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PREDICTION OF ATMOSPHERIC  
CORROSION OF HOT DIP GALVANIZED  
STEEL IN SRI LANKA AND THE RELATED  
ENERGY CONSERVATION

by  
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This thesis was submitted to the Department of Mechanical Engineering  
of the University of Moratuwa in partial fulfillment of the requirements for  
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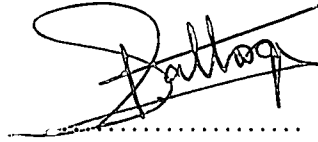


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## DECLARATION.

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*Indika Gallage*



TO

*My wife Rasika and little son Sakya*



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## Abstract

Steel is the primary material in manufacturing and building industries. At the usable state it is at a high energy level and tends to revert back to its primary energy level, which consists mainly of oxides (iron ore) and this phenomenon is called corrosion. The problem of steel corrosion is a major drawback of using the metal. Corrosion is quantified as corrosion rate that applies for any metal and it can be given as the number of  $\mu\text{m}$  from the metal surface lost as corrosion or the mass of steel lost as corrosion in  $\text{mg}/\text{m}^2$  or the mass of steel reverted back to its primary energy level.

Galvanizing, which is applying a Zinc coating on Steel, is one of the most reliable and cost effective methods of protecting steel. This method of protecting steel sacrifices one material to protect another, i.e. steel is protected by sacrificing Zinc. The primary reason to use Zinc as a coating to protect steel is the low corrosion rates of Zinc compared with Steel.

The study introduces a brief interpretation of the ratio of zinc corrosion rates to the ratios of steel corrosion rates. This kind of discussion is necessary to get a clear picture of the corrosion rates of the two materials involved.

The concept of embodied energy, which is the quantum of energy required to bring a material to its present state from its "cradle", gives us the liberty to convert a unit mass of a given material to an equivalent quantum of energy. By using the concept of embodied energy, corrosion rate can be interpreted as the rate of loss of energy or simply power loss.

The primary objective of this study is to compare the corrosion rate of Steel and Zinc and interpret it as the loss of energy and compare the energy losses. This



comparison depends on the embedded energy quantity of each material and corrosion rate each material possesses in a given environment. The comparison is done only for the atmospheric environment. This kind of analysis makes it possible to determine the energy efficiency in overcoming steel corrosion by Hot Dip Galvanizing.

The findings of a case study which is a fully Galvanized steel transmission line is presented and the EROI (Energy Return On Investment) is assessed to display the method of assessment of a corrosion protection method in the context of energy. The case study showed an EROI of 7.7.

Though embodied energy values of steel, zinc and even galvanized steel has been established , the corrosion rates of metals in Sri Lanka has not been dealt with in detail up to date. Corrosion rates of steel and zinc in Sri Lanka was essential to complete the study. The establishment of corrosion rates was completed to fulfill the main objective of the study. The corrosion rates of steel, copper and aluminum derived from the corrosion rates of zinc or the “corrosion map” of Sri Lanka is one final and very useful outcome which will be dealt in-depth.

A brief introduction, justification and methodology of the study are presented in the initial chapter. An over view of corrosion of steel, galvanizing, corrosion of zinc, the protection mechanism provided by a zinc coating and predicting corrosion are the main topics relating to the study. Corrosion rates throughout the country are calculated. After establishing corrosion rates the energy conservation done by protecting steel by a hot dip galvanized coating is demonstrated. In this demonstration the use of the findings of the study is highlighted. Finally limitations and findings of the study are discussed. The corrosion rates established for the whole country is given as an appendix.

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