EFFECT OF CORROSION INHIBITOR AND LASER SURFACE TREATMENT ON CORROSION BEHAVIOR OF STEEL USED IN CHILLING SYSTEM

by

LEONG HOI SAN

Master of Science in Electromechanical Engineering

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Supervisor

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Address:

Telephone: 853-66314890
Fax: N/A
E-mail: louis.leong@dafoo.com.mo

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University of Macau

Abstract

EFFECT OF CORROSION INHIBITOR AND LASER SURFACE TREATMENT ON CORROSION BEHAVIOR OF STEEL USED IN CHILLING SYSTEM

by Leong Hoi San

Thesis Supervisor: Prof. Kwok Chi Tat
Electromechanical Engineering

Chilled water is a popular cooling medium in HVAC system, which is always distributed to air handling units through the pipes. However, a seriouscorrosion problem has been found for the piping system if no preventative measure is taken. In order to mitigate the corrosion of pipes, the application of corrosion inhibitor and laser surface melting on black steel were attempted.

Black steel samples were immersed in tap water medium at various temperatures (5 and 13 ^{o}C), and various concentrations of sodium nitrite-based corrosion inhibitors for investigation. This study concerns the assessment of the inhibition effect by using potentiodynamic polarization method and microstructure analysis. In this thesis, sodium nitrite-based corrosion inhibitor was found to be significantly reduced the corrosion rate of specimens in tap water and formed a protective coating in-situ by the reaction between the solution and the steel

surface. In addition, it was observed that this improvement was related to the concentration of inhibitor and optimum concentration was evaluated.

On the other hand, influence of laser surface melting of black steel on both hardness and corrosion behavior was also studied. The microstructures of the as-received and laser-treated samples were characterized by using optical and scanning electron microscopy with hardness testing techniques, in various experimental conditions: with different laser beam density and scanning speed. Furthermore, investigation was also carried out on the corrosion characteristics of laser-treated specimens in 0.9 wt% $NaNO_2$ solution and tap water at 13 ^{o}C

In the case of laser surface melting, most of specimens show improved corrosion resistance and refinement of microstructure with hardness increment. In fact, the hardness and corrosion characteristic of all laser-treated specimens are strongly dependent on the scanning speed and power density of the laser beam, which in turn result in different microstructures.

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LIST OF ABBREVIATIONS

PRV.Pre-Rotation Vanes

GDP. Gross Domestic Product

emf. Electromotive Force

CUI. Corrosion under Insulation

Laser.Light Amplification by Stimulated Emission of Radiation

LTH. Laser Transformation Hardening

LSM. Laser Surface Melting

MZ. Melted Zone

HAZ. Heat Affected Zone

OM. Optical Microscopy

SEM. Scanning Electron Microscopy

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For any errors or inadequacies that may remain in this work, of course, the responsibility is entirely my own.

DEDICATION

The author wishes to dedicate this thesis to his family. Each member of the family deserves a share of this achievement. Their support and encouragement made the finishing of this study possible.

And of course, to all of his colleagues and friends who dedicate their related working experience of corrosion.

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