

CORROSION EVALUATION



PWD-BRKPT-00007/09/17/19 (PTF)

Breakpots

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

**ISSUED BY
RPP-WTP PDC**

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 multiple vessels.
- Breakpots will receive 2M Nitric and 2M Caustic cleaning solutions.
- Operation at or approaching steam temperatures will be of short duration.

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:

- Breakpots will be maintained clean and dry between uses

Concurrence JLR
Operations

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	MET	APPROVER
4	12/15/05	Update wear allowance based on 24590-WTP-RPT-04-0008	DLAdler	JRDivine	NA	SM Kirk SWVail APRangus
3	5/17/04	Addition of information regarding inadvertent nitric acid addition Append updated PCDS	DLAdler	APRangus	NA	SWVail
2	5/10/04	Revised to incorporate new PCDS	DLAdler	JRDivine	NA	APRangus
1	2/17/04	Update vessel quantity Update design temp/pressure Re-format references Append updated MSDS Add DWP note	DLAdler	JRDivine	NA	APRangus
0	7/10/02	Initial Issue	DLAdler	JRDivine	SS	SMKirk

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Corrosion Considerations:

Breakpots have no routine operations. Breakpots will non-routinely receive and transfer cell and vessel washes from sumps in various systems and emptying ejector discharge from various vessels.

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 HNO₃ of less than 2 mpy. Davis (1994) states the corrosion rate for 304L in 12% HNO₃ 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. Expected concentrations of halides in these breakpots are below 0.1 ppm. 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.

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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.

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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

24590-WTP-RPT-PR-04-0001, Rev. B
WTP Process Corrosion Data

PROCESS CORROSION DATA SHEET

Component(s) (Name/ID #) Breakpot (PWD-BRKPT-00007)

Facility PTF

In Black Cell? Yes

Chemicals	Unit ¹	Contract Maximum		Non-Routine		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/l					
Chloride	g/l					
Fluoride	g/l					
Iron	g/l					
Nitrate	g/l					
Nitrite	g/l					
Phosphate	g/l					
Sulfate	g/l					
Mercury	g/l					
Carbonate	g/l					
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 #:
 Off Normal Input Stream # (e.g., overflow from other vessels): RDP01 (24590-PTF-M6-PWD-00010, Rev 0), miscellaneous washes (see section 4.9.1)
 P&ID: 24590-PTF-M6-PWD-00001, Rev 0
 PFD: 24590-PTF-M5-V17T-00C22002, Rev 1

Technical Reports:

Notes:

1. Concentrations less than 1x 10⁻¹ 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. Receives diluted sump washes.

Assumptions:

CORROSION EVALUATION

24590-WTP-RPT-PR-04-0001, Rev. B
WTP Process Corrosion Data

PROCESS CORROSION DATA SHEET

Component(s) (Name/ID #) Breakpot (PWD-BRKPT-00009)

Facility PTF

In Black Cell? Yes

Chemicals	Unit ¹	Contract Maximum		Non-Routine		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/l					
Chloride	g/l					
Fluoride	g/l					
Iron	g/l					
Nitrate	g/l					
Nitrite	g/l					
Phosphate	g/l					
Sulfate	g/l					
Mercury	g/l					
Carbonate	g/l					
Undissolved solids	wt%					
Other (NaMnO4, Pb,...)	g/l					
Other	g/l					
pH	N/A					
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): Miscellaneous washes (see section 4.9.3)
 P&ID: 24590-PTF-M6-PWD-00001, Rev 0
 PFD: 24590-PTF-M5-V17T-00022002, Rev 1
 Technical Reports:

Notes:

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

Assumptions:

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WTP Process Corrosion Data

PROCESS CORROSION DATA

Component(s) (Name/ID #) Breakpot (PWD-BRKPT-00017)

Facility PTF

In Black Cell? Yes

Chemicals	Unit ¹	Contract Maximum		Non-Routine		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/l					
Chloride	g/l					
Fluoride	g/l					
Iron	g/l					
Nitrate	g/l					
Nitrite	g/l					
Phosphate	g/l					
Sulfate	g/l					
Mercury	g/l					
Carbonate	g/l					
Undissolved solids	wt%					
Other (NaMnO4, Pb,...)	g/l					
Other	g/l					
pH	N/A					
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-00006, Rev A
 Normal Input Stream #: N/A
 Off Normal Input Stream # (e.g., overflow from other vessels): CXP13, CXP14, PWD01, PWD19, miscellaneous sump/cell/vessel wash (see section 4.9.7)
 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.

Assumptions:

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24590-WTP-RPT-PR-04-0001, Rev. B
WTP Process Corrosion Data

PROCESS CORROSION DATA SHEET

Component(s) (Name/ID #) Breakpot (PWD-BRKPT-00019)

Facility PTF

In Black Cell? Yes

Chemicals	Unit ¹	Contract Maximum		Non-Routine		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/l					
Chloride	g/l					
Fluoride	g/l					
Iron	g/l					
Nitrate	g/l					
Nitrite	g/l					
Phosphate	g/l					
Sulfate	g/l					
Mercury	g/l					
Carbonate	g/l					
Undissolved solids	wt%					
Other (NaMnO4, Pb,...)	g/l					
Other	g/l					
pH	N/A					
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): CNP10, CNP14; cell and vessel washes from sumps (see section 4.9.8)						
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.						
Assumptions:						

CORROSION EVALUATION24590-WTP-RPT-PR-04-0001, Rev. B
WTP Process Corrosion Data**4.9.1 Breakpot (PWD-BRKPT-00007)****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-00011 (room P-0114), PWD-SUMP-00012 (room P-0117), PWD-SUMP-00013 (room P-0117a), PWD-SUMP-00031 (room P-0119), PWD-SUMP-00034 (room P-0121A), and PWD-SUMP-00036 (room P-0118).

Receives effluent from double-shelled pipe drains for the spent resin transfer.

4.9.3 Breakpot (PWD-BRKPT-00009)**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-00006 (room P-0102), PWD-SUMP-00029 (room P-0123), PWD-SUMP-00032 (room P-0123A), PWD-SUMP-00033 (room P-0123A), PWD-SUMP-00035 (room P-0122A), and PWD-SUMP-00037 (room P-0122A).

4.9.7 Breakpot (PWD-BRKPT-00017)**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-00001 (room P-0108B), PWD-SUMP-00001A (room P-0108C), and PWD-SUMP-00007 (room P-0109).

Receives content from emptying ejector for CXP-VSL-00004, PWD-VSL-00015, and PWD-VSL-00016.

4.9.8 Breakpot (PWD-BRKPT-00019)**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-00009 (room P-0112) and PWD-SUMP-00010 (room P-0113).

Receives content from emptying ejector for CNP-VSL-00001, CNP-VSL-00004, and Cs concentrate from CNP-EVAP-00001 and CNP-VSL-00004.