The influence of the fluid properties on the underwater welding

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Problem Statement:

underwater welding is conducted in a stagnant water environment, which minimizes heat effects on the workpieces. While this method results in less deformation of the workpieces, it also causes increased stress in the welding zone and poor metallurgical properties. A primary objective of this investigation is to reduce workpiece deformation and enhance the flexibility of the welding zone.

Objectives:

Conduct feasibility tests for underwater weld bead formation using flux-cored manual metal arc welding, TIG welding, and MIG welding. These tests will include visual inspections to evaluate spatter formation and workpiece deformation.

Figure 1: Welding setup

Figure 2: MIG Welding

Figure 3: CNC setup

Methods:

Underwater pilot experiments using MIG and TIG welding were conducted to evaluate weld bead formation. MIG welding, selected for its superior performance, used a portable machine (100 V, 100 A) with controlled torch velocity via a CNC tool post arm. Tap and seawater were tested to study their effects on stainless steel weld bead characteristics, with key parameters like voltage, current, and wire feed rate carefully controlled.

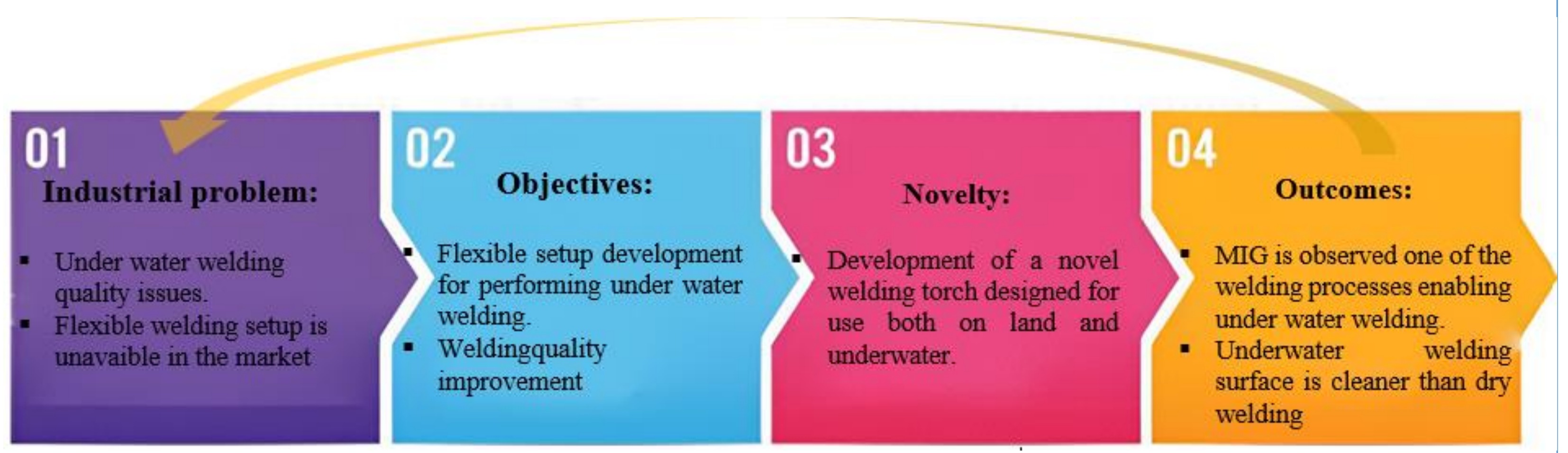

Figure 4:Work Overview

Testing and Results

Defects such as porosity, spatter, and cracks were observed. The welded specimens were cut for further analysis. Mechanical testing, including tensile and bending tests, as well as visual inspections, were performed. X-ray diffraction (XRD) was also used to assess the weld quality.

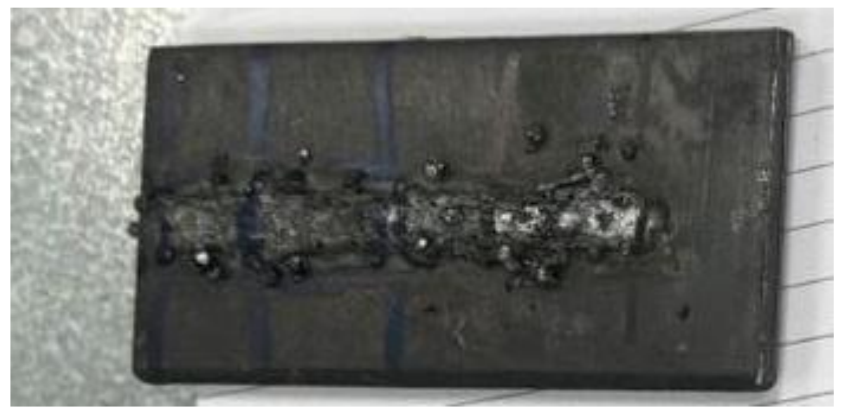

Figure 5:Weld bead specimen

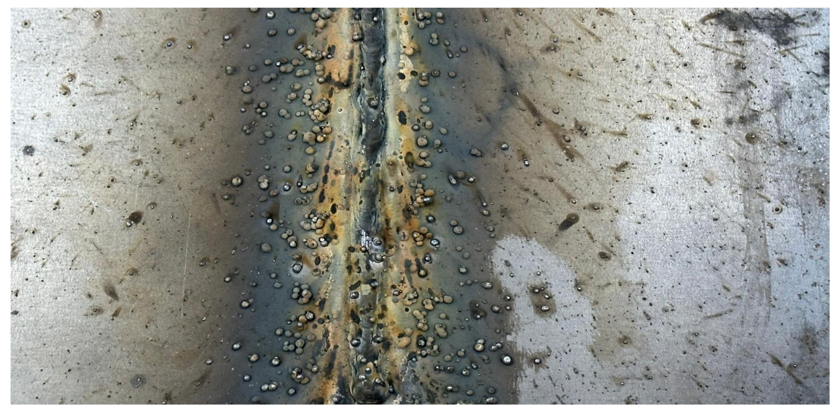

Figure 6:Dry welding spatter

Figure 7:Welding in sea water condition, porosity

Figure 8:Specimen after cutting

Results and Discussion:

The X-ray diffraction (XRD) analysis shows changes in the specimen's crystalline structure. Shifts in peaks or the appearance of new phases suggest increased hardness or strength, but these changes could also lead to brittleness or higher susceptibility to corrosion, potentially affecting the material's durability and corrosion resistance.

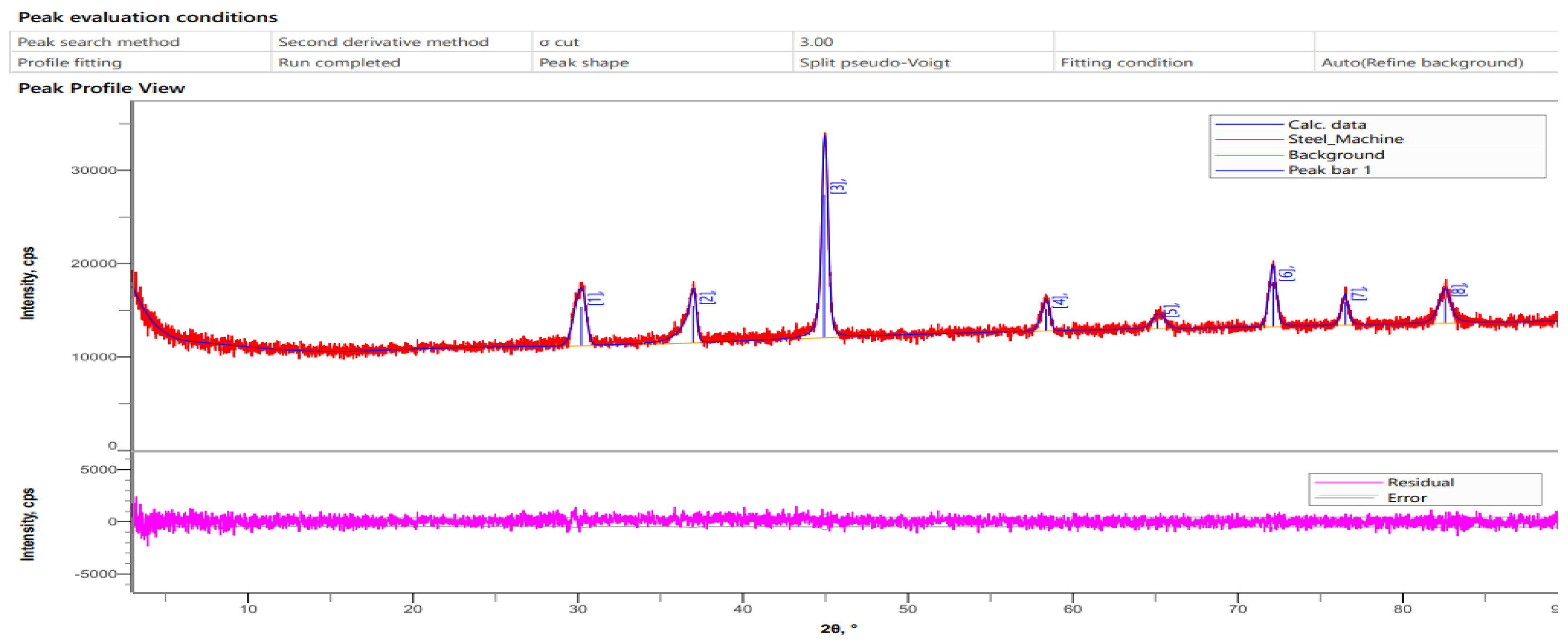

Figure 9: Peak elevation condition and peak profile

Conclusion:

The study explored the effects of underwater welding on stainless steel using MIG and TIG techniques in different water environments. Mechanical testing and XRD analysis revealed changes in phase composition and hardness, potentially increasing weld strength. However, the new phases could also lead to brittleness and corrosion susceptibility, impacting the weld's durability in marine applications.

References:

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[2] Łabanowski, J., Fydrych, D., & Rogalski, G. (n.d.). Underwater welding – A review. Gdańsk University of Technology, Faculty of Mechanical Engineering, Department of Materials Technology and Welding, Gdańsk, Poland. DOI: 10.2478/v10077-008-0040-3

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