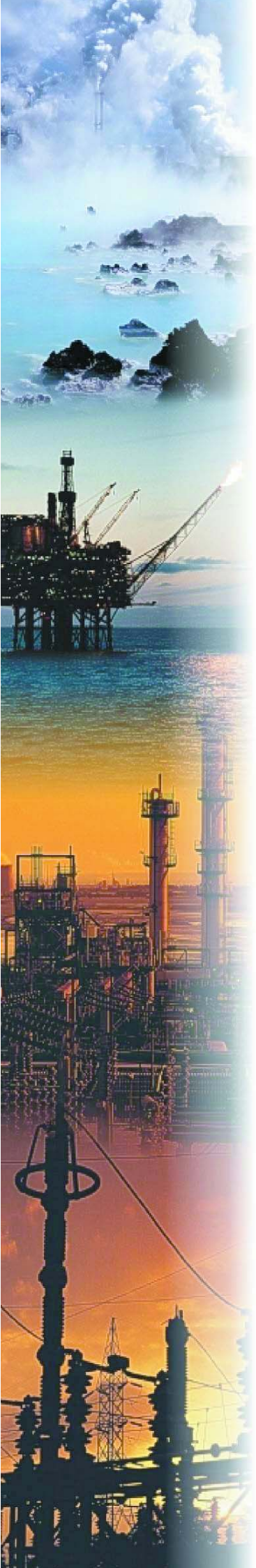

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Evaluation of Safecote Products using Electrochemical Techniques

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1. INTRODUCTION

CAPCIS is one of the world's leading independent consultancy companies in the area of corrosion, failure investigation, materials specification, chemical treatment and corrosion management. The company has developed an enviable reputation across many industrial sectors as well as the legal and insurance sector for its fundamental understanding of the behaviour of materials within different environments.

CAPCIS was established thirty years ago to provide an independent industrial and commercial focus for the ideas and knowledge emerging from the Corrosion and Protection Centre within the University of Manchester Institute of Science and Technology (UMIST). Today the company employs over 60 qualified engineers, technologists and experienced industrial consultants. CAPCIS operates from offices in Manchester, Oxford, Aberdeen and Blyth.

2. PRODUCT EVALUATION

In June 2003 CAPCIS were approached by Safecote Ltd to conduct a preliminary evaluation of their products for corrosion inhibition characteristics using electrochemical techniques.

Such techniques are short-term in nature, but provide a valuable insight as a screening comparator of performance.

Safecote Ltd, and their suppliers United Molasses, have invested considerably in understanding the fundamental performance parameters of their product, such that corrosion inhibition and other operational factors can be better understood and optimized.

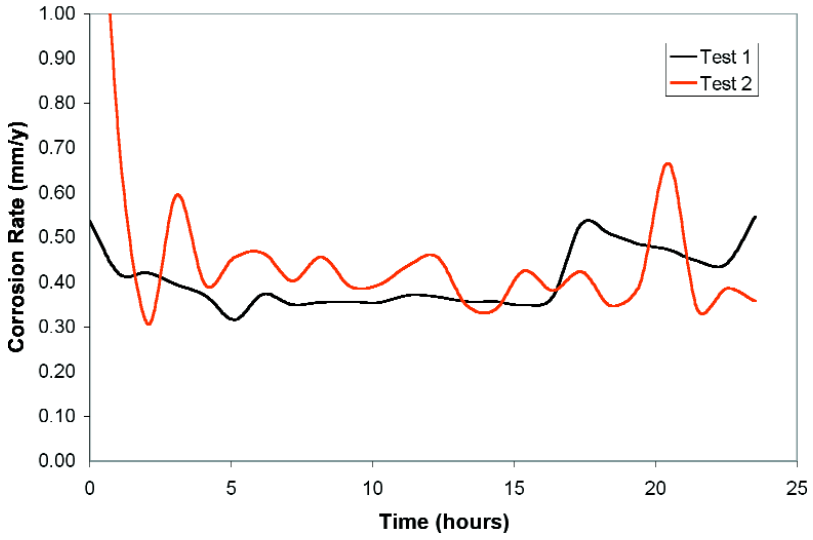
With this philosophy in mind, Safecote Ltd provided three separate samples of their product, designated as A1, A2 and A3, the components of which were not defined to CAPCIS. However, it is generally understood that the type and nature of the sugar components present were varied to evaluate their effects upon corrosion inhibition of carbon steel.

The base rock salt material used was Thawrox 6.3 mm grade, from The De-Icing Business of Salt Union Ltd.

Tests were conducted in 5% by weight rock salt solution at dosing rates equivalent to zero [pure rock salt] containing 1.5g/l [3% Safecote by weight in rock salt], 3 and 4.5g/l being equivalent to 6 and 9% Safecote in rock salt.

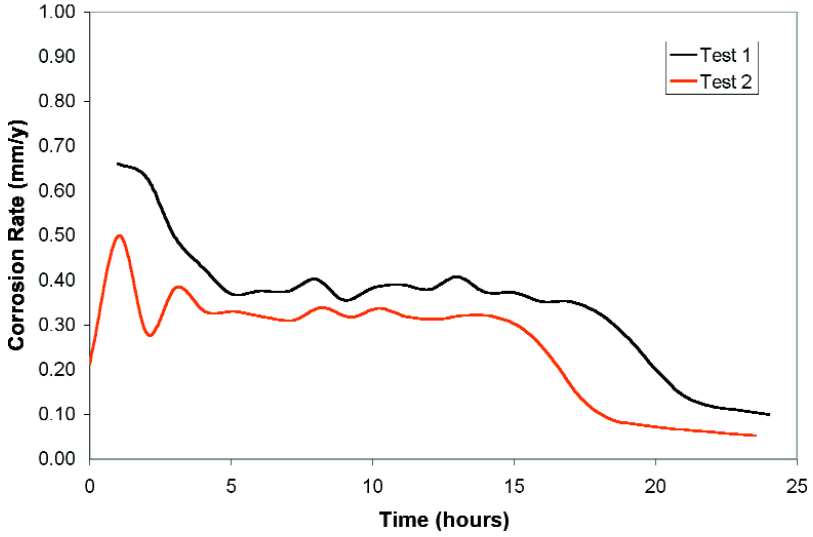
All tests were duplicated for verification purposes.

As a sample of the results, we show below graphical data for all three compositions at 1.5 g/l, equivalent to the standard 3% Safecote in rock salt below.



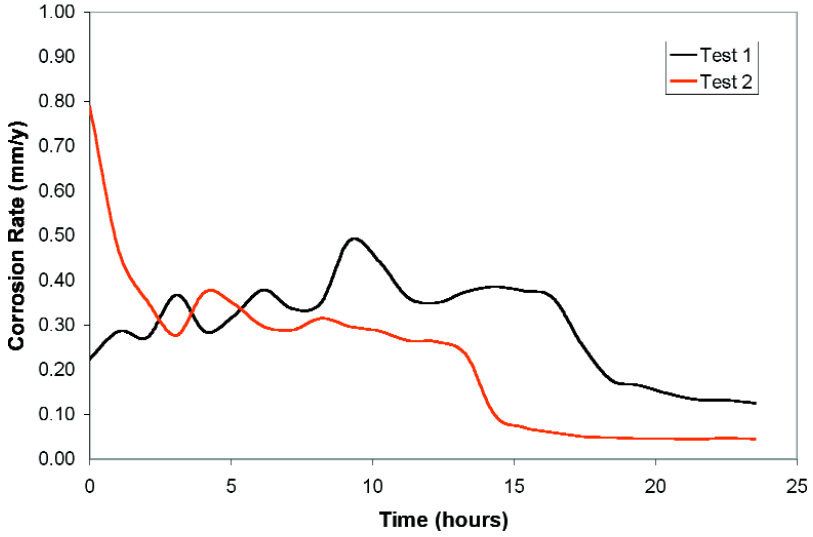
Blank - no Safecote

After 24 hours, average corrosion rate is 0.44 mm per year



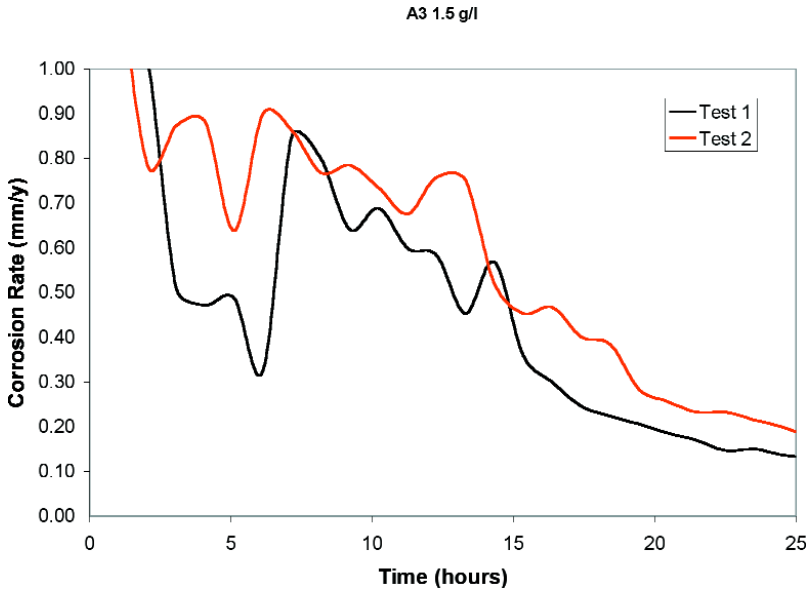
A1 1.5 g/l

After 24 hours the average corrosion rate is 0.08 mm per year



A2 1.5 g/l

After 24 hours the average corrosion rate is 0.085 mm per year



A3 1.5 g/l

After 24 hours the average corrosion rate is 0.155 mm per year.

4. SUMMARY OF INITIAL FINDINGS

From these results it is apparent that all formulations of Safecote do have a significant corrosion inhibition effect, although that provided by the A1 formulation is slightly better than that provided by A2, and significantly better than that provided by A3.

We were told (post-evaluation) that the A1 formulation contains a higher sucrose sugar level content than A2 and A3 (which had the lowest sucrose sugar content of all three). The results do show that this is a factor in the inhibition process. It is our understanding that the A2 formulation was the prior standard product.

The A1 results for the electrochemical immersion tests show a projected reduction of corrosion on carbon steel from 0.44 mm per year for rock salt only, to 0.08 mm per year when rock salt is mixed with 3% Safecote A1 formulation by weight. This represents 18% of the corrosion rate of rock salt only, and therefore a reduction in the rate by 82%.

The prior standard A2 material shows 19.3% of the corrosion rate of rock salt only, and therefore a reduction in the relative corrosion rate of 80.7%, in itself an excellent result.

We also looked at the preliminary electrochemical results for increased quantities of Safecote in all three formulations at the equivalent of both 6% and 9% by weight to rock salt. Somewhat surprisingly, these results showed that, in the short-term, no advantage in corrosion inhibition was gained, in fact for the 24 hour cycle the results were somewhat inferior to the results at 3% by weight additive, although better than rock salt alone.

In all cases, it will be recognized that these results will require further verification by a 7 day cyclic spray test in a climate controlled spray chamber to be more definitive. However, the trials clearly show that Safecote is a significant corrosion inhibitor in all cases, and that variation in the formulae to reflect types of sugar do have an impact upon corrosion inhibition characteristics.