PLANT ITEM MATERIAL SELECTION DATA SHEET

R10667003

ISSUED BY
RPP-WTP PDC

RLD-VSL-00017-A/B (PTF)
Alkaline Effluent Vessels

- Design Temperature (°F)(max/min): 180/40
- Design Pressure (psig) (max/min): 15/FV
- Location: out cell

Contents of this document are Dangerous Waste Permit affecting

Operating conditions are as stated on attached Process Corrosion Data Sheet

Operating Modes Considered:

- Normal operating conditions

Materials Considered:

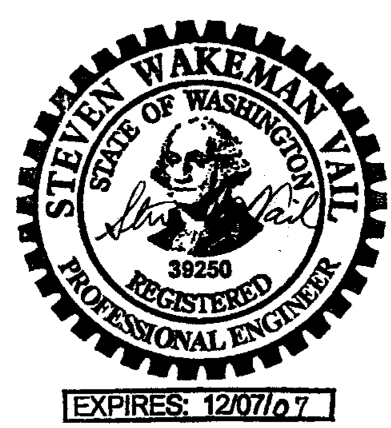
Material (UNS No.)	Relative Cost	Acceptable Material	Unacceptable Material
Carbon Steel	0.23		X
304L (S30403)	1.00	X	
316L (S31603)	1.18	X	
6% Mo (N08367/N08926)	7.64	X	
Alloy 22 (N06022)	11.4	X	
Ti-2 (R50400)	10.1		X

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

Recommended Corrosion Allowance: 0.08 inch (includes 0.024 inch corrosion allowance and 0.004 inch erosion allowance)

Process & Operations Limitations:

- Develop rinsing/flushing procedure for acid or water.



3/8/06

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This bound document contains a total of 7 sheets.

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	APPROVER
2	3/8/06	Issued for Permitting Use			
1	1/25/05	Issued for Permitting Use	DLA	JRD	SWV
0	2/17/04	Issued for Permitting Use	DLA	JRD	APR

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Corrosion Considerations:

These vessels will normally receive caustic effluent from LVP-VSL-00001, spent reagents from CRP-VSL-00001 and potentially active material from PWD-VSL-00046.

a General Corrosion
Hamner's data (1981) shows 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 shows 316 (and 316L) has a rate of less than 2 mpy up to 122°F and 50% NaOH. Dillon (2000) and Sedriks (1996) both state that the 300 series alloys are acceptable in up to 50% NaOH at temperatures up to about 122°F or slightly above. Divine's work (1986) with simulated-radwaste evaporators, six months at 140°F, showed 304L was slightly more resistant to corrosion (<0.2 mpy) than was 316L (<0.6 mpy); Ni 200, pure nickel, was much less resistant (≈7 mpy) probably due to the complexants. Zapp (1998) notes that the Savannah River evaporator vessels, operating at about 300°F, are made of 304L and have suffered no failures in about 30 years; 304L heat transfer surfaces have failed however after about 10 years.

Davis (1994) states the corrosion rate for 304L in pure NaOH will be less than about 0.1 mpy up to about 212°F though Sedriks (1996) states the data beyond about 122°F are incorrect. Danielson and Pitman (2000), based on short term studies, suggest a corrosion rate of about 0.5 mpy for 316L in simulated waste at boiling, >212°F.

Ohl and Carlos (1994), in their review of the 242-A Evaporator, found in waste similar to that expected in LAW, the corrosion of 304L after about two years of operation at 140°F was less than the accepted variability of the plate. Because of uncertainties in the starting thickness of the metal, a review of the raw data was inconclusive.

Uhlig (1948) has shown that pure nickel is resistant to corrosion by NaOH. However, as Divine (1986) pointed out, the presence of complexing agents may reverse the trend. Agarwal (2000) states that the higher nickel alloys, such as C-22, are highly corrosion resistant though specific mention of alkaline media is not made. The general literature mainly discusses cracking problems (see below) rather than uniform corrosion.

In these vessels, the hydroxide concentration will be significantly lower as is the temperature; thus, the corrosion rates will be smaller.

Conclusion:
At temperatures less than about 140°F, 304L or 316L are expected to be sufficiently resistant to the waste solution with a probable general corrosion rate of less than 1 mpy. Based on the Savannah River experience with Hanford-like waste at higher temperatures, 304L is expected to be satisfactory to 180°F. Rinsing procedure should be developed to minimize effects of acid in the presence of fluoride. A 0.08 inch corrosion allowance is recommended to compensate for the possibility of high fluoride concentrations in acid conditions.

b Pitting Corrosion
Chloride is known to cause pitting 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. Dillon and Koch (1995) are of the opinion that fluoride will have little effect. Jenkins (1998) has stated that localized corrosion can occur under the deposits on tubes, probably due to the chlorides. Further, Revie (2000) and Uhlig (1948) note that nitrates inhibit chloride pitting. Wilding and Paige (1976) note that nitric acid inhibits chloride attack though their data are at higher temperatures and concentrations.

Conclusion:
Localized corrosion, such as pitting, is not expected to be a concern at the normal operating conditions. 304L is 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, 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. The "L" grades are also more resistant to cracking than the higher carbon versions. If the concentrations are as stated, stress corrosion cracking will be minimized.

Conclusion:
Because of the normal operating environment 304L stainless steel is expected to be acceptable even to 180 °F.

e Crevice Corrosion
For the most part, the pitting discussion covers this area.

Conclusion:
See Pitting

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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 temperatures are slightly high for microbial growth. Additionally, the location of the system in the process suggests little chance of the introduction of microbes.

Conclusion:
MIC is not expected to be a problem.

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

Conclusions
Not considered to be a problem.

i Vapor Phase Corrosion
The vapor phase portion of the vessel will be spattered with solution and pitting or crevice corrosion may be a concern. A rinsing procedure should be developed to minimize the formation of deposits.

Conclusion:
Provided deposits are not allowed to remain, vapor phase corrosion is 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.

Conclusion:
Not expected to be a concern.

k Galling of Moving Surfaces
Not applicable.

Conclusion:
Not applicable.

l Fretting/Wear
Not expected to be applicable.

Conclusion:
Not a concern.

m Galvanic Corrosion
For the environment and the proposed alloys, there is not believed to be a concern.

Conclusion:
Not 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.

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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:

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

PROCESS CORROSION DATA SHEET

Component(s) (Name/ID #) Alkaline effluent vessel (RLD-VSL-00017A/B)

Facility PTF

In Black Cell? No

Chemicals	Unit[1]	Contract Maximum		Non-Routine		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/l					
Chloride	g/l	8.16E-01	1.78E+00			
Fluoride	g/l	2.09E+00	4.55E+00			
Iron	g/l					
Nitrate	g/l	3.62E+00	7.88E+00			
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-RDP-00001, Rev 0
Mass Balance Document: 24590-WTP-M4C-V11T-00005, Rev A
Normal Input Stream #: LVP21, RLD09
Off Normal Input Stream # (e.g., overflow from other vessels): See section 4.11.2, Non-routine Operations
P&ID: 24590-PTF-M6-RLD-P0003, Rev 0
PFD: 24590-PTF-M5-V17T-P0022004, Rev 0
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. T normal operation 59 °F to 125 °F, nominal 111 °F (24590-PTF-MVC-RLD-00004, Rev 0); could receive caustic scrubber purge non routinely at 125 °F
3. pH approximately 13 to 15

Assumptions:

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4.11.2 Alkaline Effluent Vessel (RLD-VSL-00017 A/B)

Routine Operations

During normal operations, RLD-VSL-00017A will receive the following feeds:

- Caustic effluent from caustic collection vessel LVP-VSL-00001
- Caustic effluent from a future caustic collection vessel
- Spent reagents from CRP-VSL-00001
- Potentially active material from the C3 drain vessel PWD-VSL-00046

Non-Routine Operations that Could Affect Corrosion/Erosion

During non-routine operations, RLD-VSL-00017A/B will receive the following feeds:

- Process condensate area sump RLD-SUMP-00003
- PWD-VSL-00045 contents that do not meet BOF transfer criteria
- Overflow from reagent vessels (from floor berms of SHR-TK-00009, DIW-TK-00001/SHR-TK-00001, and NAR-TK-00007)
- Potentially active material from non-radioactive liquid effluent tank in BOF (NLD-TK-00001)