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بسم الله الرحمن الرحيم

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قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأفلام قد أعدت دون أية تغيرات

يجب أن

تحفظ هذه الأفلام بعيدا عن الغبار

في درجة حرارة من ١٥-٢٥ مئوية ورطوبة نسبية من ٢٠-٤٠%

To be Kept away from Dust in Dry Cool place of 15-25- c and relative humidity 20-40%

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بالرسالة صفحات لم ترد بالاصل

EVALUATION OF SENSITIZATION AND STRESS CORROSION CRACKING BEHAVIOR OF 304H STAINLESS STEEL

by

ENG./AHMED SAAD MOHAMED ABO EL-AZM

B. Sc.,M.Sc.

DISSERTATION
Presented to
Faculty of Engineering at Cairo University

in Partial Fulfillment of the
Requirements for the Degree of
DOCTOR OF PHILOSOPHY

in
METALLURGY

FACULTY OF ENGINEERING, CAIRO UNIVERSITY

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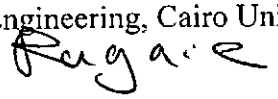
Supervisors

Prof.Dr. / Iman Salah Eldin Elmahallawi

Department of Mining, Petroleum and Metallurgy
Faculty of Engineering, Cairo University

Prof.Dr. / Randa M. Abdel – Karim
Department of
Mining, Petroleum and Metallurgy
Faculty of Engineering, Cairo University

Dr. / Ragaie M. Rashad Hassan
Department of
Mechanical Design and Production
Faculty of Engineering, Cairo University



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Approved by the

Examining Committee

.....

Prof.Dr. / Iman Salah Eldin Elmahallawi, Thesis Main Advisor

.....

Prof.Dr. / Randa M. Abdel - Karim

.....

Prof.Dr. / Fawzy Abdel - Kader El-Refaie

.....

Prof.Dr. / Abd El Aziz Fahmy Waheed

.....

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I would like to thank my wife and my children who I credit my achievement to. You were all there to lift my spirits, support my endeavors, and listen to my problems.

DEDICATION

I dedicate this dissertation to my parents, my wife, and my children

ABSTRACT

The present work is concerned with investigation of the sensitization and stress corrosion cracking (SCC) of austenitic stainless steel grade 304H in time - temperature conditions, which could be experienced during fabrication or operation at normal, transient or even abnormal operating conditions of power boiler, and other applications, and trial to conclude the optimum conditions to eliminate these risks in various phases. Potentiodynamic polarization test in 0.5 *M* NaCl was carried out. Electrochemical Potentiokinetic Reactivation (EPR) test with its two techniques single and double loop was used to evaluate the degrees of sensitization of the studied alloy at various temperatures and time durations. These techniques were used firstly in the current study to quantify the degree of sensitization of alloy 304H. However, they are originally specified in ASTM G 108 for alloys 304 and 304L. The ASTM standard committee does not restrict the use of these techniques to the two grades only, but allow studying the validity of them to other stainless steels. In the current study, the applicability of these techniques in evaluation the degree of sensitization of alloy 304H was assured. Also the time temperature sensitization (TTS) diagram was also firstly plotted for this value of carbon content.

Boiling magnesium chloride ($MgCl_2$) test was used to evaluate the susceptibility to stress corrosion cracking of sensitized 304H SS at two levels of stress. A correlation between degree of sensitization and stress corrosion cracking was established.

It was concluded that the strength properties were significantly reduced as the aging temperatures and duration increase, which was attributed to grain growth and chromium carbides precipitations.

Specimens sensitized at 550, 600, 650, 700, and 750 °C showed significant increase in degree of sensitization (DOS) with duration. This may be explained by the fact that the tendency to carbide precipitation shows considerable boundary-to-boundary variation. This is reversely related to grain boundary energy. Subsequently the degree of sensitization of the specimen increases with increasing the length of attacked grain boundary.

Meanwhile, the specimens that sensitized at 800 °C attain the highest degree of sensitization at 1 h aging duration, and then this value starts to decrease with sensitizing duration. This could be explained by the so-called healing effect occurred at high temperatures due to chromium diffusion back into the depleted zone from the matrix.