are commonly made of distinct shapes and materials, either to gain sustainability or performance. Since the product concepts evolve in complexity, the manufacturing needs to follows its steps. Thus, integration between processes is a need to fulfill the rising challenges of manufacturing. In the AM context, integrated cells with deposition and subtractive headers are already a reality. This work seeks to integrate concepts of molding with AM. This work's objective is to prospect the employment of melting pool supports concept in Wire + Arc Additive Manufacturing (WAAM), a method of AM that uses wire as feedstock and electric arc as heat source. The supports are used in the welding industry with similar goal: support the molten pool and mold it while it solidifies. It is conventionally used of assuring a safe bonding between pipe sections joined by arc weld. They minimize burn-though issues, when a hole is formed in the seam during the weld. These preforms are intended to help the formation of the root, widening the welding operating range. Comparable welding pool overflow

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happens in some WAAM conditions. In this work the GMAW process was used to additively deposit single beads aided by a Yaskawa Motoman Welding Robot. The deposit was made over a 45º beveled edge of 25.4 mm thick ASTM 1045 plate. The chamfer nose had 20 mm. The chamfer was designed to facilitate the required metallurgical bond between filler material and substrate once it was deposited right on the edge. Dissimilar to the substrate, a martensitic stainless steel ER420 were used to create 2 layers smooth 90º wall, coincident to the substrate lateral face. The smooth surfaced shape achieved was possible due to the use of a refractory high purity Zr bar as support. The bas was clamped to the lateral face of the substrate, while the material was filled inside the resulted chamfer. Cross-section of the deposit were cut and metallographically analyzed. The results showed safe metallurgic bonding, no porosity nor lack of fusion. Parts that have high demand, low geometry complexity and still benefit for WAAM, can highly be benefited from the use of this kind of support. In these special conditions, it can improve not only the manufacturing productivity due to higher deposition rate allowed, but also due to the better surface quality it results. The same bar was used in more than 30 beads, showing superior thermal shock resistance. On the other hand, supporters of this quality have prices considerably high, compared to conventional ceramic backing.

Keywords: 3D Printing; MADA; MIG/MAG; TIG; Welding.