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Why WebCorr | Performance Guarantee | Unparalleled Functionality | Unmatched Usability | Any Device Any OS | Free Training & Support | CorrCompass

Overview and Application Examples of NH3Compass

Anhydrous ammonia is manufactured by combining hydrogen and nitrogen in a molar ratio of 3:1, compressing the gas and then cooling it to about -27°F (-33°C). Corrosion at high temperatures in H2 and N2 environment include: (1) high temperature hydrogen attack (HTHA), (2) creep and stress rupture, and (3) nitriding. Corrosion at low temperatures include: (1) ammonia stress corrosion cracking (SCC), (2) ammonia carbamate formation, (3) general corrosion, (4) galvanic corrosion and other damage mechanisms.

NH3Compass is the only device and OS independent software tool on the market for the modeling and prediction of corrosion in ammonia production, storage, transport, and other services. NH3Compass is a cloud-based software that works on any device running any OS without the need for users to install or download anything. Designers, OEM engineers, consultants, operation personnel, maintenance and inspection engineers can quickly and accurately determine:

(1) the risk of high temperature hydrogen attack (HTHA) under the prevailing operating condition;

- (2) the risk of creep and stress rupture under the prevailing operating condition;
- (3) the nitriding potential and nitriding depth under the prevailing operating condition;
- (4) the corrosion rates for metals and alloys in anhydrous liquid ammonia;
- (5) the galvanic effect of coupling different metals and alloys in anhydrous liquid ammonia;
- (6) the risk of ammonia stress corrosion cracking (SCC) under the prevailing operating condition;
- (7) the risk of ammonia carbamate formation;
- (8) materials selection as affected by the changes in process parameters.

Equipment Name/Location	Line #5	
Component Nominal ID	mm	20.000
Nominal Wall Thickness	mm	7.000
Spent Operating Hours	hours	8,760
High Temperature Corrosion (Gas Phase)	ASTM 517 Grade F Steel	~
Operating Temperature	°C	500.000
Operating Pressure	MPa	9.500
NH3 Partial Pressure	MPa	0.950
H2 Partial Pressure	MPa	4.940
N2 Partial Pressure	MPa	3.610
Risk of High Temperature Hydrogen Attack (HTHA)	High risk	as per API 581
Creep and Stress Rupture (Remaining Life)	years	27.393
Nitriding Potential	atm ^{-0.5}	0.02754
Nitriding Depth	μm	616.415
Low Temperature Corrosion (Liquid Phase)	Carbon Steel welded no PWHT 🗸	
Operating Temperature	°C	25.000
Water Content in Liquid Ammonia	wt%	0.1000
Ovygen Content in Liquid Ammonia		(
oxygen content in Eiquid Ammonia	ppmw	100.000
CO2 Content in Liquid Ammonia	ppmw	4.000
CO2 Content in Liquid Ammonia General Corrosion Rate in Anhydrous Ammonia	ppmw ppmw μm/y	100.000 4.000 0.582
CO2 Content in Liquid Ammonia General Corrosion Rate in Anhydrous Ammonia Galvanic Effect When Coupled to	ppmw ppmw µm/y AISI 316L	100.000 4.000 0.582
CO2 Content in Liquid Ammonia CO2 Content in Liquid Ammonia General Corrosion Rate in Anhydrous Ammonia Galvanic Effect When Coupled to Galvanic Cell Potential, ΔE=E _B -E _A	ppmw ppmw µm/y AISI 316L mV	100.000 4.000 0.582 ~ -45
CO2 Content in Liquid Ammonia General Corrosion Rate in Anhydrous Ammonia Galvanic Effect When Coupled to Galvanic Cell Potential, ΔE=E _B -E _A Risk of Ammonia Stress Corrosion Cracking (SCC)	ppmw ppmw µm/y AISI 316L mV High risk of amn	100.000 4.000 0.582 ~ -45

NH3Compass®: Modeling & Prediction of Corrosion in Ammonia Production & Services

Figure 1 NH3Compass predicts corrosion at high temperatures and low temperatures.

Under the prevailing operating conditions shown in Figure 1 above, the selected metallurgy,

ASTM A517 Grade F steel, is predicted to have high risk of high temperature hydrogen attack (HTHA), as per API 581 risk ranking methodology. The remaining life due to creep and stress rupture is 27.393 years. The selected metallurgy is susceptible to nitriding under the the prevailing operating conditions, with a nitriding potential of 0.02754 atm^{-0.5} and nitriding depth of 616.415 μ m. At low temperatures, the selected carbon steel (no PWHT) is highly susceptible to ammonia stress corrosion



cracking (SCC) under the specified operating conditions. When the carbon steel is coupled to another metal, AISI 316L, NH3Compass predicts the galvanic cell potential of -45 mV than can cause accelerated corrosion of the anode metal. NH3Compass predicts that there is no risk of corrosion caused by ammonia carbamate formation, as shown in Figure 1.

Figures 2 and 3 below show the materials selection for both high temperature and low temperature services in ammonia production, storage, and transport.

Equipment Name/Location	Line #5		
Component Nominal ID	mm	20.000	
Nominal Wall Thickness	mm 7.000		
Spent Operating Hours	hours	8,760	
High Temperature Corrosion (Gas Phase)	ASTM 517 Grade F Steel 🗸		
Operating Temperature	ASTM 517 Grade F Steel		^
Operating Pressure	CS non-welded or welded with PWHT		
NH3 Partial Pressure	C-0.5Mo Normalized		
H2 Partial Pressure	1.25Cr0.5Mo		
N2 Partial Pressure	2.25Cr1.0Mo 2.25Cr1.0MoV		
Risk of High Temperature Hydrogen Attack (HTHA)	3Cr1.0Mo 3Cr1.0MoV		
Creep and Stress Rupture (Remaining Life)	6Cr0.5Mo		
Nitriding Potential	9Cr1MoV		
Nitriding Depth	AISI 410		
Low Temperature Correction (Liquid Phase)	AISI 450 AISI 304		
Low remperature corrosion (Liquid Phase)	AISI 304L		
Operating Temperature	AISI 310		
Mater Content in Liquid Ammonia	AISI 316		
water content in Liquid Ammonia	AISI 310L	,	-
Oxygen Content in Liquid Ammonia	ppmw	100.000	_
CO2 Content in Liquid Ammonia	ppmw	4.000	
General Corrosion Rate in Anhydrous Ammonia	μm/y	0.582	
Galvanic Effect When Coupled to	AISI 316L		~
Galvanic Cell Potential, $\Delta E = E_B - E_A$	mV	-45	
Risk of Ammonia Stress Corrosion Cracking (SCC)	High risk of amn	nonia SCC	
Risk of Ammonium Carbamate Corrosion	No risk of corrosion by carbamate		

Figure 2 Materials selection for high temperature services in ammonia production.

Equipment Name/Location	Line #5		
Component Nominal ID	mm	20.000	
Nominal Wall Thickness	mm	7.000	
Spent Operating Hours	hours	8,760	
High Temperature Corrosion (Gas Phase)	ASTM 517 Grade F Steel	~	
Operating Temperature	°C	500.000	
Operating Pressure	MPa	9.500	
NH3 Partial Pressure	MPa	0.950	
H2 Partial Pressure	ASTM 517 Grade F Steel		
N2 Partial Pressure	CS non-welded or welded with PWHT		
Risk of High Temperature Hydrogen Attack (HTHA)	C-0.5Mo Normalized		
Creep and Stress Rupture (Remaining Life)	1Cr0.5Mo		
Nitriding Potential	1.25Cr0.5Mo		
Nitriding Depth	2.25Cr1.0MoV		
	3Cr1.0Mo		
Low Temperature Corrosion (Liquid Phase)	3Cr1.0MoV		
Operating Temperature	9Cr1MoV		
Water Content in Liquid Ammonia	AISI 410		
Water content in Equilit Annionia	AISI 430		
Oxygen Content in Liquid Ammonia	AISI 304 AISI 304L		
CO2 Content in Liquid Ammonia	AISI 316		
Conoral Corrosion Pata in Anhydrous Ammonia	AISI 316L		
General Conosion Rate in Annyurous Annionia	2205 DSS	*	
Galvanic Effect When Coupled to	AISI 304L	~	
Galvanic Cell Potential, $\Delta E = E_B - E_A$	mV	-45	
Risk of Ammonia Stress Corrosion Cracking (SCC)	High risk of amm	nonia SCC	
Risk of Ammonium Carbamate Corrosion	No risk of corrosion by carbamate		

NH3Compass®: Modeling & Prediction of Corrosion in Ammonia Production & Services

Figure 3 Materials selection for low temperature services in ammonia production, storage, and

transport.

The powerful applications of NH3Compass are truly unlimited in engineering design, materials

selection, process optimization, inspection and maintenance, modeling and prediction of

corrosion in ammonia production, storage, transport, and other services.

Click here to contact us for licensing details and experience the power of NH3Compass.

NH3Compass, giving you the right directions in the Modeling and Prediction of Corrosion in Ammonia Production, Storage, and Transport.

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