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A COMPARISON OF THE CORROSION BEHAVIOUR OF 444 FERRITIC AND 316 AUSTENITIC STAINLESS STEELS IN ACIDIC CHLORIDE MEDIA

Feyisayo Victoria, Adams

A dissertation submitted to the Faculty of Engineering and the Built Environment, University of the Witwatersrand, in fulfilment of the requirements for the degree of Masters of Science in Engineering.

Johannesburg, 2009

DECLARATION

I declare that this dissertation is my own, unaided work. It is being submitted to the University of the Witwatersrand, Johannesburg for the degree of Master of Science in Engineering. It has not been submitted before in any University for any degree or examination.

_____

(Signature of candidate)

_____ **Day of** _____ **2009**

ABSTRACT

The application and demand for 316 austenitic stainless steels in many industries including chemical, petroleum, process, marine, etc, and recently as architectural materials, together with the recent global economy crisis, present a strong challenge to engineers to search for a low cost alternative stainless steel with similar corrosion resistant properties to 316 austenitic stainless steel. As a result of the corrosion behavior of a comparatively low cost 444 ferritic stainless steel is compared in this study, with that of 316 austenitic stainless steel in acidic chloride environments where 316 are typically and mostly applied. The pitting corrosion resistances of the two alloys were studied by means of immersion tests and electrochemical techniques including cyclic potentiodynamic polarization, open circuit corrosion potential measurements and chronoamperometry. All the corrosion measurements were carried out at room temperature and at varying concentrations of the electrolytes. The alloys were also characterized prior and after corrosion tests using an optical microscope, scanning electron microscope, a Raman spectrometer and a X-ray diffractometer. The alloys displayed similar corrosion behaviour with slight differences in their corrosion resistance in all the solutions. The passivity of both alloys remained stable with no passivity breakdown and pitting in the lower concentrations of all the investigated solutions. It displayed poor passivation in 1 M hydrochloric acid. Alloy 316 was generally more resistance in all the solutions than alloy 444. Alloy 444 was better corrosion resistant in chloride environments than in the sulphuric acid, while alloy 316 was more resistant in sulphuric acid than in a chloride environment. This was corroborated by SEM analysis, and 444 had more corrosion pits in sulphuric acid while alloy 316 had more pits in chloride environments. XRD and Raman spectroscopy indicated that the corrosion products on alloy 444 in all the solutions were amorphous in nature, while those observed for alloy 316 were crystalline. It can be concluded that alloy 444 can be applied and successfully used to replace alloy 316 in chloride environments especially in sulphuric acid containing 3.5 % NaCl solution.

DEDICATION

This dissertation is dedicated to the almighty God for his immense love and grace upon my life and for taking me this far.

ACKNOWLEDGEMENT

My first appreciation goes to God the all sufficient, the powerful, all glorious, all merciful. He is the giver of my life, the hope that I have. I appreciate Him for teaching me, for given me wisdom and for seeing me through. I have the greatest pleasure to express my profound gratitude and appreciations to the following persons who have contributed in one way or the other to the success of the study.

Professor J. Herman Potgieter: For being the channel through whom God used to make me undertake and complete this study at WITS University. Thanks for your fatherly love, financial assistance, moral support, effective supervision, words of encouragement - indeed you are a father. My God will reward you greatly.

Mr Josias Van Der Merwe: For efficient expertise and critical supervision, love and co-operations throughout the work.

Dr. Peter Apata Olubambi: For your consistent love, care and struggles towards my academic pursuit. You brought me to South Africa and have ever been a strong supporter.

I wish to thank **Bruce Mothibeli** and **Aubrey Xoseka,** for your readiness and assistance in getting all facilities used for the laboratory work of this study. I appreciate **Mrs Caroline M. Lalkhan, and Mr Abraham R. Seema (EMU, WITS)** for your kind assistance during the SEM study. I deeply appreciate **Johnson Olugbenga** for your kind assistance during the XRD analysis. My gratitude goes to **Nthabiseng Maledi** for taking your time to see that the Raman analyses were done. Thanks to **Nompumelelo Thanjekwayo**, **Zvanaka Msindo** and **David Konadu** for their assistance during the electrochemical study.

Special thanks to all my friends, **the Olubambis, the Ilemobades, Mrs Bola Ikotun, Mrs Seyi Akpor, Mr and Mrs Adewale Adeleke, Mrs Abe, Mr James Adewumi, Enoch Ogunmuyiwa, Chris Idibie, Mr Ayo Afolabi, Mr Abdufatai Jimoh** for the sweet fellowship, love, courage, prayers, words of exhortations and encouragements. You really

made me feel at home during my study. Thanks to my Pastors, Pastor and Pastor (Mrs) **Gbenga Ojo for their prayers and encouragement.**

I will not forget to appreciate these two people whom God used to shape my life. **Mrs Bola Adewumi and Prof. Oladele Akogun** I can boldly say that staying with you all those years were really a blessing and all the lessons I learnt have shaped my life. Thanks to my brother and sister **Olalekan Babalola** and **Olayide Babalola** for being real and ideal family to be proud of. I thank my parents **Mr and Mrs Olabode Babalola** for the love care and good training I received from you. I am really blessed by the both of you. I thank my grandfather **Pa Babalola Okejipapo** for being my friend and mentor, for his prophesy which actually came to pass by my journey to South Africa. I will never forget you. I wish to specially express my sincere appreciations to my husband **Mr Clement Kayode Adams** for your love, understanding, kindness and the motivations I receive from you every moment. Thanks for standing by me and for all the prayers.

Finally, I gratefully acknowledge the financial support received from **the Financial Aid Office of the University of the Witwatersrand** for partly funding this study.

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