

**FINAL YEAR PROJECT REPORT
BACHELOR OF ENGINEERING (HONS) (CIVIL)
FACULTY OF CIVIL ENGINEERING
MARA INSTITUTE OF TECHNOLOGY
SHAH ALAM, SELANGOR D.E.**

The logo of MARA Institute of Technology is a shield-shaped emblem. It features a yellow graduation cap at the top, with several horizontal lines below it. The shield is filled with a light purple color, and there are white curved lines at the bottom, resembling a stylized 'M' or a bridge.

**ANTI-CORROSION SYSTEM OF REINFORCED
CONCRETE STRUCTURES IN MARINE
ENVIRONMENT**

**FAUZI BIN MAT
OCTOBER 1997**

ACKNOWLEDGEMENTS

In the name of Allah, the Most Beneficent, Most Merciful, the Lord of the Universe. Alhamdulillah, with His help I manage to complete my final year project successfully. Praise be to His Prophet Muhammad, his companions and those who follow his path as what he preached upon, may Almighty Allah keep us in His blessing.

I wish to express many thanks to my supervisor, En. Turahim Abd. Hamid for his valuable contribution, guidance, criticisms and suggestions which enabled me to complete the project as planned.

Thanks are also due to En. Lim Chain Eng from RNC Total Corrosion Control Sdn. Bhd. for providing some materials needed for my project. My deepest gratitude also goes to laboratory staffs En. Kamaruddin and En. Saiful, and those friends for their unselfish assistance and guidance in carrying out the experiment towards the completion of the project.

Last but not least, the author wishes to express special thanks to his beloved parents, brothers and sisters for their encouragement, understanding, moral and financial support throughout the course of my study in ITM, Shah Alam, Selangor Darul Ehsan.

Fauzi b. Mat
October 97

CONTENTS

Acknowledgments	i
Table of Contents	ii
List of Tables	vi
List of Figures	viii
Abstract	x

CHAPTER 1: INTRODUCTION

1.0	General	1
1.1	Objective	2
1.2	Scope of Work	2

CHAPTER 2: CORROSION

2.0	General	4
2.1	Causes of Corrosion in Concrete	4
	2.1.1 Carbonation of concrete	5
	2.1.2 Chloride in concrete	7
2.2	The Electrochemical Process of Corrosion	7

ABSTRACT

The effect of corrosion on concrete is rarely taken into consideration although it is known that the concrete can experience chemical reaction due to certain condition of exposure. Marine structures are likely exposed to corrosion as the sea water contains a lot of chemical contents that may lead to severe chemical corrosion if precaution is not taken into accounts. The study provides an overview of the current state of art of corrosion control as well as to steel.

The study also discusses the application of Migrating Corrosion Inhibitor (MCI) for protection of reinforced concrete structures against corrosion. Measurements of corrosion potentials were carried out in the laboratory on reinforced concrete samples subjected to chloride attack to represent the marine environment.

Based on the study, samples containing MCI show to have better performance and protection against chloride attack compare to the control samples although no corrosion activity is observed.

CHAPTER ONE

INTRODUCTION

1.0 General

Corrosion is considered as one of the major problems facing many industries worldwide especially marine related industries such as ship, building, oil and gas industries. It is estimated that an average of 3% to 5% of nation Gross National Profit gets lost to the direct results of corrosion. This figure normally runs into billions of dollars. In the United States the annual cost of corrosion and protection against corrosion is estimated at 90 billion dollars. For the whole of Europe the cost is in excess of \$ 104 billion dollars and over 10 billion dollars per year in the UK or the loss of over 1 tonne of steel every 90 seconds.

Inhibitors are widely used in corrosion control to protect different structures from corrosion. The use of inhibitors might be the best solution in those instances where concrete is prepared with brackish or sea water, or with sands having a high chloride content. At present, calcium nitrite is one of the most commonly used inhibitors, to prevent concrete reinforcement from degradation. However, several countries in Europe have banned the use of this inhibitor because it is affected by the environmental trends. Calcium nitrite is an anodic inhibitor and therefore effective at low chloride concentrations. If chloride concentrations reach a critical level and insufficient amounts are added, corrosion becomes intensely localised, thus simulating the attack.