MULTI METAL

Institut für
Beratung · Forschung · Systemplanung ·
Verpackungsentwicklung und -prüfung
an der Fachhochschule Hamburg

BFSV

Test Report
No. 4643B/00

Testing of the corrosion protection effect of VCI-film

Client LOGIN EUROPE S.r.l.

41012 Italy

Content of the order

The client supplied one VCI-film to the BFSV on September 19, 2000.

Description: **VCI-2000 Film**

The corrosion protection effect of the VCI-film had to be tested.

In order to perform this, a sample with LDPE-film and without VCI-substance (reference sample) as well as a sample with VCI-protection were produced and a changing climate testing was performed (simulation of climatic shipping stress).
After the test the corrosion effects on the metals were examined visually and the based on this examination the corrosion protection effect of the VCI-film was evaluated.

Summary result

Corrosion protection effect of the VCI-2000 Film at:

- Steel: **Good**
- Brass: **Good**
- Copper: **Good**

Date	:	October 31, 2000
Pages	:	3
Appendices	:	2
Official in Charge	:	Dipl.-Ing. W. Reimers

1. Test performed

1.1 Films

For the reference sample: LDPE-film without VCI-substance (thickness: 100 µm)

For the VCI-protected samples: **VCI-2000 Film** (thickness: 100 µm)

1.2 Metal samples

- Steel (St 37)
- Brass (Ms 60)
- Copper (El-Cu)

Dimensions of the metal samples: 75 x 50 mm, thickness: 3 mm.

Before the beginning of the testing the surface of the samples was grinded (Abrasive paper: 320) and cleaned with methane.
The samples made of zink coated steel were only cleaned with methane.

1.3 Testing apparatus

The metal samples for each testing sample were fixed to a plastic holder with two plastic rings at the ends in order to grant certain distance and to prevent the films touching the samples.

Bags were manufactured from each film (volume about. 10 l), the sample holders were inserted and the ends of the bags were welded.
The prepared samples were stored at room temperature (about 20 °C) (conditioning phase, duration: 24 h).
After that a paper that had been soaked with 5 ml deionised water was inserted in the bags and the bags were closed again.

Picture 1 in Appendix 1 shows the prepared samples.

1.4 Testing

In order to produce cyclical bedewing of the metal samples, the following changing climate testing was performed with the samples in a climatic chamber:

40 °C / 90 % RH	5 h
Change to 10 °C / 90 % RH	1 h
10 °C / 90 % RH	5 h
Change to 40 °C / 90 % RH	1 h

- Cycle duration:	12 h
- Number of cycles:	20 (10 days)

After the testing the film bags were cut open and the metal samples were dried at room temperature (1 h) and the corrosion effects were visually examined and documented.

2. Test results / Examination of the metal samples

In the following table the corrosion effects and their area percentages are listed.

Film	Corrosion on the metal samples (Area percentages)		
	Steel	Brass	Copper
LDPE-film Reference sample	Brown spots, intensified at the peripheral area (ca. 5 %)	Discolouring of the surface (ca. 40 %)	Discolouring of the whole surface (100 %)
VCI-2000 Film	No corrosion	Very slight discolouring of the surface (< 1 %)	Slight discolouring of the surface (< 5 %)

Picture 2 in Appendix 1 shows the metal samples of the reference sample before the test.

Picture 3 in Appendix 2 shows the state of the metal samples after the test:
- Reference sample
- VCI-2000 Film

3. Evaluation of the corrosion protection effect

Based on the corrosion effects of the unprotected reference sample and on the intensity of the climatic stress, the examination of the test results leads to the following judgement of the corrosion protection effect of the VCI-2000 Film:

Corrosion protection effect of the VCI-2000 Film at:

- Steel: **Good**
- Brass: **Good**
- Copper: **Good**

Head of the institute — Official in Charge

Prof. K.-R. Eschke — Dipl.-Ing. W. Reimers

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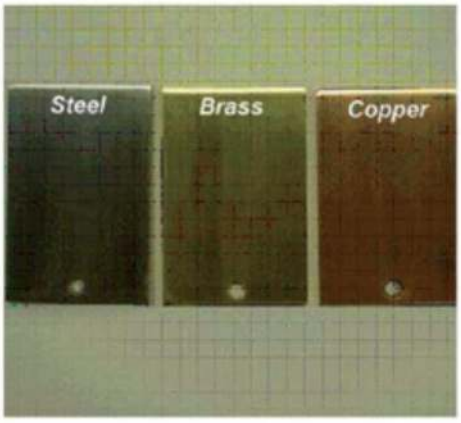
Appendix 1 to Test Report No. 4643B/00

Picture 1: film bags with metal samples (prepared samples)



Steel Brass Copper

Picture 2: metal samples of the reference sample before the test

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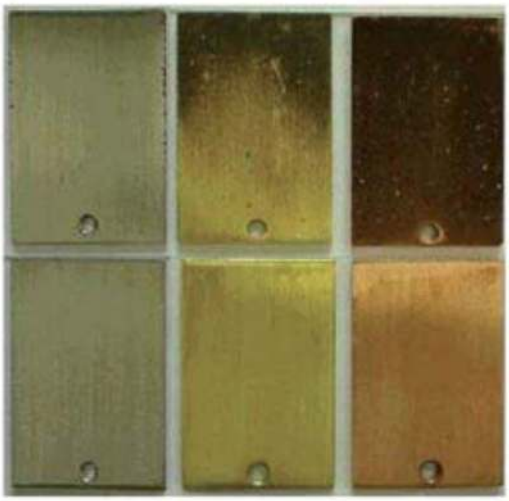
Appendix 2 to Test Report No. 4643B/00

LDPE-Film (reference sample)



VCI-2000 Film

Picture 3: state of the metal samples after the test