CORROSION EVALUATION

R10667995

RLD-VSL-00003 (LAW)
Plant Wash Vessel

- Design Temperature (°F)(max/min): 200/-23
- Design Pressure (psig) (internal/external): 15/FV
- Location: incell

Offspring items
RLD-AGT-00001

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 Modes Considered:

- Normal operation

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

Material Required: UNS N08367/N08926

Top head: 316 (max 0.030% C; dual certified)

Note: Vessel upgraded to 6% Mo because it will be used as a back-up for RLD-VSL-00005.

Recommended Corrosion Allowance: 0.04 inch (includes 0.024 inch corrosion allowance and 0.004 inch erosion allowance)

Process & Operations Limitations:

- Develop rinsing/flushing procedure
- Develop lay-up strategy

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Concurrence DMB
Operations

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	MET	APPROVER
4	3/14/06	Modify operating description	DLAdler	HMKrafft	NA	SWVail

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REVISION HISTORY

3	5/25/05	Update wear allowance based on 24590-WTP-RPT-M-04-0008	DLAdler	JRDivine	NA	APRangus
2	6/30/04	Incorporate new PCDS Add Section p – Inadvertent Addition of Nitric Acid	DLAdler	JRDivine	NA	APRangus
1	11/18/03	Update design temp/pressure Specify mat'l for top head Append updated MSDS Editorial Changes Re-format references Add DWP note	DLAdler	JRDivine	NA	APRangus
0	4/22/02	Initial Issue	JRDivine	DLAdler	SS	BPosta
REV	**DATE**	**REASON FOR REVISION**	**PREPARER**	**CHECKER**	**MET**	**APPROVER**

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Corrosion Considerations:

RLD-VSL-00003 routinely receives effluent and overflow from the SBS condensate collection vessel, effluent from the C1/C2 and the C3/C5 drains/sump collection vessels and sump discharges. During off-normal events, RLD-VSL-00003 receives off-spec feed from the concentrate receipt vessels. While the normal operating temperature ranges from 59 to 68 °F, an overflow or transfer from RLD-VSL-00005 could take the temperature up to 104 °F. This condition is considered non-routine. Vessel is equipped with a mechanical agitator to keep solids in suspension.

a General Corrosion
In the proposed pH operating range, no specific information was found for the general/uniform corrosion of stainless steels or other material in the given waste. However, the austenitic and higher alloy steels typically have low corrosion rates, < 1 mpy, in the given environment even at the maximum temperature. This lack of data is not critical because the alloys needed for the system generally fail by pitting, crevice corrosion, or cracking.

Assuming the stated normal operating conditions are correct, 304L will be acceptable with a small uniform corrosion rate.

Conclusion:
Under normal operating conditions, 304L, 316L, or better will be acceptable.

b Pitting Corrosion
Normally the vessel is to operate between 59 and 68°F at a pH range of 1 to 8 with a minimum of halides. Berhardsson (1981) et al conclude 304L or 316L could be used based on temperatures and stated low-chloride conditions. However, at the stated non-routine concentrations of halides, a 6% Mo would be desirable.

If the vessel were filled with process water and left stagnant, there would be a tendency to pit. The time to initiate would depend on the source of the water, being shorter for filtered river water and longer for DIW. Pitting has been observed in both cases.

Conclusion:
Based on the stated normal operating conditions, 304L and 316L are acceptable.

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 cause stress corrosion cracking is unknown. In part this is because the amount varies with temperature, metal sensitization, and the environment. But 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. Generally, as seen in Sedriks (1996) and Davis (1987), stress corrosion cracking does not usually occur below about 140°F. With the proposed conditions, 304L will be acceptable.

Conclusion:
304L is expected to be satisfactory.

e Crevice Corrosion
Few solids are expected under normal conditions and crevice corrosion should be a minimum.

Conclusion:
Also see Pitting

f Corrosion at Welds
Corrosion at welds is not considered a problem in the proposed environment.

Conclusion:
Weld corrosion is not considered a problem for this system.

g Microbiologically Induced Corrosion (MIC)
The proposed operating conditions are suitable for microbial growth, but the system is downstream of the main entry points of microbes.

Conclusion:
MIC is not considered a problem.

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h Fatigue/Corrosion Fatigue
Corrosion fatigue is a not expected to be a problem if the piping and nozzles are properly supported.

Conclusions
Not expected to be a concern.

i Vapor Phase Corrosion
Vapor phase corrosion is not expected to be a concern.

Conclusion:
Not a concern.

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. Because of the low pH, the agitator blade can be Ultimet but it is not considered necessary. Using the same material for the agitator as the vessel is satisfactory.

Conclusion:
Not expected to be a problem.

k Galling of Moving Surfaces
Not applicable.

Conclusion:
Not applicable.

l Fretting/Wear
No contacting surfaces expected.

Conclusion:
Not applicable.

m Galvanic Corrosion
No significantly 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 for metallic vessels.

Conclusion:
Not applicable.

p Inadvertent Nitric Acid Addition
At this time, the design does not provide for the presence of nitric acid reagent in this system. Additionally, the vessel sees low pH under normal operating conditions.

Conclusion:
Not applicable.

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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. Berhardsson, S, R Mellstrom, and J Oredsson, 1981, *Properties of Two Highly Corrosion Resistant Duplex Stainless Steels*, Paper 124, presented at Corrosion 81, NACE International, Houston, TX 77218
4. Davis, JR (Ed), 1987, *Corrosion, Vol 13*, In "Metals Handbook", ASM International, Metals Park, OH 44073
5. Sedriks, AJ, 1996, *Corrosion of Stainless Steels*, John Wiley & Sons, Inc., New York, NY 10158

Bibliography:

1. Agarwal, DC, *Nickel and Nickel Alloys*, In: Revie, WW, 2000. *Uhlig's Corrosion Handbook*, 2nd Edition, Wiley-Interscience, New York, NY 10158
2. Davis, JR (Ed), 1994, *Stainless Steels*, In ASM Metals Handbook, ASM International, Metals Park, OH 44073
3. Hamner, NE, 1981, *Corrosion Data Survey*, Metals Section, 5th Ed, NACE International, Houston, TX 77218
4. Jones, RH (Ed.), 1992, *Stress-Corrosion Cracking*, ASM International, Metals Park, OH 44073
5. Koch, GH, 1995, *Localized Corrosion in Halides Other Than Chlorides*, MTI Pub No. 41, Materials Technology Institute of the Chemical Process Industries, Inc, St Louis, MO 63141
6. Phull, BS, WL Mathay, & RW Ross, 2000, *Corrosion Resistance of Duplex and 4-6% Mo-Containing Stainless Steels in FGD Scrubber Absorber Slurry Environments*, Presented at Corrosion 2000, Orlando, FL, March 26-31, 2000, NACE International, Houston TX 77218.
7. Uhlig, HH, 1948, *Corrosion Handbook*, John Wiley & Sons, New York, NY 10158
8. Van Delinder, LS (Ed), 1984, Corrosion Basics, NACE International, Houston, TX 77084
9. Wilding, MW and BE Paige, 1976, *Survey on Corrosion of Metals and Alloys in Solutions Containing Nitric Acid*, ICP-1107, Idaho National Engineering Laboratory, Idaho Falls, ID

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

PROCESS CORROSION DATA SHEET

Component(s) (Name/ID #) Plant wash vessel (RLD-VSL-00003)

Facility LAW

In Black Cell? No

Chemicals	Unit[1]	Contract Maximum		Non-Routine (Note 3)		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/l	4.06E-02		5.06E-02	5.11E-02	
Chloride	g/l	1.17E-02		1.22E+01	1.34E+01	
Fluoride	g/l	7.04E-03		2.60E+00	2.87E+00	
Iron	g/l	1.37E-03		2.62E-02	2.54E-02	
Nitrate	g/l	1.58E-01		2.35E+00	1.96E+00	
Nitrite	g/l	3.13E-02				
Phosphate	g/l	2.41E-02				
Sulfate	g/l	1.20E-02				
Mercury	g/l	6.19E-04		9.91E-01	3.44E-02	
Carbonate	g/l	8.41E-02				
Undissolved solids	wt %			1.4%	1.3%	
Other (Pb)	g/l	3.02E-04		6.10E-03	3.84E-04	
Other	g/l					
pH	N/A					Note 4
Temperature	°F					Note 2, Note 3

List of Organic Species:

References

System Description: 24590-LAW-3YD-30-00001, Rev 0
Mass Balance Document: 24590-WTP-M4C-V11T-00005, Rev A
Normal Input Stream #: RLD25
Off Normal Input Stream # (e.g., overflow from other vessels): N/A
P&ID: 24590-LAW-M6-RLD-00001, Rev 2
PFD: 24590-LAW-M5-V17T-00014, Rev 4
Technical Reports: N/A

Notes:

1. Concentrations less than 1x 10^{-4} g/l do not need to be reported; list values to two significant digits max.
2. T operation 59 °F (BOD) to 88 °F (24590-LAW-3YD-20-00001, Rev 0, p. C-2)
3. Non routine: T operation 59 °F to 104 °F is overflow or transfer from RLD-VSL-00005.
4. pH 1 to 8 (CCN 063607)

Assumptions:

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Plant Wash Vessel (RLD-VSL-00003)

Routine Operations

The plant wash vessel is normally empty, but effluent sources for the plant wash vessel (RLD-VSL-00003) include:

- Vessel washes
- Off-specification batches and washdown from the concentrate receipt vessels, melter feed prep vessels and melter feed vessels
- Effluent from the SBS condensate collection vessel (RLD-VSL-00005) under off-normal operations
- Effluents from the C1/C2 drain/sump collection vessel (NLD-VSL-00005)
- Effluent from the C3/C5 drain/sump collection vessel (RLD-VSL-00004)
- The overflow from the SBS condensate collection vessel (RLD-VSL-00005)
- Sump discharges from the process cells and the liquid effluent cells

This vessel is designed to handle the largest volume from any vessel/equipment wash or drain in the LAW vitrification facility. The largest volume is from the SBS condensate collection vessel (RLD-VSL-00005). If both the plant wash vessel (RLD-VSL-00003) and the SBS condensate collection vessel (RLD-VSL-00005) are full and sample results have not been determined, or if the PT facility cannot receive the contents, then transfer will not be initiated. The plant wash vessel (RLD-VSL-00003) and the SBS condensate collection vessel (RLD-VSL-00005) are located in the same room.

The vessel is equipped with a mechanical agitator to maintain solids in suspension.

The plant wash pumps (RLD-PMP-00001A/B) are in-vessel vertical pumps and can be routed to various locations via the RLD pump bulge (RLD-BULGE-00004). Sampling capability is provided using a sampling leg off the pump recirculation line to an autosampler unit. The collected effluent, including plant wash vessel (RLD-VSL-00003) vessel washings, will be periodically pumped to the PT facility plant wash vessel (PWD-VSL-00044).

Non-Routine Operations that Could Affect Corrosion/Erosion

- The vessel can also be washed via internal spray nozzles.
- Receives overflows from RLD-VSL-00005.
- Though not a routine operation, if the need arises, the plant wash vessel (RLD-VSL-00003) contents can be transferred to the SBS condensate collection vessel (RLD-VSL-00005), and vice versa.
- Though not expected to be a routine operation, reagents can be introduced into the vessel through the spray nozzles for chemical adjustment of the vessel contents.

Mechanical agitators on the plant wash vessel (RLD-VSL-00003) and pumps with recirculation capability are operated to suspend captured solids. Suspended solids are entrained into the effluent and are periodically removed from the vessels when the vessel contents are pumped to the specified vessel in the PT facility. If necessary, vessels can be flushed with water.