

MECHANICAL PROPERTIES OF STEEL IN AQUEOUS CORROSION

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I certify that the project entitled “Mechanical Properties of Steel In Aqueous Corrosion” is written by Cho Ching Liang. I have examined the final copy of this project and in our opinion; it is fully adequate in terms of scope and quality for the award of the degree of Bachelor of Engineering. I herewith recommend that it be accepted in partial fulfillment of the requirements for the degree of Bachelor of Mechanical Engineering.

Examiner

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MECHANICAL PROPERTIES OF STEEL IN AQUEOUS CORROSION

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Report submitted in partial fulfilment of the
requirements for the award of the degree of
Bachelor of Mechanical Engineering

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6 DECEMBER 2010

SUPERVISOR'S DECLARATION

I hereby declare that I have checked this project and in my opinion, this project is adequate in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering.

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I hereby declare that the work in this project is my own except for quotations and summaries which have been duly acknowledged. The project has not been accepted for any degree and is not concurrently submitted for award of other degree.

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LIST OF ABBREVIATIONS

ASTM	American Society for Testing and Materials
UTS	Ultimate Tensile Strength
AISI	American Iron and Steel Institute
SCC	Stress Corrosion Cracking
PH	Potentiometric Hydrogen Ion Concentration

ABSTRACT

Steel is the most common structural material and is used in a wide range of environments. Serious problems from environmental attack may be presented which significantly decrease characteristics of mechanical properties such as tensile, torsion, bending, hardness and fatigue stress and thus durability and service lifetime. In this experiment, the effect of the fresh water environment and sea water environment corrosion to the tensile strength, flexural strength and hardness of AISI 1010 steel will be determined. First, the test specimens will be prepared according to the ASTM standards. Next, the immersion of the steel to the corrosive environment up to a month according to ASTM G31. The specimens were cleaned and tested for tensile flexural and hardness properties. Losses in yield strength and ultimate tensile strength for tensile test, losses in yield load for flexural test and a significant decrease in hardness of the steel is observed after it is corroded compare to the initial condition. The result obtained showed that losses in mechanical properties for specimens exposed to sea water were higher than those exposed to fresh water for every properties tested.

ABSTRAK

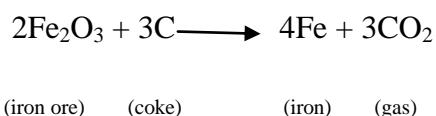
Besi merupakan bahan struktur yang paling umum dan digunakan dalam pelbagai pembangunan dalam persekitaran. Masalah serius dari serangan persekitaran boleh menyebabkan impak negatif yang signifikan terhadap ciri-ciri sifat mekanik daya tahan dan masa perkhidmatannya struktur bangunan berkurang. Matlamat kajian ini adalah menentukan pengaruh pengakisan daripada air tawar dan air laut terhadap kekuatan ketegangan, kelentur dan kekerasan besi AISI 1010. Setelah mencemur specimen dalam medium mengkakis selama satu bulan dengan mengikut standard ASTM G31. Specimen dibersihkan dan kekuatan ketegangan, kelenturan dan kekerasan specimen-specimen tersebut akan diuji. Kerugian kekuatan luluh dan kekuatan tarikan utama untuk ketegangan, kerugian beban hasil untuk uji lentur dan kerugian yang signifikan dalam kekerasan besi diamati selepas pengakisan berbandingkan dengan keadaan awal. Kerugian dalam sifat mekanik untuk specimen yang dicemur dalam air laut lebih tinggi daripada yang dicemur dalam air tawar untuk setiap ciri-ciri mekanik besi.

CHAPTER 1

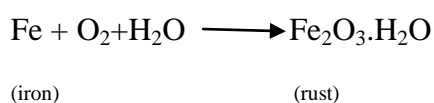
INTRODUCTION

1.1 INTRODUCTION

The corrosion of steel arises from its unstable thermodynamics nature. Steel is manufactured by iron, which is made in a blast furnace by reducing ores such as haematite (Fe_2O_3) with carbon in form of coke. This process can be illustrated in a simple chemical form (Zaki Ahmad, 2006):



This reaction occurs at a very high temperature but the final products, iron and eventually steel are unstable. Consequently, when steel is exposed to moisture and oxygen it tends to revert to its original form. This process can be illustrated as chemical terms (Zaki Ahmad, 2006):



Corrosion is the degradation of a material properties or mass over time due to environmental effect. When steel is in contact with air and oxygen it will reduced to rust. In this case, we would say that the corrosion occurs. If either of these materials is absent, corrosion usually will not take place. Basic environmental variables such as potentiometric hydrogen ion concentration (PH), temperature and stress will have effect on the corrosion rate.

There are three primary reasons for concern and study of corrosion. The reasons are safety, economics and conservation. For example premature failure of bridges or

structures due to effect of corrosion and effect of corrosion in mechanical properties of metals can result in human injury and even lost of lives. Piping is another major type of equipment subjected to corrosion. This includes the water pipes at home, where the corrosion attack mostly from the inside, as well as the underground water, gas and oil pipelines that crisscross our land.

1.2 PROJECT BACKGROUND

The corrosion rates of metals are different in different types of environments which has a significant impact on the mechanical properties of metals.

The group of environments comprises fresh water in lakes, rivers, pipelines, rains and ground water. Water possesses several properties, one being its ability to dissolve to some degree most of the inorganic substances occurring in nature (Pierre, 2008). Because of this property, water typically contains a variety of impurities that may cause problems through the formation of deposits in water lines and boilers. Besides this, corrosion jeopardizes the mechanical properties of the metals of the pipelines systems by causing leaks and breaks and affecting the water quality.

Seawater is used by many industries, such as shipping, offshore oil and gas production, power plants and coastal industrial plants. The main use of seawater is for cooling purpose and also firefighting in oilfield (Pierre, 2008). Seawater is normally more corrosive than fresh water and thus has more significant impact on the mechanical properties of metals because of the higher conductivity and the penetrating power of the chloride ion through surface film on the metal.

1.3 PROBLEM STATEMENT

In recent years, study of the corrosion has become significant. A lot of time and money were spent to study about the corrosion. All these study are aimed to study the behaviour of material and enhance the safety of equipment, structures, prevent leakage of gas and oil pipelines and water pipelines. Corrosion will have effect on the mechanical properties of steel.

1.4 PROJECT OBJECTIVE

The aims of this project are to investigate the effect of corrosion in fresh water and sea water environment conditions to tensile, bending strength and hardness of steel.

1.5 SCOPE OF THE PROJECT

The specimens AISI 1010 steel were cut ASTM standard and placed in fresh water with 0% salinity and seawater with 35.1% salinity which was the corrosive environment for a certain period. This study involved laboratory work such as tensile and bending test of corroded specimens. The scope of this study involved 3 phases of work. The preliminary work was to prepare the specimens for tensile and bending test based on ASTM standards. The second phase was to expose the specimens into the corrosive environments (fresh water and seawater) according to ASTM G31 and cleaned according to ASTM G1 standard. Finally, the tensile and bending tests were carried out using INSTRON Universal Testing Machine and the hardness of the specimens after corrosion was tested by Vickers hardness test machine.

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