

Vapour Phase Corrosion Inhibitors from South African Renewable Resources and their Evaluation

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ABSTRACT

For a compound to be classified as a vapour phase corrosion inhibitor (VCI), it must possess two basic properties: volatility and ability of the vapour to retard the corrosion rate.

INTRODUCTION

During manufacture, storage and transport, corrosive substances in the environment easily attack metal items. Corrosion inhibitors are substances which, when added to corrosive environments in relatively small dosages, will drastically reduce corrosion rates.

A VCI needs to be a volatile compound or a mixture of compounds. It reaches the surfaces that need to be protected from corrosion via the vapour phase and forms a relatively stable bond at the interface of the metal.

Selection of a suitable inhibitor for a metal (steel, copper, aluminium and galvanized steel) in an environment depends on the vapour pressure of the compounds. Suitable chemicals from the petroleum industry are used as corrosion inhibitors but often chemicals from renewable resources have been overlooked. Furfural is produced from bagasse (a by-product of sugarcane processing) and furfural and many of its derivatives, such as furfuryl alcohol, can be used as VCI-building blocks.

METHODOLOGY

Furfural and furfural derivatives were reacted with different amines to produce potential VCIs. The products were evaluated using a humidity chamber method. A suitable vapour pressure is a requirement for a VCI. Conventional vapour pressure measurement methods require specialised instruments and are labour-intensive. A thermal analysis technique like thermogravimetry (TG) provides a simple experimental set-up. It also allows rapid and convenient estimation, using small amounts of substances.

RESULTS

COMPOUND	CORROSION RATE ($\mu\text{m/a}$)
Reference (no inhibitor)	200 \pm 50
Furfural oxime	< 10
Organic salts from furfuryl alcohol and	
• Cyclohexylamine	< 10
• Dicyclohexylamine	< 10
• Morpholine	< 10

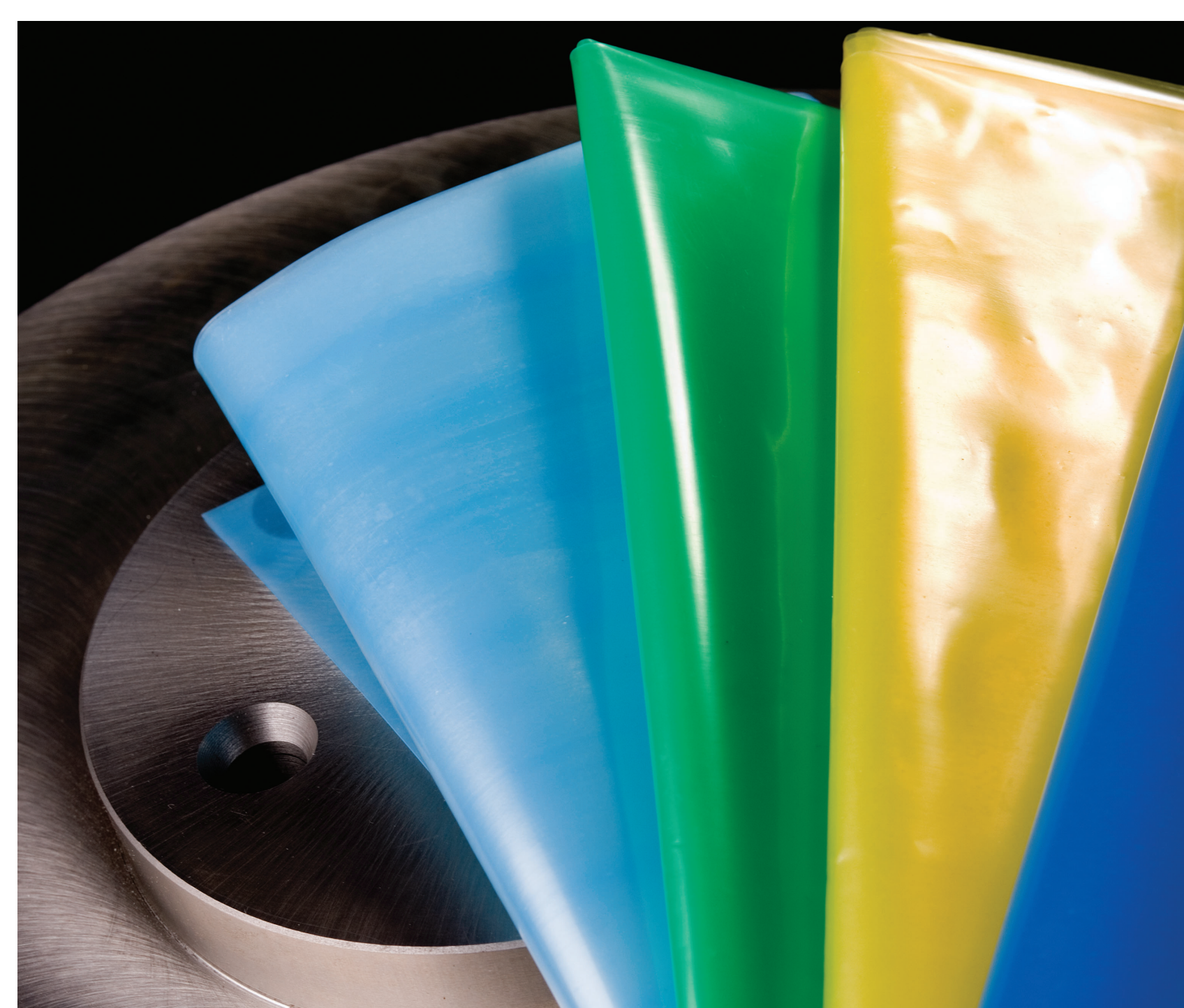
Table 1. Corrosion rates of mild steel treated with furfural derivatives

CONCLUSION

Many compounds synthesised from furfural and its derivatives with a variety of amines proved to be excellent VCIs for mild steel. Screening of potential VCIs from furfural and furfural derivatives will be done using thermogravimetry.



Picture 1: VCI coated papers



Picture 2: VCI-plastics for different metals



Picture 3: A VCI-protected metal item (without corrosion) and an unprotected, corroded metal item



Picture 4: VCI-diffusers and VCI-sachets for metal protection during transport and storage. Samples by courtesy of Bonchem