CORROSION EVALUATION

PWD-BRKPT-00008 & 10 (PTF)

Breakpots

- Design Temperature (°F)(Max/min): 368/40
- Design Pressure (psig) (Max/min): 15/FV
- Location: incell

Contents of this document are Dangerous Waste Permit affecting

Operating conditions are as stated on attached Process Corrosion Data Sheet

Operating Conditions Considered:

- Breakpots may receive cell and vessel wash from multiple sumps.
- Breakpots may receive emptying ejector discharge from UFP-VSL-00062A/B/C (non-routine condition).
- Breakpots will receive 2M Nitric and 2M Caustic cleaning solutions.
- Operation at or approaching steam temperatures will be of short duration.
- Assume breakpots will be maintained clean and dry between uses

Materials Considered:

Material (UNS No.)	Relative Cost	Acceptable Material	Unacceptable Material
Carbon Steel	0.23		X
304L (S30403)	1.00	X	
316L (S31603)	1.18	X	
6% Mo (N08367/N08926)	7.64	X	
Alloy 22 (N06022)	11.4	X	
Ti-2 (R50400)	10.1		X

Recommended Material: 304 (max 0.030% C; dual certified)

Recommended Corrosion Allowance: 0.040 inch (includes 0.024 inch corrosion allowance and 0.004 inch erosion allowance)

Process & Operations Limitations:

- None

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Concurrence NA
C & T

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	MET	APPROVER
2	3/8/05	Update wear allowance based on 24590-WTP-RPT-04-0008	DLAdler	JRDivine	NA	APRangus
1	5/17/04	Addition of information regarding inadvertent nitric acid addition Append updated PCDS	DLAdler	APRangus	NA	SWVail
0	5/11/04	Initial Issue	DLAdler	JRDivine	APR	APRangus

CORROSION EVALUATION

Corrosion Considerations:

Breakpots have no routine operations. Breakpots will non-routinely receive and transfer cell and vessel washes from sumps in and emptying ejector discharge from UFP-VSL-00062A/B/C.

a General Corrosion
Hamner (1981) lists a corrosion rate for 304 (and 304L) in NaOH of less than 20 mpy. The corrosion rate for 316L is shown as less than 2 mpy. Davis (1994) states the corrosion rate for 304L in pure NaOH will be less than about 0.1 mpy up to about 125°F. Dillon (2000) says either 304L or 316L can be used for up to 30% (≈10 M) and temperatures to boiling without concern – 316L may be better for NaOH highly contaminated with NaCl. Both the Avesta Corrosion Handbook (1999) and the Occidental Chemical Caustic Soda Handbook (2000) approve of the 300 series at up to about 200°F.

Hamner (1981) lists a corrosion rate for 304 (and 304L) in 2 M HNO_3 of less than 2 mpy. Davis (1994) states the corrosion rate for 304L in 12% HNO_3 will be less than about 1 mpy up to about 212°F.

Conclusion:
Operations at or approaching steam temperatures are expected to be of short duration. 304L is suitable.

b Pitting Corrosion
At the concentrations temperatures used, NaOH will not pit 304L. There is some potential for pitting if the NaOH is contaminated with NaCl. At the concentrations and temperatures used, nitric acid will not pit 304L.

Conclusion:
Pitting is not considered a problem.

c End Grain Corrosion
End grain corrosion only occurs in metal with exposed end grains and in highly oxidizing acid conditions.

Conclusion:
Not expected in this system.

d Stress Corrosion Cracking
The exact amount of chloride required to stress corrosion crack stainless steel is unknown. In part, this is because the amount varies with temperature, metal sensitization, and the environment. However, it is also unknown because chloride tends to concentrate under heat transfer conditions, by evaporation, and electrochemically during a corrosion process. Hence, even as little as 10 ppm can lead to cracking under some conditions. According to Sedriks (1996) and Davis (1987), it is observed that alkaline conditions reduce the probability of the initiation of stress corrosion cracking to essentially zero. Further, the use of "L" grade stainless reduces the opportunity for sensitization.

Conclusion:
The use of 304L is expected to be acceptable for the stated conditions.

e Crevice Corrosion
See Pitting.

Conclusion:
See Pitting

f Corrosion at Welds
Weld corrosion is not considered a problem for this system.

Conclusion:
Not a concern.

g Microbiologically Induced Corrosion (MIC)
The proposed operating conditions are not conducive to microbial growth.

Conclusion:
MIC is not considered a problem.

h Fatigue/Corrosion Fatigue
Corrosion fatigue is a not expected to be a problem.

Conclusions
Not expected to be a concern.

CORROSION EVALUATION

i Vapor Phase Corrosion
Not expected to be a problem.

Conclusion:
Not expected to be a problem.

j Erosion
Velocities are expected to be low. Erosion allowance of 0.004 inch for components with low solids content (< 2 wt%) at low velocities is based on 24590-WTP-RPT-M-04-0008.

Conclusion:
Not considered to be a concern.

k Galling of Moving Surfaces
Not applicable.

Conclusion:
Not applicable.

l Fretting/Wear
No contacting surfaces expected.

Conclusion:
Not applicable.

m Galvanic Corrosion
No dissimilar metals are present.

Conclusion:
Not applicable.

n Cavitation
None expected.

Conclusion:
Not believed to be of concern.

o Creep
The temperatures are too low to be a concern.

Conclusion:
Not applicable.

p Inadvertent Nitric Acid Addition
Higher chloride contents and higher temperatures usually require higher alloy materials. Nitrate ions inhibit the pitting and crevice corrosion of stainless alloys. Furthermore, nitric acid passivates these alloys; therefore, lower pH values brought about by increases in the nitric acid content of process fluid will not cause higher corrosion rates for these alloys. The upset condition that was most likely to occur is lowering of the pH of the vessel content by inadvertent addition of 0.5 M nitric acid. Lowering of pH may make a chloride-containing solution more likely to cause pitting of stainless alloys. Increasing the nitric acid content of the process fluid adds more of the pitting-inhibiting nitrate ion to the process fluid. In addition, adding the nitric acid solution to the stream will dilute the chloride content of the process fluid.

Conclusion:
The recommended materials will be able to withstand a plausible inadvertent addition of 0.5 M nitric acid for a limited period.

CORROSION EVALUATION

References:

1. 24590-WTP-RPT-M-04-0008, Rev. 2, *Evaluation Of Stainless Steel Wear Rates In WTP Waste Streams At Low Velocities*
2. 24590-WTP-RPT-PR-04-0001, Rev. B, *WTP Process Corrosion Data*
3. Avesta Sheffield Corrosion Handbook, 1999, 8th Ed., Avesta, Sweden
4. Davis, JR (Ed), 1987, *Corrosion, Vol 13*, In "Metals Handbook", ASM International, Metals Park, OH 44073
5. Davis, JR (Ed), 1994, *Stainless Steels*, In ASM Metals Handbook, ASM International, Metals Park, OH 44073
6. Dillon, CP (Nickel Development Institute), Personal Communication to J R Divine (ChemMet, Ltd., PC), 3 Feb 2000.
7. Hamner, NE, 1981, *Corrosion Data Survey*, Metals Section, 5th Ed, NACE International, Houston, TX 77218
8. Occidental Chemical Corporation, *Caustic Soda Handbook*, 2000, Dallas, TX 75244
9. Sedriks, AJ, 1996, *Corrosion of Stainless Steels*, John Wiley & Sons, Inc., New York, NY 10158

Bibliography:

1. Divine, JR, 1986, Letter to A.J. Diliberto, *Reports of Experimentation*, Battelle, Pacific Northwest Laboratories, Richland, WA 99352
2. Uhlig, HH, 1948, *Corrosion Handbook*, John Wiley & Sons, New York, NY 10158
3. Zapp, PE, 1998, *Preliminary Assessment of Evaporator Materials of Construction*, BNF—003-98-0029, Rev 0, Westinghouse Savannah River Co., Inc for BNFL Inc.

CORROSION EVALUATION

PROCESS CORROSION DATA SHEET

Component(s) (Name/ID #) Breakpot (PWD-BRKPT-00008)

Facility PTF

In Black Cell? Yes

Chemicals	Unit[1]	Contract Maximum		Non-Routine		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/l			3.15E+01	3.17E+01	
Chloride	g/l			1.21E+01	1.45E+01	
Fluoride	g/l			1.44E+01	1.73E+01	
Iron	g/l			2.31E+00	2.60E+00	
Nitrate	g/l			2.23E+02	2.59E+02	
Nitrite	g/l			6.69E+01	8.01E+01	
Phosphate	g/l			4.83E+01	5.66E+01	
Sulfate	g/l			2.57E+01	3.08E+01	
Mercury	g/l			7.47E-02	1.94E-02	
Carbonate	g/l			9.03E+01	9.93E+01	
Undissolved solids	wt%					
Other (NaMnO4, Pb,...)	g/l					
Other	g/l					
pH	N/A					Note 3
Temperature	°F					Note 2

List of Organic Species:

References

System Description: 24590-PTF-3YD-PWD-00001, Rev 1
Mass Balance Document: 24590-WTP-M4C-V11T-00005, Rev A
Normal Input Stream #: N/A
Off Normal Input Stream # (e.g., overflow from other vessels): UFP33, UFP09, UFP32, UFP45, and miscellaneous washes (see section 4.9.2)
P&ID: 24590-PTF-M6-PWD-00001, Rev 0
PFD: 24590-PTF-M5-V17T-00022002, Rev 1
Technical Reports:

Notes:

1. Concentrations less than 1x 10^{-4} g/l do not need to be reported; list values to two significant digits max.
2. Steam is used for transfer. The breakpot is normally empty and at ambient temperature most of the time.
3. pH possible from various sources 13 to 14.

Assumptions:

CORROSION EVALUATION

PROCESS CORROSION DATA SHEET

Component(s) (Name/ID #) Breakpot (PWD-BRKPT-00010)

Facility PTF

In Black Cell? Yes

Chemicals	Unit[1]	Contract Maximum		Non-Routine		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/l			3.15E+01	3.17E+01	
Chloride	g/l			1.21E+01	1.45E+01	
Fluoride	g/l			1.44E+01	1.73E+01	
Iron	g/l			2.31E+00	2.60E+00	
Nitrate	g/l			2.23E+02	2.59E+02	
Nitrite	g/l			6.69E+01	8.01E+01	
Phosphate	g/l			4.83E+01	5.66E+01	
Sulfate	g/l			2.57E+01	3.08E+01	
Mercury	g/l			7.47E-02	1.94E-02	
Carbonate	g/l			9.03E+01	9.93E+01	
Undissolved solids	wt%					
Other (NaMnO4, Pb,...)	g/l					
Other	g/l					
pH	N/A					Note 3
Temperature	°F					Note 2

List of Organic Species:

References

System Description: 24590-PTF-3YD-PWD-00001, Rev 1
Mass Balance Document: 24590-WTP-M4C-V11T-00005, Rev A
Normal Input Stream #: N/A
Off Normal Input Stream # (e.g., overflow from other vessels): UFP33, UFP09, UFP32, UFP45, and miscellaneous washes (see section 4.9.4)
P&ID: 24590-PTF-M6-PWD-00001, Rev 0
PFD: 24590-PTF-M5-V17T-00022002, Rev 1
Technical Reports:

Notes:

1. Concentrations less than 1x 10^{-4} g/l do not need to be reported; list values to two significant digits max.
2. Steam is used for transfer. The breakpot is normally empty and at ambient temperature most of the time.
3. pH from various sources approximately 13 to 14.

Assumptions:

4.9.2 Breakpot (PWD-BRKPT-00008)

Routine Operations

This breakpot serves as a moisture separator for ejected plant wash from PT vessels. The breakpot does not accumulate any fluid.

Non-Routine Operations that Could Affect Corrosion/Erosion

Receives content from emptying ejector for UFP-VSL-00062C.

Receives cell and vessel washes from PWD-SUMP-00002A (room P-0108), PWD-SUMP-00004 (room P-0104), and PWD-SUMP-00005 (room P-0102A).

4.9.4 Breakpot (PWD-BRKPT-00010)

Routine Operations

This breakpot serves as a moisture separator for ejected plant wash from PT vessels. The breakpot does not accumulate any fluid.

Non-Routine Operations that Could Affect Corrosion/Erosion

Receives cell and vessel washes from PWD-SUMP-00002 (room P-0108A), PWD-SUMP-00003 (room P-0106), and PWD-SUMP-00026 (room P-0123).

Receives content from emptying ejector for UFP-VSL-00062A and UFP-VSL-00062B.