



Technical assessment of Humidur coating system



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SR.16.11493

**Technical assessment of Humidur coating system
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Executive summary

Within Shell assets and projects there is a tendency to use alternative coating systems compared to the conventional primer/epoxy midcoat/UV resistant topcoat coating system for atmospheric conditions, especially for maintenance purposes for offshore applications.

One of the options is a maintenance coating system, the Humidur coating system, manufactured by Acotec, Belgium. The Humidur coating product is a single layer surface tolerant 2-component solvent-free modified epoxy coating.

It is the intention to extend the use of this optional maintenance coating system to Shell assets globally. This report describes the technical assessment of the Humidur coating system based on manufacturer information, Shell assets experiences, other track records and (third) laboratory test reports.

It was concluded that Humidur FP can be approved to be used within Shell assets and projects for Sa2½ blasted steel and provisional for St2 and St3 prepared steel surfaces.

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1. Introduction and Objectives

Within Shell assets and projects there is a tendency to use alternative coating systems compared to the conventional primer/epoxy midcoat/UV resistant topcoat coating system for atmospheric conditions, especially for maintenance purposes for offshore applications. The maintenance coating systems are applied under field conditions which means that the application conditions and surface preparation requirements are less controlled and less strict compared to shop applications. The demand for this type of coating systems is increasing and Shell Project & Technology Engineering is following this development in consultation with the Shell Fabric Maintenance teams and the coating manufacturers.

One of the options is a maintenance coating system, the Humidur coating system, manufactured by Acotec, Belgium.

The Humidur coating product is a single layer surface tolerant 2-component solvent-free modified epoxy coating. It can be applied as a one-coat system with a minimum thickness of 400 to 600 μm . It cures fast, fully cured within 24 hours at 20°C.

In 2014 and 2015, Humidur was used as maintenance coating system for Shell UK offshore assets such as Shearwater, Gannet, Nelson, Brent. Also onshore plant installations based in St Fergus, Mossmorran and Corrib used the Humidur coating system.

It is the intention to extend the use of the optional maintenance coating systems to other Shell assets globally as there is a considerable interest within other Shell assets and project teams for this coating system. This report describes the technical assessment of the Humidur coating system based on manufacturer information, Shell assets experiences, other track records and (third) laboratory test reports.

2. Scope of TRT program

As part of the 3rd party Technology Replication Trust (TRT) program, the Humidur coating system was identified as a Technology to be deployed within Shell assets and projects, see Appendix 1.

3. Shell experiences and other track records

The experiences of Humidur within Shell assets are presented in the Table 1. The work started in 2014 for the NSP gas plants and Shell UK offshore platforms. The application of Humidur was mainly performed by brush/ rollers and laid out as patch repair for equipment, risers, pipes, structural steel, etc. In most cases the steel surface was cleaned and prepared by grit blasting to achieve a Sa 2½ steel surface. The experiences from the applicators were positive. The application can easily be done by brush in 1 or 2 coats to apply a thickness of minimum 500 µm. Combined with the fast curing time, there is a large cost saving in the application costs. Several Maintenance Coating Contractors have provide feedback (technically and costs) on the advantages of using this coating system.

On Brent Alpha, the coating was applied in January 2015 and a first assessment was done in October 2015. The impression was that the coating performed as it should be. The coating is tightly adhered to the steel surface and no signs of defects or breakdown were observed. The coating only showed signs of discoloration and slight chalking due to UV exposure.

The local Shell UK MCE staff is very positive concerning the use and performance of the Humidur coating system. Although there has been only one year of exposure, the staff is of the opinion that the coating will provide sufficient corrosion protection for the coming 10 years.

An overview of customers world-wide is shown in Appendix 2. Additionally Acotec, the coating manufacturer, provided Job Reports for the coating system applied over the last 10 years (internal Job Reports).

During trial and case studies for Shell proposes, adhesion testing of the coating system was performed; the results are shown in Table 2.

For Shell purposes, it is intended to use the Humidur FP product. This product has a higher resistance to water, chlorides, chemicals, etc. compared to Humidur ME. Technical Datasheets for the Humidur ME, E and FP product are presented in Appendix 3.

Aquaterra [1] did a gap analysis based on the required testing as per Shell DEP 30.48.00.31-Gen. "Protective coatings for onshore and offshore facilities". It was shown that concerning the testing requirements as specified in the Shell DEP there were some gaps for the different Humidur products. It is recommended to perform long term testing (ISO 20340) to get a full picture of the expected lifetime of the Humidur coating based on different surface preparation methods and requirements.

Table 1: Humidur coating application within Shell assets

Shell asset and year of application	Coating system	Surface preparation	Application conditions
NSP Gas Plants 2014 and 2015	Humidur ME	Sa2.5	Brush/roller
NSP Internal Tank Coating July 2015	Humidur ME	Sa2.5	spray
Brent Alpha 2014/2015	Humidur ME	Sa2.5	Brush on 6" line and fittings
Brent Charlie 2014/2015	Humidur ME	Bristle Blaster	Brush
Brent Bravo 2014/2015	Humidur ME		
Nelson 2014/2015		Sa 2.5	Structural steelwork and adjacent lines
Shearwater	Humidur ME	Sa 2.5	
Corrib Oct 2015	Humidur FP & TC	Sa 2.5	Brush Patch applied

Table 2: Overview of test results for Humidur based on internal and 3rd party test reports

Humidur coating type	ME	FP	E
<i>TESTING</i>		SGS REPORT APRIL 2013	
<i>ISO 20340 ageing test</i>		600 to 1000 um Sa 2.5 corrosion creep 8 mm no photo's	
			Exova Norsok report June 2012 2000 um Sa 2.5 NORSOK M-501
<i>Water Immersion ISO 2812-2</i>			0.5 mm corrosion creep
<i>Cathodic Disbondment ISO 15711</i>			13 mm disbonding
<i>Adhesion testing Oct 2012</i>	Needle gun 17 Mpa Blistle blaster 18 Mpa Grinding disc 18 Mpa Manual prep 9 Mpa No prep 6 Mpa Grit blasting 11 MPa	Needle gun > 20 Mpa Blistle blaster > 20 Mpa Grinding disc > 20 Mpa Manual prep 13.5 Mpa No prep 15 Mpa Grit blasting 13 MPa	Needle gun > 20 Mpa Blistle blaster > 20 Mpa Grinding disc > 20 Mpa Manual prep 10 Mpa No prep 4.5 Mpa Grit blasting 12.5 Mpa
<i>Adhesion testing April 2014 tested after 96 h drying</i>	Wire brush > 20 Mpa Needle gun > 20 Mpa Manual Sander > 20 MPa		
<i>Adhesion test June 2015</i>		High Pressure Water Cleaning 6.5 to 11 MPa	
<i>Adhesion test on SS316L blasted</i>	power tool St3 10 MPa	blasted 32 MPa power tool St3 10.4 to 17.6 MPa	
<i>EIS May 2015 3 weeks seawater exposure</i>	minimal water uptake	minimal water uptake	minimal water uptake
<i>EIS July 2015</i>	almost no degradation after 17 years of exposure		
<i>Salt spray testing 2400 h</i>		Belwind report Oct 2013 1000 um Sa 2.5 blasted corrosion creep 1-2 mm	
<i>resistance to water, gasoline, diesel and biodiesel ISO 2812-1 (3 weeks)</i>		no degradation	
<i>expected lifetime</i>		5 years by mech prep St 3 7 years by Bristle Blaster St3 10 years by blasting > 10 years by blasting and TC application	

4. Laboratory test reports and other test data

Acotec performed a lot of testing for the Humidur products internally and at third party laboratories. An overview of the most relevant testing is presented in Table 2.

In 2012, testing was done for the Humidur E product (thickness 2000 μm) according to Norsok specification. Only water immersion and cathodic disbondment testing was performed, no ageing testing according ISO 20340 was performed [2].

For the Humidur FP product (thickness 600 to 1000 μm), ageing testing was performed according ISO 201340 and the corrosion creep for all three test panels was 8 mm (requirement is maximum 8 mm [3]).

Salt spray testing for Humidur FP (thickness 1000 μm) resulted in a corrosion creep of 1 to 2 mm [4].

A lot of adhesion test data is available, for non-exposed samples as well as for exposed samples [1]. Additionally, information is available from field trials and case studies. From these it can be concluded that the adhesion between the Humidur product and steel surface is extremely good. Adhesion values above 20 MPa were measured. Even on St2 and St3 prepared steel surfaces, the adhesion strength was high.

5. Evaluation of Humidur coating systems

Based on information received from the coating manufacturer, the expected lifetime of the Humidur coating system is as follows:

- 5 years with mechanical preparation to St2
- 7 years with Bristle Blaster surface preparation to St3
- 10 years with a single-coat on Sa2½ prepared steel
- 10 years on Sa2½ prepared steel with single coat and top coat

The laboratory testing for the Humidur coating systems is mainly based on partly testing of a coating system. For the Humidur FP product, ISO 20340 ageing testing was performed but no sea water immersion and cathodic disbonding testing was performed.

For Humidur E, a Norsok test report is available describing Sea water immersion testing and cathodic disbonding testing, but no ISO 20340 ageing testing was performed. The overall thickness of the Humidur E during this Norsok testing was 2000 µm. This is far more than what is specified for normal applications.

A substantial amount of testing was performed to assess the adhesion of the Humidur coating system on different prepared steel surfaces. The adhesion of the Humidur coating is extremely good. Mostly above 20 MPa even for St2 and St 3 prepared steel surfaces. Even after a certain exposure period in seawater and/or atmospheric conditions, the adhesion is still high.

This confirms the surface tolerant properties of the Humidur coating systems.

Acotec provide 7 years and 20 years warranty letters for the Humidur products, see Appendix 4.

Within Shell there is no experience concerning the long term performance of the Humidur coating system. The longest experience is only 1 to 2 years. Within other oil and gas companies, there is more long term experience with this product; several reports and case studies indicate that Humidur has a life time of more than 10 years. This is mainly based on experiences with grit blasted steel.

To achieve an approval according to Shell DEP 30.48.00.31-Gen. 'Protective coating for onshore and offshore facilities' it is required to perform the test program as is described in this DEP. This was discussed with Acotec, the manufacturer of the Humidur coating product and there is an initial proposal to start a test program for the Humidur FP product with focus on the surface tolerant properties of the coating systems.

In the meantime, the use of Humidur coating systems with Shell assets and project is encouraged for maintenance purposes.

The overall performance of the Humidur coating product is mainly dependent on the application. For this reason, all coating applicators shall be trained by Acotec staff and during application, an Acotec approved inspectors shall be present to witness the coating application and testing.

6. Conclusions and recommendations

The technical assessment of the Humidur coating systems for application within the Shell assets is based upon:

- 1) Shell experiences mainly in UK area
- 2) other track records and job reports provided by Acotec
- 3) available test report provided by Acotec

It was concluded that Humidur FP can be approved to be used within Shell assets and projects for Sa2½ blasted steel and provisional for St2 and St3 prepared steel surfaces.

To achieve more information on the expected long term performance in relation with ISO 20340 ageing testing as specified in the Shell DEP 30.48.00.31-Gen. "Protective coatings for onshore and offshore facilities", it is recommend to execute the following test program:

Purpose

Qualification of Humidur FP as new and maintenance coating for application for Shell assets for atmospheric, splash zone and submerged conditions

Application conditions

Application of Humidur FP on different prepared steel panels:

- 1) Sa2.5
- 2) St3
- 3) St2
- 4) UHP
- 5) on existing coating

Surface Preparation and Coating Application shall be executed by Acotec staff. For each condition, at least 10 panels shall be coated.

Application by:

- a) spraying
- b) brush

Testing required

Testing of the coated steel panels shall be done by a recognized coating laboratory. The following testing shall be performed:

- 1) Ageing resistance according ISO 20340 (4200 h)
- 2) Seawater immersion according ISO 20340 (4200 h)
- 3) Impact resistance
- 4) Adhesion before and after testing
- 5) Thick film cracking

All testing shall be in accordance with Shell DEP 30.48.00.31-Gen. 'Protective Coatings for onshore and offshore facilities'.

This test program will be executed by Shell PTE in collaboration with an independent third party laboratory.

References

- [1] Acotec/Humidur Paint System Technical Evaluation, Aquaterra, 04-09-2014.
- [2] Norsok Pre-Qualification Report 'Testing in accordance with Norsok Rev 5 June 2004 System No. 7'; Exova ref: N956610-A, 15/06/2012.
- [3] Performance testing coating system according to ISO 20340 – Humidur FP coating system'; SGS Intron report A865670/R20120591, 29 April 2013.
- [4] Coating tests for Belwind, October 24, 2013.

Appendix 1. TRT slide 'Humidur – Single Layer Surface Tolerant Coating'



3PT One
Slide_MMI_Humidur.p

Appendix 2. Overview of customers world-wide using Humidur coating products



Overview Customers
Worldwide.pdf

Appendix 3. Technical datasheets for Humidur ME, E and FP



Humidur ME
datasheet.pdf



Humidur E
datasheet.pdf



Humidur FP
datasheet.pdf

Appendix 4. Warranty letters from Acotec for Humidur coating products



warranty letters
Appendix 4.pdf

Bibliographic information

Classification	Restricted
Report Number	SR.16.11493
Title	Technical assessment of Humidur coating system
Author(s)	J.R. van Bokhorst (GSNL-PTE/EMMI)
Keywords	Coating, corrosion, Humidur, maintenance
Date of Issue	June 2016
Period of Work	March - May 2016
US Export Control	Non US - Public Domain
WBSE Code	ZZPT/015243/010901
Approved by	D. Wilms (GSNL-PTE/EMMI)
Sponsoring Company / Customer	Shell Global Solutions International B. V.
Issuing Company	Shell Global Solutions International B.V., Amsterdam P.O. Box 38000 1030 BN Amsterdam The Netherlands

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