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APPENDIX 3

CORROSION RESISTANCE TESTING

CONTENTS

1. BACKGROUND

In an initial study, SR INI+ was found to be a suitable corrosion inhibitor for BIO LIQUIDE, a biological parts washer cleaner. However, the applicant wishes to carry out the following additional studies:

- ❑ Check the effectiveness of SR INI+ in the Bio Liquide containing the microorganism tablet, both after 24 hours of action and after 2 weeks;
- ❑ Check that SR INI+ is not aggressive towards aluminium;
- ❑ Determine optimal dosage for SR INI+.

2. TEST METHODS AND CONDITIONS.

2.1. MEASCOVA02 method: "Effectiveness of an anticorrosion additive on metals in accelerated ageing".

2.1.1. Principle

Mild steel coupons are placed in containers containing the solution to be tested. The containers are closed and then placed in an oven at a set temperature for a specified time. The appearance of the coupons is observed at the end of the test period.

2.1.2. Test conditions :

- ❑ 40 x 20 mm, 1 mm thick steel coupons in E24 steel
- ❑ Mechanical sanding and acetone degreasing of coupons
- ❑ Test time = 24 hours
- ❑ Test temperature = 45 °C

2.1.3. Interpreting the results :

The appearance of the coupons is noted at the end of the test period. Particular attention will be paid to the presence or absence of pitting, the extent of corroded areas in terms of surface area, and the appearance of the test solution.
An inhibitor is said to be effective at the rate tested if no corrosion, either generalized or pitting, is observed.

2.2. MEASCOVN03 method: "Effectiveness of an anticorrosion additive on cast-iron shavings". (based on DIN 51360-part2)

2.2.1. Principle :

Standardized cast-iron chips spread out on filter paper in a Petri dish are brought into contact with the test solution. The stains left on the filter paper at the end of the test period are used to determine the anti-corrosive power of the solution.

2.2.2. Test conditions :

Standardized cast iron chips in accordance with DIN 51360 65 mm
diameter filter paper
Test time= 2 hours Test temperature
= 20 °C

2.3. Interpreting the results :

The extent of the stains left on the filter paper can be used to define corrosion grades (see DIN 51360, part2).
The level of protection is acceptable when the corrosion grade does not exceed 1.

3. RESULTS

3.1. Efficacy of SR INI+ in the presence of micro-organisms.

3.1.1. Preparation of test solutions.

- ❑ The corrosion inhibitor is dosed at 5% in the concentrate.
- ❑ The concentrated solutions thus prepared were then diluted to 20% in softened water.
- ❑ The micro-organism is added to this solution at a dosage of 0.27g/l (i.e. one tablet per 100 liters).
- ❑ A control solution containing no inhibitor is used for each test method.

3.1.2. Results after 24 hours of micro-organism action

Test solutions were stored for 24 hours at 37°C with aeration before testing.

3.1.2.1. MEASCOVA02 method: "Effectiveness of an anticorrosion additive on metals in accelerated ageing".

Photos of the coupons at the end of the trial period are shown on page 6. Their description is given in the table below:

	TEST 1	TEST 2
Indicator	Blackened coupon with corroded areas	Blackened coupon with corroded areas
SR INI+ 5%	Coupon intact	Coupon intact

3.1.2.2. MEASCOVN03 method: "Effectiveness of an anticorrosion additive on cast-iron swarf". (based on DIN 51360-part2)

Photos of the filter papers at the end of the test period are shown on page 6. Corrosion grade results are given in the table below:

	Corrosion grade
Indicator	4
SR INI+ 5%	1

3.1.3. Results after 2 weeks of micro-organism action

Test solutions were stored for 2 weeks at 37°C with aeration, prior to testing.

3.1.3.1. MEASCOVA02 method: "Effectiveness of an anticorrosion additive on metals in accelerated ageing".

Photos of the coupons at the end of the trial period are shown on page 7. Their description is given in the table below:

	TEST 1	TEST 2
Indicator	Blackened coupon with corroded areas	Blackened coupon with corroded areas
SR INI+ 5%	Coupon intact	Coupon intact

3.1.3.2. MEASCOVN03 method: "Effectiveness of an anticorrosion additive on cast-iron swarf". (based on DIN 51360-part2)

Photos of the filter papers at the end of the test period are shown on page 7. Corrosion grade results are given in the table below:

	Corrosion grade
Indicator	4
SR INI+ 5%	0

3.1.4. Conclusion

SR INI+ retains its effectiveness even in the presence of micro-organisms.

3.2. Effect of SR INI+ on Aluminum

3.2.1. Preparation of test solutions.

- ❑ The corrosion inhibitor is dosed at 5% in the concentrate.
- ❑ The concentrated solutions thus prepared were then diluted to 20% in softened water.
- ❑ The micro-organism is added to this solution at a dosage of 0.27g/l (i.e. one tablet per 100 liters).
- ❑ A control solution containing no inhibitor is used for each test method.
- ❑ The solutions thus prepared were placed at 37°C for 24 h, with aeration, before testing.
- ❑ For comparative purposes, Inhibitor-X was tested at the same time as SR INI+.

3.2.2. Results.

Aluminum coupons were immersed in the various test solutions at 37°C. The appearance of the coupons after 1 hour's immersion and after 24 hours' immersion is described in the table below (see photos on page 8):

	1H immersion	24H immersion
Indicator	Coupon intact	Slightly faded coupon
SR INI+ 5%	Coupon intact	Tarnished coupon
X 5% inhibitor	Whitish coupon "White rust" formation	Greyish coupon corroded all over

3.2.3. Conclusion.

Under its conditions of use, the biological fountain containing SR INI+ is not aggressive towards aluminum. On more prolonged contact, it may tarnish the metal surface, but does not corrode it.
The biological fountain containing Inhibitor-X is very aggressive towards aluminum, even after only a short contact time.

3.3. Determining the optimum dosage of SR INI+.

As the Cast Iron Chip Test Method is the reference for users of degreasers and lubricants, it will be used to determine the optimum dosage of SR INI+. The acceptance level for this method is grade 1 maximum.

3.3.1. Preparation of test solutions.

- ❑ SR INI+ is dosed at different percentages in the concentrate: 5%, 4% and 3%.
- ❑ The concentrated solutions thus prepared were then diluted to 20% in softened water.
- ❑ The micro-organism is added to this solution at a dosage of 0.27g/l (i.e. one tablet per 100 liters).
- ❑ A control solution containing no inhibitor is used for each test method.
- ❑ The solutions thus prepared were placed at 37°C for 24 h, with aeration, before testing.

3.3.2. Results.

Photos of the filter papers obtained at the end of the test are shown on page 7. The corrosion grade is given in the following table:

	Corrosion grade
Indicator	4
SR INI+ 5%	1
SR INI+ 4%	2
SR INI+ 3% DISCOUNT	3

3.3.3. Conclusion

The dosage of SR INI+ required to obtain Grade 1 is 5% in the concentrate.

4. CONCLUSIONS

Additional tests showed that :

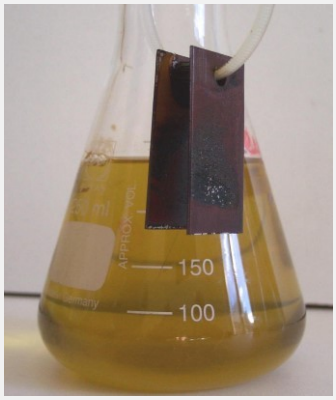
- ❑ SR INI+ retains its effectiveness in the biological fountain even in the presence of micro-organisms;
- ❑ the biological fountain containing SR INI+ is not aggressive towards aluminum under its conditions of use;
- ❑ the optimum dosage of SR INI+ is 5% in the concentrate.

5. PHOTOS OF THE RESULTS.

5.1. Efficacy of SR INI+ in the presence of micro-organisms.

5.1.1. Results after 24 hours of micro-organism action

5.1.1.1. MEASCOVA02 method: "Effectiveness of an anticorrosion additive on metals in accelerated ageing".

TEMOIN	SR INI+ 5%
	

5.1.1.2. MEASCOVN03 method: "Effectiveness of an anticorrosion additive on cast-iron swarf". (based on DIN 51360-part2)

TEMOIN	SR INI+ 5%
	

5.1.2. Results after 2 weeks of micro-organism action

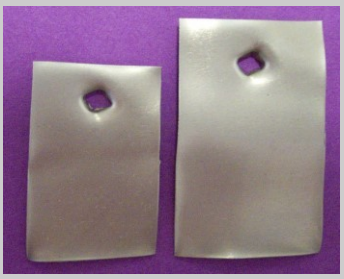
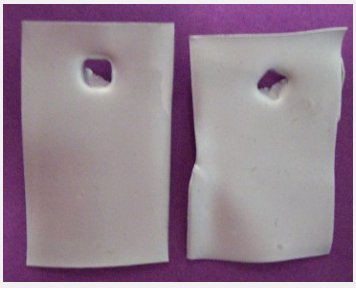
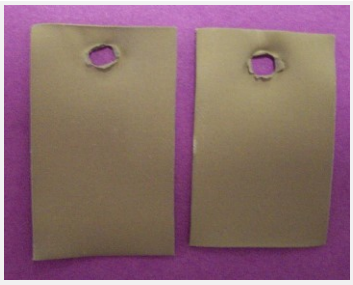
5.1.2.1. MEASCOVA02 method: "Effectiveness of an anticorrosion additive on metals in accelerated ageing".

Indicator	SR INI+ 5%
	

5.1.2.2. MEASCOVN03 method: "Effectiveness of an anticorrosion additive on cast-iron swarf". (based on DIN 51360-part2)

Indicator	SR INI+ 5%
	

5.2. Effect of SR INI+ on Aluminum

	1H immersion	24H d'immersoin
Indicator		
SR INI+ 5%		
X 5% inhibitor		

5.3. Determining the optimal dosage of SR INI+.

5.3.1. MEASCOVN03 method: "Effectiveness of an anticorrosion additive on cast-iron swarf". (based on DIN 51360-part2)

Indicator	SR INI+ 5%	SR INI+ 4%	SR INI+ 3% DISCOUNT