

**CORRELATION BETWEEN THE DEGREE OF
CORROSION AND THE ULTRASONIC PARAMETERS IN
STEEL**

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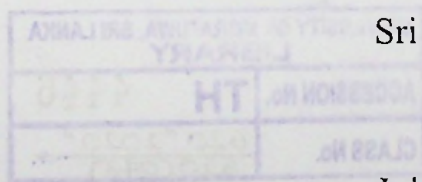
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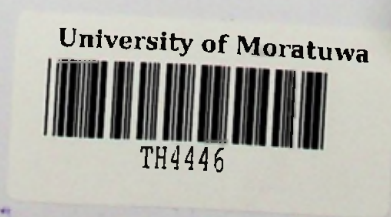
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DECLARATION

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Abstract

In metallurgical engineering, corrosion is considered as one of the main reasons for the failure of metallic components. The main reason for this is that, the corrosion is a phenomenon which is mainly influenced by the nature itself. It is very important to eliminate or reduce corrosion since it can lead to major disasters which can negatively affect the human lives and properties. Inaccurate estimations, inaccessibility of the areas of corrosion, limitations for the destructive tests can be identified as some of the main reasons for the wrong and misleading preliminary corrosion investigations, which lead to catastrophic failures. Conventionally, the degree of corrosion is determined using destructive testing methods. Also, most of the research work in this area has focused on the uniform corrosion/general attack faced by steels across a range of atmospheres. With those methods, the real degree of corrosion cannot be revealed since it is difficult to address regarding the corrosion penetrations or pits. Therefore, those are inaccurate up to some extent. In contrast to that, Ultrasonic testing methods would be more effective and convenient to overcome above limitations and would be able to open a new area of estimating the degree of corrosion accurately. Also this study sought to contribute to this field by examining whether the penetration of corrosion beyond the general attack has a significant effect on the load-bearing capacity of mild steel.

Also, in some cases such as in bridges and pipelines ultrasonic non-destructive method would be really advantageous since it is not only non-destructive but also it will allow reaching inaccessible locations easily. Further, an Ultrasonic wave can easily propagate through steel and its attenuation would provide a measurable reading to express the degree of corrosion including every minor detail.

The research work is basically focused on measuring the degree of corrosion accurately using ultrasound attenuation. The selected steel materials were subjected to corrosion in a standard accelerated environment for a defined period of time. Then after a set of experiments, the degree of corrosion has been represented by the weight loss per unit

area, corrosion rate and the corrosion penetration depth in to the material. Furthermore, the research work was able to cover the area of the mechanical property deterioration. The tensile samples were also corroded in the same standard accelerated environment as mentioned above, and subjected to periodic tensile testing and corrosion weight loss analyses. Further, the corroded samples were examined under optical and scanning electron microscopy to observe the penetration behavior of corrosion in to the material. The results showed that the actual breaking loads deviated negatively from the expected load-bearing capacity, which was determined through conventional methods. This deviation showed a close correlation to the increase of penetration of corrosion with time.

Meanwhile, the ultrasound attenuation related to each of those corroded samples was measured simultaneously. Finally, all the data were analyzed through mathematical software such as MATLAB and SPSS to generate final correlations. Thereby, a nondestructive method through ultrasound attenuation was developed to determine the accurate degree of corrosion and to predict the remaining load bearing capacity of corroded structures.

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LIST OF ABRREVIATIONS

ASTM - American Society for Testing and Materials

CS – Carbon Steel

CR – Corrosion Rate

DAC – Difference in Attenuation Coefficient

EDX - Energy Dispersive X-Ray Analysis

EN - European Norm

EMAR – Electro Magnetic Acoustic Resonance

EMAT - Electro-Magnetic Acoustic Transducer

FEM -Finite Element Method

GDP - Gross Domestic Product

IGC – Inter-Granular Corrosion

ISO - International Organization for Standardization

PDC – Penetration Depth of Corrosion

RAC – Reference Attenuation coefficient

SEM – Scanning Electron Microscope

SCC - Stress Corrosion Cracking

TEM - Transmission Electron Microscope

TAC - Total Attenuation Coefficient

WLPA –Weight Loss Per unit Area

XRD - X-Ray Diffractometer

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