PLANT ITEM MATERIAL SELECTION DATA SHEET

R10668000

LCP-VSL-00001 & LCP-VSL-00002 (LAW)
LAW Concentrate Receipt Vessel

- Design Temperature (°F)(max/min): 150/40
- Design Pressure (psig) (max/min): 15/FV
- Location: process cell

Offspring items

LCP-AGT-00001 -- LCP-AGT-00002

ISSUED BY
RPP-WTP PDC

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Operating conditions are as stated on attached Process Corrosion Data Sheet

Cannot be maintained during the 40 year design life.

Options Considered:

- The vessel is filled with waste at up to 122°F.
- The vessel will be washed with process water or caustic.

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: 316 (max 0.030% C; dual certified)

Recommended Corrosion Allowance: 0.040 inch (includes 0.024 inch corrosion allowance and 0.016 inch general erosion allowance)

Process & Operations Limitations:

- Develop rinsing/flushing procedure for acid and water.
- Develop lay-up strategy.

STEVEN WAKEMAN VAIL
STATE OF WASHINGTON
39250
REGISTERED PROFESSIONAL ENGINEER
3/14/06
EXPIRES: 12/07/07

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Corrosion Considerations:

Vessels receive waste for melter feed. Operating temperature range is 77 to 150°F, with a nominal operating temperature of 122°F, and operating pH range is 11 to 14.5. Spray nozzles are present to spray inside of vessel with demineralized water. NaOH is also available to the spray nozzles. Vessels have mechanical agitators and internal transfer pumps.

a General Corrosion
Hamner (1981) lists a corrosion rate for 304 (and 304L) in NaOH of less than 20 mpy (500 μm/y) at 77°F and over 20 mpy at 122°F. He also states 316 (and 316L) has a rate of less than 2 mpy in 50% NaOH at temperatures up to 122°F. Dillon (2000) and Sedriks (1996) both state that the 300 series stainless steels are acceptable in up to 50% NaOH at temperatures up to about 122°F or slightly above. The corrosion rate for 304L in pure NaOH is expected to be less than about 1 mpy up to about 212°F though Sedriks states the data beyond about 122°F are incorrect due to the presence of oxidizing agents.

In this system, the normal pH, nitrate concentrations and temperatures are such that 304L and 316L stainless steels will be acceptable.

Conclusion:
304L or 316L is expected to be sufficiently resistant to the waste solution with a probable general corrosion rate of less than 1 mpy.

b Pitting Corrosion
Chloride is known to cause pitting of stainless steels and related alloys in acid and neutral solutions. Dillon (2000) is of the opinion that in alkaline solutions, pH>12, chlorides are likely to promote pitting only in tight crevices such as might form after partial removal of deposits during multiple rinse cycles. Dillon and Koch (1995) are both of the opinion that fluoride will have little effect in an alkaline media.

The nominal operating temperature for these vessels is 122 °F. At this temperature, 304L or 316L stainless steels would be acceptable in the proposed alkaline-nitrate waste.

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, probably because residual chlorides are likely to remain.

Conclusion:
Localized corrosion, such as pitting, is common but can be mitigated, if caused by chlorides, using alloys with higher nickel and molybdenum contents. Based on the expected operating conditions, 316L is expected to be satisfactory.

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

Conclusion:
Not applicable to 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, the environment and also 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), chloride stress corrosion cracking does not usually occur below about 140 °F. With the proposed temperatures, 316L is recommended.

Conclusion:
At the normal operating conditions, 316L stainless is the minimum recommended.

e Crevice Corrosion
See Pitting.

Conclusion:
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 under normal operating conditions.

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

Conclusion:
Not a concern.

h Fatigue/Corrosion Fatigue
Corrosion fatigue does not appear to be a concern.

Conclusions
Not expected to be a concern.

i Vapor Phase Corrosion
Vapor phase corrosion will be a function of the degree of agitation, solution chemistry, and temperature. Under the stated conditions, and with the presence of wash rings in the vessel, vapor phase corrosion does not appear to be a concern.

Conclusion:
Not expected to be a concern.

j Erosion
Velocities within the vessel are expected to be small. Based on 24590-WTP-RPT-M-04-0008, a general erosion allowance of 0.016 inch is adequate for components with solids content less than 27.3 wt%.

Conclusion:
Not expected 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 significantly dissimilar metals are present.

Conclusion:
Not expected to be a concern.

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
At this time, the design does not provide for the presence of nitric acid reagent in this system.

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. Davis, JR (Ed), 1987, *Corrosion, Vol 13*, In "Metals Handbook", ASM International, Metals Park, OH 44073
4. Dillon, CP (Nickel Development Institute), Personal Communication to J R Divine (ChemMet, Ltd., PC), 3 Feb 2000.
5. Hamner, NE, 1981, *Corrosion Data Survey*, Metals Section, 5th Ed, NACE International, Houston, TX 77218
6. 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
7. 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. Anderson, TD, 21 December 2000, to JR Divine: No provision for adding nitric or other acid.
3. Davis, JR (Ed), 1994, *Stainless Steels*, In ASM Metals Handbook, ASM International, Metals Park, OH 44073
4. Jones, RH (Ed.), 1992, *Stress-Corrosion Cracking*, ASM International, Metals Park, OH 44073
5. Ohl, PC to PG Johnson, Internal Memo, Westinghouse Hanford Co, *Technical Bases for Cl- and pH Limits for Liquid Waste Tank Cars*, MA: PCO:90/01, January 16, 1990.
6. Uhlig, HH, 1948, *Corrosion Handbook*, John Wiley & Sons, New York, NY 10158
7. Van Delinder, LS (Ed), 1984, *Corrosion Basics*, NACE International, Houston, TX 77084
8. Zapp, PE, 1998, *Preliminary Assessment of Evaporator Materials of Construction*, BNF—003-98-0029, Rev 0, Westinghouse Savannah River Co., Inc for BNFL Inc.

PLANT ITEM MATERIAL SELECTION DATA SHEET

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

PROCESS CORROSION DATA SHEET

Component(s) (Name/ID #) LAW concentrate receipt vessel (LCP-VSL-00001, LCP-VSL-00002)

Facility LAW

In Black Cell? No

Chemicals	Unit[1]	Contract Maximum		Non-Routine		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/l	3.87E+01	3.53E+01			
Chloride	g/l	1.84E+01	2.00E+01			
Fluoride	g/l	1.84E+01	2.01E+01			
Iron	g/l	2.84E+00	2.90E+00			
Nitrate	g/l	2.73E+02	2.89E+02			
Nitrite	g/l	8.22E+01	8.93E+01			
Phosphate	g/l	5.93E+01	6.30E+01			
Sulfate	g/l	3.16E+01	3.43E+01			
Mercury	g/l	9.46E-02	3.16E-02			
Carbonate	g/l	1.29E+02	1.11E+02			
Undissolved solids	wt%	5.0%	4.8%			
Other (Pb)	g/l	6.89E-01	2.94E-02			
Other	g/l					
pH	N/A					Note 2
Temperature	°F					Note 3, Note 4

List of Organic Species:

References

System Description: 24590-LAW-3YD-LCP-00001, Rev 0
Mass Balance Document: 24590-WTP-M4C-V11T-00005, Rev A
Normal Input Stream #: TCP03/LCP01
Off Normal Input Stream # (e.g., overflow from other vessels):
P&ID: 24590-LAW-M6-LCP-P0001, 24590-LAW-M6-LCP-P0002, Rev 1
PFD: 24590-LAW-M5-V17T-P0001, -P0002, Rev 0
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. pH 11 to 14.5 (24590-WTP-M4C-V11T-00005, Rev A)
3. T operation 77 °F to 150 °F, T nominal 122 °F(24590-LAW-MVC-LFP-00001, Rev C)
4. The 150 F is maximum temperature from pretreatment and no additional design margin is required.

Assumptions:

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6.1.1. LAW Concentrate Receipt Vessels (LCP-VSL-00001 and LCP-VSL-00002)

Routine Operations

LAW concentrate receipt vessels (CRV) are designed for receiving waste for melter feed. The equipment associated with the CRVs that promote decontamination and decommissioning includes:

- The internal spray nozzles that spray the inside of the vessel with demineralized water
- Flushing the inside of the vessel with demineralized water (from spray nozzles or transfer from the PT facility) draining of the vessel heel, use of other decontamination solutions (NaOH and so on) through header connections to the spray nozzles during final decontamination and decommissioning

Each LAW CRV is equipped with the following:

- Mechanical agitator (LCP-AGT-00001, -00002)
- Two 100 % pumps (LCP-PMP-00001A/B, -00002A/B) to transfer LAW concentrate
- Internal rotary spray nozzles for periodic wash-down
- Overflow to RLD-VSL-00004, C3/C5 drains/sump collection vessel via a common overflow header
- Pressure, level (redundant), temperature, and density instruments

Non-Routine Operations that Could Affect Corrosion/Erosion

- Overflows to RLD-VSL-00004
- Washing required on failure of agitator