

Method to Ascertain the Corrosion Inhibition Properties of Vapro 830 Environmentally Friendly VCI Mineral Stone Paper in High Salinity and 100% Humidity Environment

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Article Info

Article History
Date of Publication:
13th March 2017

Keywords:
VCI Mineral Paper
Corrosion Inhibition
ASTM B117, Paris
Climate Treaty
2015

Abstract

To Evaluate the Corrosion Inhibition Properties of Vapro 830 Environmentally Friendly Vapro VCI Mineral Stone Paper in High Salinity and Humidity Environments using ASTM B117 Salt Spray Chamber.

Introduction

Protecting metallic parts against corrosion in high salinity and humidity environment during shipment and storage poses a great challenge to many manufacturers globally.

With 197 countries having signed the Paris Climate Treaty Agreement in 2015, 172 countries having ratified the said treaty to reduce carbon emission, there is an urgent need to use more environmentally friendly packaging products to reduce carbon footprint.

Hence, there is an upward industrial trend to use Anti-Corrosion Papers instead Hydrocarbon Rust Preventives or VCI Anti-Corrosion Polyethylene films.

However, the production and use of anti-corrosion and packaging paper has a number of adverse effects on the environment which are known collectively as paper pollution. Pulp mills contribute to air, water and land pollution.

Pulp and paper is the third largest industrial polluter to air, water, and land in both Canada and the United States, and releases well over 100 million kg of toxic pollution each year. In addition, discarded paper is a major component of many landfill sites, accounting for about 35 percent by weight of municipal solid waste (before recycling). Even paper recycling contributes to pollution due to the sludge produced during de-inking.

Worldwide, the pulp and paper industry is the fifth largest consumer of energy, accounting for four percent of all the world's energy use. The pulp and paper industry uses more water to produce a ton of product than any other industry.

Therefore, great efforts are needed to ensure that the environment is protected during the production, use and recycling/disposal of this enormous volume of material.

It has long been the object of the authors' research to provide an alternative to the pulp-based standard anti-corrosion paper, as it does not use trees, water, chlorine, acids, or petroleum in its creation. It is primarily made from minerals such as calcium carbonate, one of the most common substances on the planet; found in the shells of marine organisms, pearls, and eggshells, or as natural by-products of water and limestone in quarries.

The Vapro VCI Mineral Stone paper made in an effort to solve the above-described problems. It is made from minerals fortified with Vapro VCI proprietary corrosion inhibitors, UV Agents, Anti-Static Agent and Special Binder.

It employs a combination of synergistic corrosion inhibitors such as Anodic, Cathodic, Adsorption, Volatile Corrosion Inhibitors, Azole compounds, Titanium Dioxide, Zinc Oxide, or Silicone Dioxide as inorganic UV blockers, Anti-Static Agent such as Aromatic Sulfonamide, the Aromatic Sulfonamides may be Ortho, Meta, or Para substituted on the aromatic part thereof, or may be N-substituted on the amide group thereof, Synthetic Polymer Binder such as Polyethylene, Polypropylene powders and Polyvinyl Alcohol (PVA) as special binder.

However, there is no precedent or test thus far to evaluate the corrosion inhibition properties of VCI Mineral Stone Paper in high salinity and humidity environment.

Due to its excellent moisture repellent properties, the usage of Polyethylene VCI film to protect equipment and metallic parts from corrosion during storage or shipping has been globally accepted now than ever before.

Corrosion is a multi-billion dollars problem globally, as such, evaluating the vapour corrosion inhibition properties of Vapro VCI Mineral Paper is of paramount importance to all manufacturers.

In view of the above, there is a need to test the corrosion inhibition efficiency of Vapro 830 VCI Mineral Paper in a high salinity and humidity environment by adopting the ASTM B117 Test Method

Test Method ASTM B117

The ASTM B117 salt spray test is a standardized and popular corrosion test method to check corrosion resistance of materials and surface coatings. Salt spray testing is an accelerated corrosion test that produces a corrosive attack to coated samples in order to evaluate the suitability of the coating for use as a protective finish. The appearance of the corrosion products (rust or other oxides) is evaluated after a predetermined time.

Rationale

The authors decided to adopt this method to evaluate the corrosion inhibition efficiency of Vapro 830 VCI Mineral Stone Paper by simulating and subjecting it the most extreme and harsh environmental conditions using the ASTM B117 Salt Spray Chamber Test Method.

The purpose of the said test is to set a precedent for higher level of standard of testing for all VCI Papers subject to high salinity and humidity environment.

Test Method Used

ASTM B117 This method is used to determine the corrosion protection effect of VCI papers and films on a defined test object of high carbon steel blades.

Test object

5 pieces of high carbon mild steel blades.

Test Sample

5 x (25 x 150mm) VCI Mineral Stone paper (Thickness= 120 gsm)

Test Equipment

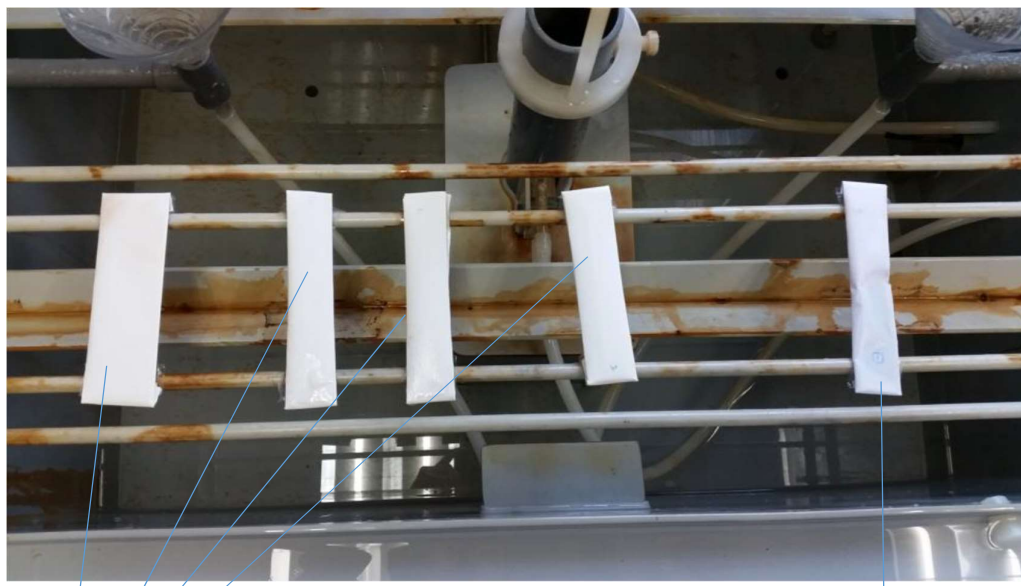
ASTM B117 Compliant Salt Spray Chamber

Principle of the test method

- 1) Remove and degrease oil protective coating from the five high carbon steel blades by soaking it in Isopropyl alcohol. The blades were then left to dry.
- 2) Four metal blades were wrapped with Vapro 830 VCI Mineral Stone Paper.
- 3) The remainder one was wrapped with normal mineral paper. It is used as control/ yardstick for the experiment.
- 4) Then left aside for 24 hours to allow the V.C.I ions to polarize the metal surfaces. The said process will form a passive film on the metal samples, which protects metal from corrosion.
- 5) All Samples were placed into the salt spray Chamber with 100% relative humidity, 5% salt spray solution. Please see picture (1) and (2).



Picture 1 with Salt Spray Chamber Covered



Picture 2 with Salt Spray Chamber Cover Removed

Control

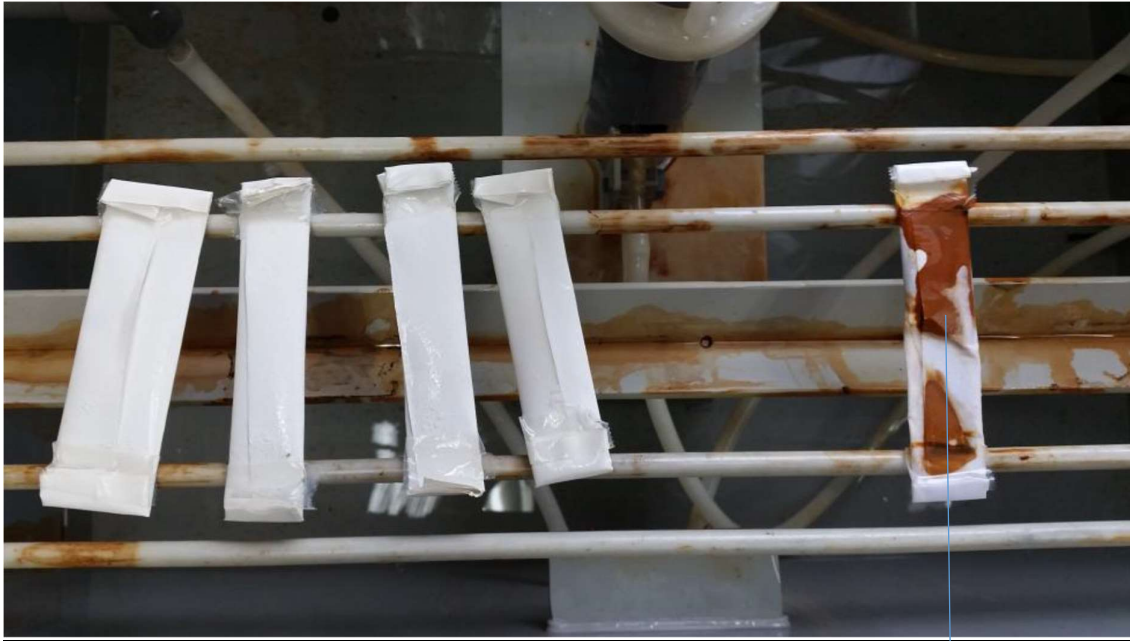
blade

Blades protected with Vapro 830 VCI Mineral Stone Paper

- 6) Monitoring of metals for rust and corrosion on the metal surfaces was carried out.

Analysis Results:

- 1) Control started to corrode at day 1. Please see Picture (3).



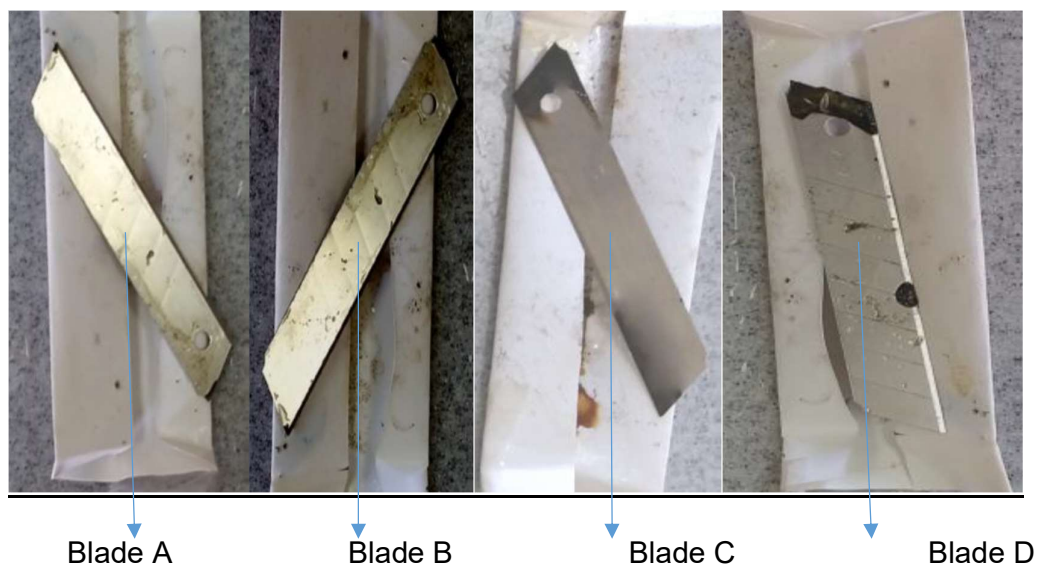
Picture 3

Control Blade

started to

Corrode.

- 2) After 7 days (168 hours) in the salt spray chamber, control blade corroded badly (see picture 5 below). As observed, Blades that are protected with Vapro 830 VCI Mineral Stone Paper have only slight rust on Blade A and B, no rust on Blade C and slight corrosion on Blade D (see picture 4 below). The said test was terminated at 168 hours which is the duration of the test.



Picture 4

3) After 168 hours in the salt spray chamber, the control blade was corroded badly and samples wrapped with VCI mineral paper had minimum corrosion when compared with control. Please see picture (5).

Control blade badly corroded ←



Conclusion

Based on the accelerated test, slight corrosion was expected to be found on the Blades protected with Vappro 830 VCI Mineral Stone Paper and severe corrosion on the Control Blade. Results turned out to be better than expected, slight rust on Blades A & B, no rust on Blade C, slight corrosion on Blade D and severe corrosion on Control Blade.

The above results indicate that the Vappro 830 VCI Mineral Stone Paper is able to protect metallic parts against corrosion in high salinity and humidity environment during shipment or storage where the actual environmental factors are not as harsh as the induced parameters for the said test.

References:

- 1) ASTM B117- 16 Standards for Operating Salt Spray (Fog) Apparatus.
<https://www.astm.org> › Standards & Publications.
- 2) [Patent WO2017023201A1 - Chemical composition for anti-corrosion ...](#)
- 3) www.google.com/patents/WO2017023201A1?cl=en
- 4) Feb 9, 2017 - **Mineral** Paper with Corrosion Inhibition, UV Resistant and Anti-Static Properties seem to be a good alternative to replace the Pulp-based Anti-Corrosion Paper. Primarily **mineral/stone papers** are made from calcium carbonate, silica powder and polypropylene or polyethylene resin.
- 5) [vci Poly material vs vci paper, vci packaging items, corrosion ...](#)
www.sealrust.com/technical/ sealrust® **VCI** Poly Product : Technical Information. ... Advantages of **VCI** Poly Products over **VCI Paper**. **VCI** Poly material has many advantages over Traditional **VCI paper** products used as packaging medium for protection of metal surface from corrosion and rust
- 6) [Paper 04418 - Cortec Corporation](#)
<https://www.cortecvci.com/Publications/Papers/VCIFundamentals/04418.pdf>
The **paper** presents the example of such a program and the data of this study. Corrosion protection provided by **VCI** vs. distance from its source was evaluated by corrosion monitoring, utilizing metal coupons and Corrosometer with special probs. Keywords: Vapor corrosion inhibitor, corrosion **tests**, corrosion rate, corrosion ...
- 7) [ENVIRONMENTAL MANAGEMENT IN PULP AND PAPER INDUSTRY ...](#)
www.icontrolpollution.com/.../environmental-management-in-pulp-and-paper-industr... by A Saadia - 1970 - Cited by 4 - [Related articles](#) In **pulp and paper industry** air **pollution** is **caused due to** odour emitting reduced sulphur compounds such as hydrogen sulphide, methylmercaptan, dimethyl sulphide, and particulate matter SO₂ and NO_x present in the gases emitted by different process units. Gaseous emission from **pulp and paper** mills can be broadly.
- 8) [Environmental impact of pulp and paper mills \(PDF Download Available\)](#)
<https://www.researchgate.net/.../281761323> Environmental impact of pulp and pa... Nov 22, 2017 - The paper aims to present the environmental impact of **pulp and paper** manufacturing and the most important **production** and control practices to **pollution**. 2.1. Air emissions. Chemical pulping is the main source for air. emissions in the pulp and paper industry, mainly due the fact that chemical pulping is ...
- 9) [Environmental impact of paper - IPFS](#)

https://ipfs.io/ipfs/.../wiki/Environmental_impact_of_paper.html The **production** and use of **paper** has a number of adverse effects on the environment which are known collectively as **paper pollution**. **Pulp** . Bleaching mechanical **pulp** is not a major **cause** for environmental concern since most of the organic material is retained in the **pulp**, and the chemicals used (hydrogen peroxide and .

10) Water Pollution from Pulp and Paper Mills (pp.245-252)

https://www.novapublishers.com/catalog/product_info.php?products_id=35376 **Pulp and paper** mills are considered one of the most polluting **industries** worldwide. Paper making process demands large amount of fresh water and produces enormous quantities of wastewater. The wastewater is contaminated by ... To mitigate the **pollution caused by pulp** and paper mill wastewater, the possible ways of

11) Paris Agreement | Climate Action - European Commission

<https://ec.europa.eu> › ... › International action on climate change › Climate negotiations. At the **Paris climate conference** (COP21) in December **2015**, 195 countries adopted the first-ever universal, legally binding global climate deal. United Nations flag © Comstock. The **agreement** sets out a global action plan to put the world on track to avoid dangerous climate change by limiting global warming to well below ..

12) Paris Climate Change Conference - November 2015 - unfccc

unfccc.int › Meetings **Paris Climate Change Conference** - November **2015**. The twenty-first session of the **Conference** of the Parties (COP) and the eleventh session of the **Conference** of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP) took place from 30 November to 11 December **2015**, in Paris, France. pdf-icon

13) Paris Agreement on climate change - the United Nations

www.un.org/sustainabledevelopment/climatechange/

Nov 16, 2017 - To address **climate** change, countries adopted the **Paris Agreement** at the COP21 in **Paris** on 12 December **2015**. The **Agreement** entered into force less than a year later. In the **agreement**, all countries agreed to work to limit global temperature rise to well below 2 degrees Celsius, and given the grave risks