# Angkasa Jurutera Perunding Sdn. Bhd.

**(37134-X)**

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# ASSESSMENT
# OF
# THE
# EFFECTIVENESS
# OF
# SPLASHPRO SYSTEM
# FOR
# THE
# SPLASH ZONE
# CORROSION PROTECTION SYSTEM

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August 2011

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# ASSESSMENT OF THE EFFECTIVENESS OF SPLASHPRO SYSTEM FOR THE SPLASH ZONE CORROSION PROTECTION SYSTEM

**CONTENT**

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# ASSESSMENT OF THE EFFECTIVENESS OF SPLASHPRO SYSTEM FOR THE SPLASH ZONE CORROSION PROTECTION SYSTEM

## GENERAL

The purpose of this document is to provide an assessment of the effectiveness of the SplashPro System for the Splash zone corrosion protection system.

The assessment is made based on the industry practice of corrosion protection and the test reports carried out by independent testing facilities.

## SplashPro

SplashPro is a system manufactured by CENTRAL PLASTICS COMPANY based in Oklahoma, USA which have manufacturing facilities in USA, Latin America and China.

The petrolatum based system comprises the primer STACPrime, the filler STACfill, the wrap STACWrap and the outer HDPE jacket.

## STAC System Sdn Bhd

STAC System Sdn Bhd is the exclusive agentof Central Plastics Company for the SplashPro System in Malaysia.

STAC System Sdn Bhd is a Malaysian company with 100% bumiputra equity and is registered with the Ministry of Finance and Petronas.

## Angkasa Jurutera Perunding Sdn Bhd

Angkasa Jurutera Perunding Sdn Bhd is a Malaysian owned and incorporated Engineering Consultancy practice with over 40 years of experience in the engineering field with experience in a wide range of projects in the Building Services, Civil & Structure, M&E, Oil & Gas, Marine, Industrial, Commercial and Marine sectors.

Angkasa Jurutera Perunding is registered with the Board of Engineers and the Ministry of Finance.

# ASSESSMENT OF THE EFFECTIVENESS OF SPLASHPRO SYSTEM FOR THE SPLASH ZONE CORROSION PROTECTION SYSTEM

## TERMS OF REFERENCE

Angkasa Jurutera Perunding Sdn Bhd is commissioned to provide an assessment of the effectiveness of the SplashPro System in providing the corrosion protection system for the splash zone.

The assessment was made based on the following test reports

1. Cathodic Disbondment Testing of STACWrap
   by ITI Anti-Corrosion, Inc.
   Feb 7, 1992.

   Refer to Test Report No.1.
   Appendix I

2. Testing of a Petrolatum Tape: Salt Spray Exposure of 500 hours
   by Technical Inspection Services, Inc, Houston, Texas, USA.
   Dec 2, 1991.

   Refer to Test Report No. 2.
   Appendix II

3. Testing of a Petrolatum Tape: Water Vapor Permeability
   by Technical Inspection Services, Inc, Houston, Texas, USA.
   Dec 6, 1991.

   Refer to Test Report No. 3.
   Appendix III

4. Test Result of Corrosion Rate
   by Nippon Corrosion Engineering Company Ltd,
   1985-1990.

   Refer to Test Report No. 4.
   Appendix IV

# ASSESSMENT OF THE EFFECTIVENESS OF SPLASHPRO SYSTEM FOR THE SPLASH ZONE CORROSION PROTECTION SYSTEM

## SUMMARY OF TEST REPORTS

The results and salient points of the tests are summarized as follows:

| Test | Type of Test | Test Standard | Testing Agency | Results | Comment |
|---|---|---|---|---|---|
| Test No.1 | Cathodic Disbondment | ASTM-G8 | ITI Anti-Corrosion, Inc | Disbond average radius = 1.2mm | Good |
| Test No.2 | Salt Spray for 500 hours | ASTM-B117 | Technical Inspection Services, Inc | No apparent active corrosion at test sites | Good |
| Test No.3 | Water Vapor Permeability | ASTM D1653-85 | Technical Inspection Services, Inc | WVT = 0.48g/sq.m/24 hr<br>WVP=0.0023 metric - perms<br>P=0.0000292 metric perms-cm | Good |
| Test No. 4 | Corrosion rate | Comparing original & measured, protected and non-protected | Nippon Corrosion Engineering Company Ltd | 1.27 years = > 99.43%<br>2.25 years = > 99.77%<br>4.94 years = > 99.95 % | Good |

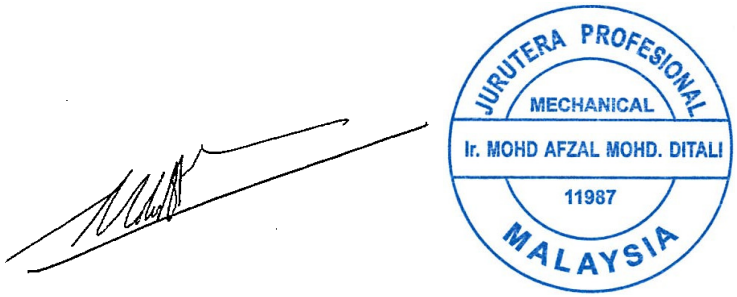
Details of the test shall be referred to in the Appendices

# ASSESSMENT OF THE EFFECTIVENESS OF SPLASHPRO SYSTEM FOR THE SPLASH ZONE CORROSION PROTECTION SYSTEM

## CONCLUSION

Based on the above tests using the prescribed methods and accepted standards, it was proven that the product performed well and is suitable and effective for use for the corrosion protection of the splash zone.

It is therefore recommended that SplashPro system be considered for Splash zone corrosion protection as it is effective and complies with the prescribed standards.




Prepared by:

**Angkasa Jurutera Perunding Sdn Bhd**
August 2011

# ASSESSMENT OF THE EFFECTIVENESS OF SPLASHPRO SYSTEM FOR THE SPLASH ZONE CORROSION PROTECTION SYSTEM

## APPENDIX

## APPENDIX I

**Test Report No.1**
Cathodic Disbondment Testing of STACWrap
by
ITI Anti-Corrosion, Inc.
Feb 7, 1992.

Corrosion Technology
Coatings & Inspection
Testing & Advisory Services

ITI Anti-Corrosion, Inc.
10175 Harwin, Suite 110
Houston, Texas 77036
Telephone (713) 771-0688
Telex: 5101007700
Fax: (713) 776-9634

*Technical Report #92-012*

*CenPro Incorporated*
*523 N. Sam Houston Parkway East*
*Suite 450*
*Houston, Texas 77060*

*Attention: M. Edgar Lewis*

# *CATHODIC DISBONDMENT TESTING OF STAC-WRAP*

*February 7, 1992*

*Prepared by Gary Cox*

*ITI Contract #639*

## INTRODUCTION

*As the request of Mr. Edgar Lewis of CenPro, ITI Anti-Corrosion has conducted cathodic disbondment testing of Stac-Wrap per ASTM-G8.*

## RESULTS

| PIPE #22 | ELECTROLYTE | VOLTAGE | DURATION | TEMP | DISBOND RADIUS/MM |
|---|---|---|---|---|---|
| 1 | NaCl, 3% | -1.5 VDC | 30 days | 77°F | 1.00 |
| 2 | NaCl, 3% | -1.5 VDC | 30 days | 77°F | 1.40 |

**DISBOND RADIUS AVERAGE = 1.20MM**

## APPENDIX II

**Test Report No. 2.**
Testing of a Petrolatum Tape: Salt Spray Exposure of 500 hours
by
Technical Inspection Services, Inc, Houston, Texas, USA.
Dec 2, 1991

TECHNICAL INSPECTION SERVICES, INC.
Quality Audit - Quality Control
Houston, Texas 77034

5202 South Shaver
Telephone 713-947-6630
Fax 713-947-7796

Report #05-1385-1

Testing of a Petrolatum Tape:
Salt Spray Exposure for 500 Hours

TO: Mr. Edgar Lewis
CenPro Inc.
523 N. Sam Houston Pkwy.
Suite 450
Houston, TX 77060

BY: Paul E. Partridge Reprinted 6-28-94
Paul E. Partridge
Technical Director
December 2, 1991

## Introduction

This report covers the testing of two samples for 500 hours in the salt spray environment described in ASTM B117.

## Procedure

Specimens measuring 4" x 8" were blasted to white metal with a 2-mil profile. They were coated with a thin film of Stacprime. One plate received one layer of 6" wide tape and the other received two layers. The tape was wrapped around the edges of the plates. An "X" scribe was made on the lower half of the plates. The plates were then exposed to the salt spray environment at 95F for 500 hours (21 days).

## Results

There was a red rust stain on the outer surface of the coating along the scribe. When the coating was peeled back, there were no apparent active corrosion sites at the steel substrate. There were dark corrosion stains along the scribe marks with a typical width of 1 to 2 millimeters.

pep/51385-1

## APPENDIX III

**Test Report No. 3.**
Testing of a Petrolatum Tape: Water Vapor Permeability
by
Technical Inspection Services, Inc, Houston, Texas, USA.
Dec 6, 1991.

TECHNICAL INSPECTION SERVICES, INC.
Quality Audit - Quality Control
Houston, Texas 77034

5202 South Shaver
Telephone 713-947-6630
Fax 713-947-7796

Report #05-1385-2

Testing of a Petrolatum Tape:
Water Vapor Permeability

For: Mr. Edgar Lewis
CenPro Inc.
523 N. Sam Houston Pkwy.
Suite 450
Houston, TX 77060

By: Paul E. Partridge Reprinted 6-28-94
Paul E. Partridge
Technical Director
December 6, 1991

## Introduction

This report covers the testing two specimens of Cenpro 50 mil petrolatum tape per ASTM D1653-85.

## Procedure

Specimens measuring approximately 3 inches in diameter were tested on Gardco cups using Method A, wet cup method, under Condition A, low relative humidity at 73F. Water was added to the cups, the specimens were sealed in place, and the cups were then placed in a dessicator with calcium chloride dessicant. The rate of mass loss was taken from a plot of the data when the rate stabilized. The following values were calculated from the equations in section 14 of the ASTM standard.

## Results

Water Vapor Transmission Rate = WVT = (G/t)/A
Permeance = WVP = WVT/Delta P ; Delta P = S(R1-R2)
Permeability Coefficient = P = (WVP)*l

| Definition | Metric Units | English Units |
|---|---|---|
| G = Weight Change | = 0.0048 grams | = 0.07406 grains |
| t = Time of Change | = 4*(24 hours) | = 96 hours |
| A = Test Area | = 0.0025 sq.meters | = 0.8195 sq.ft. |
| S = Sat. Vapor Press. at 73F | = 20.815 mm Hg | = 0.8195 in.Hg |
| R1 = Rel. Hum. at source | = 100% | = 100% |
| R2 = Rel. Hum. at sink | = 0% | = 0% |
| l = Film Thickness | = 0.127 cm | = 50 mils |

### Water Vapor Transmission Rate

WVT : (Metric Units) = 0.02 grams per square meter per hour
= 0.48 grams per square meter per 24 hours

(English Units) = 0.029 grains per square foot per hour

Permeance

WVP : (Metric Units) = 0.00023 grams per square meter per 24 hours per millimeter of mercury (metric perms)

(English Units) = 0.00035 grains per square foot per hour per inch of mercury (perms)

Permeability Coefficient

P : (Metric Units) = 0.0000292 grams * centimeter of thickness per square meter per 24 hours per millimeter of mercury (metric perm-centimeter)

(English Units) = 0.0175 grains * mil of thickness per square foot per hour per inch of mercury (perm-mils)

pep/51385-2

## APPENDIX IV

**Test Report No. 4.**
Test Result of Corrosion Rate
by
Nippon Corrosion Engineering Company Ltd,
1985-1990.

## Test result of Corrosion Rate of Protected Test Pieces (Ref. DWG No. 2)

1. First Inspection (May 22, 1986) Testing Period : 1.27 Years

| Position of Test Piece | Test Piece No. | Weight of Test Pieces (g) Original | Weight of Test Pieces (g) Measured | Weight Loss of Test Pieces (g) | Corrosion Rate (mm/yr) |
|---|---|---|---|---|---|
| 1 - 1 | 1 | 7.46 | 7.4569 | 0.0031 | 0.00012 |
| 1 - 2 | 2 | 7.60 | 7.5839 | 0.0165 | 0.00065 |
| 1 - 3 | 3 | 7.64 | 7.6299 | 0.0101 | 0.0004 |
| 1 - 4 | 13 | 7.19 | 7.1857 | 0.0043 | 0.00015 |
| 1 - 5 | 14 | 7.54 | 7.5373 | 0.0027 | 0.00011 |
| 1 - 6 | 15 | 7.30 | 7.2944 | 0.0056 | 0.00022 |
| 1 - 7 | 25 | 7.29 | 7.2810 | 0.0090 | 0.00035 |
| 1 - 8 | 26 | 7.18 | 7.0165 | 0.0185 | 0.00072 |
| 1 - 9 | 27 | 7.06 | 7.0356 | 0.0244 | 0.00095 |

2. Second Inspection (May 15, 1987) Testing Period: 2.25 Years

| Position of Test Piece | Test Piece No. | Weight of Test Pieces (g) Original | Weight of Test Pieces (g) Measured | Weight Loss of Test Pieces (g) | Corrosion Rate (mm/yr) |
|---|---|---|---|---|---|
| 2 - 1 | 6 | 7.45 | 7.4349 | 0.0121 | 0.000271 |
| 2 - 2 | 5 | 7.25 | 7.2475 | 0.0026 | 0.000057 |
| 2 - 3 | 4 | 7.26 | 7.2426 | 0.0174 | 0.000399 |
| 2 - 4 | 18 | 7.40 | 7.2426 | 0.0227 | 0.000511 |
| 2 - 5 | 17 | 7.26 | 7.2481 | 0.0119 | 0.000273 |
| 2 - 6 | 16 | 7.02 | 7.0095 | 0.0105 | 0.000249 |
| 2 - 7 | 30 | 7.24 | 7.2310 | 0.0090 | 0.000207 |
| 2 - 8 | 29 | 7.50 | 7.4970 | 0.0030 | 0.000067 |
| 2 - 9 | 28 | 7.41 | 7.3974 | 0.0126 | 0.000283 |

3. Third Inspection (January 27, 1990) Testing Period: 4.94 Years

| Position of Test Piece | Test Piece No. | Weight of Test Pieces (g) Original | Weight of Test Pieces (g) Measured | Weight Loss of Test Pieces (g) | Corrosion Rate (mm/yr) |
|---|---|---|---|---|---|
| 3 - 1 | 7 | 7.34 | 7.3360 | 0.0040 | 0.000040 |
| 3 - 2 | 8 | 7.22 | 7.2172 | 0.0028 | 0.000028 |
| 3 - 3 | 9 | 7.40 | 7.3913 | 0.0087 | 0.000088 |
| 3 - 4 | 19 | 7.59 | 7.5844 | 0.0056 | 0.000056 |
| 3 - 5 | 20 | 7.30 | 7.2993 | 0.0007 | 0.000007 |
| 3 - 6 | 21 | 7.48 | 7.4762 | 0.0038 | 0.000038 |
| 3 - 7 | 31 | 7.21 | 2.7092 | 4.5008 | 0.045337 |
| 3 - 8 | 32 | 7.21 | 7.2963 | 0.0037 | 0.000037 |
| 3 - 9 | 33 | 7.73 | 7.7257 | 0.0043 | 0.000043 |

## Test Result of Corrosion Rate of Non-Protected Test Pieces

1. First Inspection (May19, 1986) Testing Period: 1.27 Years

| Position of Test Piece | Test Piece No. | Weight of Test Pieces (g) Original / Measured | | Weight Loss of Test Pieces (g) | Corrosion Rate (mm/yr) |
|---|---|---|---|---|---|
| 1 - 3 | 161 | 175.8214 | 169.2476 | 6.5738 | 0.2684 |
| 1 - 6 | 165 | 177.4929 | 170.7267 | 6.7662 | 0.2762 |
| 1 - 9 | 169 | 176.0551 | 171.8014 | 4.2537 | 0.1736 |

2. Second Inspection (May 15, 1987) Testing Period: 2.25 Years

| Position of Test Piece | Test Piece No. | Weight of Test Pieces (g) Original / Measured | | Weight Loss of Test Pieces (g) | Corrosion Rate (mm/yr) |
|---|---|---|---|---|---|
| 2 - 3 | 162 | 175.9800 | 168.4223 | 7.5577 | 0.1744 |
| 2 - 6 | 166 | 176.5829 | 168.0472 | 8.6087 | 0.1963 |
| 2 - 9 | 170 | 176.9308 | 170.4000 | 6.5308 | 0.1507 |

3. Third Inspection (January 27, 1990) Testing Period: 4.94 Years

| Position of Test Piece | Test Piece No. | Weight of Test Pieces (g) Original / Measured | | Weight Loss of Test Pieces (g) | Corrosion Rate (mm/yr) |
|---|---|---|---|---|---|
| 3 - 3 | 163 | 175.3360 | 157.8467 | 17.4893 | 0.1838 |
| 3 - 6 | 167 | 175.8540 | 165.8548 | 20.9992 | 0.2207 |
| 3 - 9 | 171 | 175.4639 | 163.8016 | 11.6623 | 0.1225 |

## Corrosion Protection Effectiveness (%)

1. First Inspection (May 22, 1986) Testing Period: 1.27 Years

| | | | | | |
|---|---|---|---|---|---|
| Position of Test Piece | 1 - 3 | Corrosion Protection Effectiveness | = | $\frac{6.5738\ (g) - 0.0101\ (g)}{6.5738\ (g)}$ | x 100 = 99.85(%) |
| | 1 - 6 | Corrosion Protection Effectiveness | = | $\frac{6.7662\ (g) - 0.0056\ (g)}{6.7662\ (g)}$ | x 100 = 99.92 (%) |
| | 1 - 9 | Corrosion Protection Effectiveness | = | $\frac{4.2537\ (g) - 0.0244\ (g)}{4.2537\ (g)}$ | x 100 = 99.43 (%) |

2. Second Inspection (May 15, 1987) Testing Period: 2.25 Years

| | | | | | |
|---|---|---|---|---|---|
| Position of Test Piece | 2 - 3 | Corrosion Protection Effectiveness | = | $\frac{7.5577(g) - 0.0174\ (g)}{7.5577\ (g)}$ | x 100 = 99.77 (%) |
| | 2 - 6 | Corrosion Protection Effectiveness | = | $\frac{8.5087\ (g) - 0.0106\ (g)}{8.5087\ (g)}$ | x 100 = 99.88 (%) |
| | 2 - 9 | Corrosion Protection Effectiveness | = | $\frac{6.5308\ (g) - 0.0126\ (g)}{6.5308\ (g)}$ | x 100 = 99.81 (%) |

3. Third Inspection (January 27, 1990) Testing Period: 4.94 Years

| | | | | | |
|---|---|---|---|---|---|
| Position of Test Piece | 3 - 3 | Corrosion Protection Effectiveness | = | $\frac{17.4893\ (g) - 0.0087(g)}{17.4893\ (g)}$ | x 100 = 99.95 (%) |
| | 3 - 6 | Corrosion Protection Effectiveness | = | $\frac{20.9992\ (g) - 0.0038\ (g)}{20.9992\ (g)}$ | x 100 = 99.98 (%) |
| | 3 - 9 | Corrosion Protection Effectiveness | = | $\frac{11.6623\ (g) - 0.0043\ (g)}{11.6623\ (g)}$ | x 100 = 99.96 (%) |