EFFECT OF TIG WELDING ON CORROSION BEHAVIOR OF 316L STAINLESS STEEL

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EFFECT OF TIG WELDING ON CORROSION BEHAVIOR OF 316L STAINLESS STEEL

By

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DECLARATION AND VERIFICATION REPORT

FINAL YEAR RESEARCH PROJECT

It is hereby declared and verified that this research entitled: **Effect of TIG Welding on Corrosion Behavior of 316L Stainless Steel** by **Mohammad Arif bin Mat Rayani**, Matric No. **UK 16779** has been examined and all errors identified have been corrected. This report is submitted to the Department of Maritime Technology as partial fulfillment towards obtaining the **Bachelor Degree of Applied Science (Maritime Technology)**, Faculty of Maritime Studies and Marine Science, Universiti Malaysia Terengganu.

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I hereby declare that this thesis entitled **EFEECT OF TIG WELDING ON CORROSION BEHAVIOR OF 316L STAINLESS STEEL** is the result of my own research except as cited in the references.

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EFFECT OF TIG WELDING ON CORROSION BEHAVIOR OF 316L STAINLESS STEEL

ABSTRACT

316L stainless steel is one of the most consumable materials in pipe, flange, valve and others. It is an alloy which was produced to encounter the weaknesses of their basic element such as hardness, strength, corrosion resistant and other properties in certain aggressive condition such as seawater and petroleum environment. In this study, 316L stainless steel was used to study the effect of the cooling method of tungsten inert gas (TIG) welding in causing the corrosion in solution. There are two different cooling methods for each type of metals where the samples were cooled in a room temperature or air cooling while another samples facing the rapid cooling process called quenching. 316L stainless steel had divided into 3 partitions which is heat affected zone (HAZ), weld metal and base metal. The corrosion behavior and microstructure of weld metal, HAZ, base metal and as-weld (coupled weld and base) were compared together. Microstructure was investigated using scanning electronic microscopy (SEM) through image of grain boundaries on metal. Tungsten inert gas was used to weld the samples. The samples were exposed to the highly corrosive environment in salt spray chamber at 37°C which provide very similar environment as the real marine environment. After being in the chamber for several periods, the samples weight loss analysis was done. The samples continued with test of electrochemical impedance spectroscopy using the frequency response analyzer (FRA) and general purposes electrochemical system (GPES) module. Weight loss analysis done before and after the samples being put in the salt spray chamber to determine their changes after several periods. Based on the result, it was determined that corrosion rate of quenching samples more than air cooling samples because of HAZ increased anodic element. So, quenching method as post weld heat treatment (PWHT) increased the corrosion rate of as-weld samples. HAZ samples have less corrosion resistance than weld metal and base thereby being attacked preferentially by localized corrosion.

KESAN KIMPALAN TIG TERHADAP SIFAT PENGARATAN DARIPADA 316L STAINLESS STEEL

ABSTRAK

316L stainless steel adalah salah satu bahan yang paling laris digunakan dalam paip, bebibir, injap, dan peralatan marin yang lain. la merupakan aloi yang dihasilkan untuk mengatasi kelemahan elemen asas seperti kekerasan, kekuatan, tahan kakisan dan banyak lagi dalam keadaan berisiko seperti air laut dan persekitaran petroleum. Dalam kajian ini, 316L stainless steel telah digunakan untuk mengkaji kesan kaedah penyejukan kimpalan gas lengai tungsten (TIG) menyebabkan kakisan dalam larutan. Terdapat dua kaedah penyejukan di mana sampel ini disejukkan pada suhu bilik atau pendinginan udara manakala sampel yang lain menghadapi proses penyejukan yang cepat dipanggil pelindap kejutan. 316L stainless steel telah dibahagikan kepada 3 bahagian dimana zon terkeana haba (HAZ), logam kimpal dan besi asas. Sifat kakisan dan mikrostruktur logam kimpal, HAZ, logam asas dan logam pasangan (dua logam dikimpal) dibezakan bersama. Mikrostruktur telah dikaji menggunakan mikroskop imbasan elektronik (SEM) melalui imej sempadan bijian pada logam Ciri-ciri pengaratan logam kimpal, logam HAZ, logam asas dan logam pasangan (dua logam dikimpal) dikaji bersama untuk mencari perbezaan. Gas tungsten lengai telah digunakan untuk mengimpal sampel. Sampel-sampel terdedah kepada persekitaran yang sangat mengakis dalam kebuk semburan garam pada 37°C yang menyediakan persekitaran yang amat serupa sebagai persekitaran marin sebenar. Setelah berada di dalam ruang bagi tempoh tertentu, analisis kehilangan berat sampel yang telah dilakukan. Seterusnya, sampel dijalankan dalam ujian electrochemical impedance spectroscop menggunakan frequency response analyzer (FRA) dan general purposes electrochemical system (GPES) modul. Analisis kehilangan berat yang dilakukan sebelum dan selepas sampel yang dimasukkan ke dalam ruang semburan garam untuk menentukan nilai perubahan terhakis. Berdasarkan keputusan diperolehi, kadar kakisan sampel pelindapkejutan lebih banyak daripada sampel penyejukan udara kerana sampel pelindapkejutan mempunyai banyak unsur anodic. Maka, kaedah pelindapkejutan sebagai rawatan haba selepas kimpalan (PWHT) meningkatkan kadar kakisan sampel logam pasangan. HAZ sampel mempunyai daya tahan kakisan yang kurang daripada logam kimpal dan logam asas dan seterusnya HAZ lebih kerap diserang oleh mekanisme kakisan setempat.