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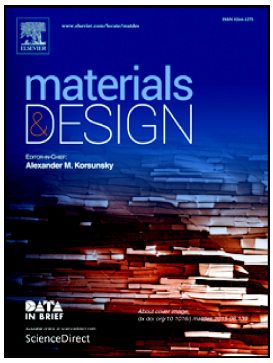

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Effect of water depth on weld quality and welding process in underwater fiber laser welding

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Abstract: A series of experiments under various water depths were performed using an optical fiber laser without draining the welding zone to study the effect of water depth on the laser welding. The ULBW processes were also monitored using a camera. Firstly, welding experiments were performed with laser power 3.0 kW, welding speed 0.6 m/min, focal position 0 mm. It was found that water has a slight effect on the ULBW, particularly when the water depth is less than 3 mm; however, when the water depth is greater than 7 mm, water has a strong hindering effect on ULBW and leads it to failure. In the process of direct ULBW, the 'beam channel' is formed in the water environment between the incident laser beam and the target surface as a result of the gas pressure inside the plasma exceed the water pressure depending on the water depth. The stability of the 'beam channel', which gradually worsens with increasing water depth, have an important influence on the weld bead quality and the welding process stability. Additionally, laser power has the greatest effect on the available water depth, followed by the welding speed, while focal position has little effect on it.

Keywords: Underwater laser beam welding; Welding process; Weld quality; Optical fiber laser

1. Introduction

Underwater welding is an important repairing and maintenance technology that is widely used in offshore oil and gas industries, ships and nuclear power plants. As reported by Bucurel and Hlifka, underwater welding primarily uses manual arc welding and flux-cored wire welding processes [1]. Underwater welding has developed rapidly in recent years. In our previous study,