PLANT ITEM MATERIAL SELECTION DATA SHEET

R10667002

PWD-VSL-00033, (PTF)
Ultimate Overflow Vessel

- Design Temperature (°F)(max/min): 225/0
- Design Pressure (psig) (max/min): 15/FV
- Location: out cell
- PJM Discharge Velocity (fps): 40
- Drive Cycle: 17 % (at 40 fps)

ISSUED BY
RPP-WTP PDC

Offspring items

PWD-VSL-00131, PWD-VSL-00132
PWD-PJM-00031– PWD-PJM-00038,
PWD-RFD-00131, PWD-RFD-00132

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 which can range from acidic to alkaline
- Alkaline conditions at elevated temperature
- Acid conditions with elevated halides and temperatures, such as would occur if the tank contained a volume of alkaline waste and two or three volumes of 5 N nitric acid were added.

Materials Considered:

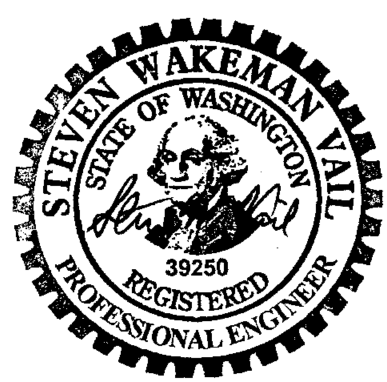
Material (UNS No.)	Relative Cost	Acceptable Material	Unacceptable Material
Carbon Steel	0.23		X
304L (S30403)	1.00		X
316L (S31603)	1.18	X	
6% Mo (N08367/N08926)	7.64	X	
Alloy 22 (N06022)	11.4	X	
Ti-2 (R50400)	10.1		X

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; localized protection required as discussed in section j)

Process & Operations Limitations:

- Develop rinsing/flushing procedure for acid and water.
- Develop a recovery procedure for non-routine vessel overflows.



3/8/06

EXPIRES: 12/07/07

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This bound document contains a total of 8 sheets.

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	APPROVER
2	3/8/06	Issued for Permitting Use	[signature]	[signature]	[signature]
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Corrosion Considerations:

PWD-VSL-00033 receives material from various sources including drains and flushes from waste feed and transfer lines, drains in the C5/R5 cells and bulges, and plant wash from RLD-VSL-00008. During non-routine operations, this vessel could receive overflow material from most systems within Pretreatment.

a General Corrosion
Under normal operation, the concentrations of most chemicals will be sufficiently low that 304L will be satisfactory. Further, in this vessel, the temperatures normally will be sufficiently low that uniform corrosion will not be a concern, the main exceptions being non-routine operations or from ultrafilter cleaning. The amount of fluoride is expected to be small although ultrafilter washing with nitric acid might result in a high acidic fluoride concentration. Wilding and Paige (1976) have shown that in 5% nitric acid with 1000 ppm fluoride at 290°F, the corrosion rate of 304L can be as high as 5 mpy.

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 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 are acceptable in up to 50% NaOH at temperatures up to about 122°F or slightly above. Divine's work 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 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. Ohl & Carlos, in their review of the 242-A Evaporator, found in waste similar to that expected, the corrosion of 304L after about two years of operation at 140°F was less than the accepted variability of the plate.

Davis (1987) states the corrosion rate for 304L in pure NaOH will be less than about 0.11 mpy up to about 212°F though Sedriks (1996) states the data beyond about 122°F are low due to oxidizing agents. Danielson & 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.

Conclusion:
If the temperature were to remain in the stated operating conditions and the environment were alkaline, 304L would be marginally satisfactory with 316L better.

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 the data are at higher temperatures and concentrations.

Conclusion:
Localized corrosion, such as pitting, is common and would be a concern in waste with the expected maximum halide levels. However, the presence of nitrate will mitigate their effects. Under normal conditions with agitation, 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, 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. If the concentrations are as stated, stress corrosion cracking will be minimized. Although caustic cracking is possible above 140°F, it is not expected under these conditions, probably due to the presence of oxidizing species such as nitrate.

Conclusion:
Because of the normal operating environment, 316L stainless steel is expected to be acceptable.

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e Crevice Corrosion
For the most part, the pitting discussion covers this area. Should acid cleaning be used, the presence of excessive heat tint (darker than a light or straw yellow) could lead to crevice corrosion.

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.

g Microbiologically Induced Corrosion (MIC)
The proposed operating temperatures are suitable for microbial growth, but the location of the system in the process suggests little chance of the introduction of microbes. Further, the alternation between acidic and alkaline conditions is not conducive to their growth.

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.

Conclusion:
Pitting is a possible concern but is covered by the pitting discussion.

j Erosion
Based on past experiments by Smith & Elmore (1992), the solids are soft and erosion is not expected to be a concern for the vessel wall. Based on 24590-WTP-RPT-M-04-0008, a general erosion allowance of 0.016 inch is adequate for components with maximum solids content up to 27.3 wt%. Additional 316L stainless steel should be provided as localized protection for the applicable portions of the bottom head to accommodate PJM discharge velocities of up to 12 m/s with solids concentrations of 26.7 wt% for a usage of 19 % operation as documented in 24590-WTP-M0C-50-00004. PWD-VSL-00033 requires at least 0.083-inch additional protection. The 26.7 wt% is considered to be conservative and is based on the WTP Prime Contract maximum. During normal operation, the solids content of PWD-VSL-00033 is expected to be well below the anticipated maximum.

The wear of the PJM nozzles can occur from flow for both the discharge and reflood cycles of operation. At least 0.053-inch of additional 316L stainless steel should be provided on the inner surface of the PJM nozzle to accommodate wear due to PJM discharge and suction velocities with solids concentrations of 26.7 wt% for usage of 19 % operation as documented in 24590-WTP-M0C-50-00004.

Conclusion:
The recommended corrosion allowance provides sufficient protection for erosion of the vessel wall. Additional localized protection for the bottom head will accommodate PJM discharge velocities and for the PJM nozzles will accommodate PJM discharge and reflood velocities.

k Galling of Moving Surfaces
Not applicable.

Conclusion:
Not applicable.

l Fretting/Wear
Not expected to be applicable.

Conclusion:
Not a concern.

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m Galvanic Corrosion
For the environment and the proposed alloys, galvanic corrosion 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.

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.

PLANT ITEM MATERIAL SELECTION DATA SHEET

References:

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2. 24590-WTP-RPT-M-04-0008, Rev. 2, *Evaluation Of Stainless Steel Wear Rates In WTP Waste Streams At Low Velocities*
3. 24590-WTP-RPT-PR-04-0001, Rev. B, *WTP Process Corrosion Data*
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3. Agarwal, DC, *Nickel and Nickel Alloys*, In: Revie, WW, 2000. *Uhlig's Corrosion Handbook*, 2nd Edition, Wiley-Interscience, New York, NY 10158
4. Jones, RH (Ed.), 1992, *Stress-Corrosion Cracking*, ASM International, Metals Park, OH 44073
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24590-WTP-RPT-PR-04-0001, Rev. B
WTP Process Corrosion Data

PROCESS CORROSION DATA SHEET

Component(s) (Name/ID #) Ultimate overflow vessel (PWD-VSL-00033)

Facility PTF

In Black Cell? No

Chemicals	Unit[1]	Contract Maximum		Non-Routine (Note 3)		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/l			9.79E+01	7.25E+01	
Chloride	g/l			4.24E+01	3.14E+01	
Fluoride	g/l			5.08E+01	3.76E+01	
Iron	g/l			1.88E+02	1.27E+02	
Nitrate	g/l			6.83E+02	5.80E+02	
Nitrite	g/l			2.34E+02	1.73E+02	
Phosphate	g/l			1.67E+02	1.23E+02	
Sulfate	g/l			9.00E+01	6.66E+01	
Mercury	g/l			1.31E+00	1.83E+00	
Carbonate	g/l			2.57E+02	1.91E+02	
Undissolved solids	wt%			26.7%	26.5%	Note 5
Other (NaMnO4, Pb,...)	g/l					
Other	g/l					
pH	N/A					Note 4
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 #: NA
Off Normal Input Stream # (e.g., overflow from other vessels): Note 3
P&ID: 24590-PTF-M6-PWD-P0002, Rev 2
PFD: 24590-PTF-M5-V17T-P0022001, 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 77 °F (24590-PTF-MVC-PWD-00029, Rev 0)
3. Receives streams from FRP-VSL-00002ABCD, FEP-VSL-00017AB, FEP-VSL-00005, TLP-VSL-00009, TCP-VSL-00001, HLP-VSL-00022, HLP-VSL-00027AB, HLP-VSL-00028, UFP-VSL-00002, UFP-VSL-00062AB, CXP-VSL-00001, CXP-VSL-00005, CXP-VSL-00026ABC, RDP-VSL-00002, CNP-VSL-00003/4, CNP-DIST-00001, CNP-EVAP-00001, PVP-HEME-00001ABC, PVP-VSL-00001, PWD-VSL-00015/16/43/44, RLD-VSL-00017AB
4. Receives numerous streams, mainly highly basic (pH 13 to 14), with the exception of the RDP and CNP component streams which can be as low as pH 0.2
5. Overflow is diluted to Newtonian fluid with water as soon as normal operation is achieved. Expected minimum dilution ratio 1.5.

Assumptions:

4.9.11 Ultimate Overflow Vessel (PWD-VSL-00033)

Routine Operations

PWD-VSL-00033 is located at the -45 ft level in a pit that allows limited remote access to equipment. It has a batch volume of 15,000 gallons. The vessel is sized to handle the highest overflow rate for 30 minutes and/or match the size of PWD-VSL-00043 since both of these vessels are in the pit of the PT facility.

Vessel PWD-VSL-00033 receives material during normal operations from the following sources:

- Pipe and annulus drains and flushes from waste feed and transfer lines between facilities
- Gravity drains from C5/R5 cells located above elevation 0 ft 0 in.
- All gravity drains from C5/R5 process bulges
- C5 floor drains
- All gravity drains from C5/R5 sample cabinets
- Line flushes from the laboratory drains
- Plant wash from RLD-VSL-00008 via RLD-BRKPT-00004
- C3 overflow and drain headers
- An air in-bleed and forced purge air are provided to dilute hydrogen generated in vessel PWD-VSL-00033. Wash rings are used for vessel washing. RFDs transfer the effluent from PWD-VSL-00033 to PWD-VSL-00044.
- Reverse flow diverters transfer the effluent from vessel PWD-VSL-00033 to PWD-VSL-00044.
- Vessel PWD-VSL-00033 vents to the vessel vent caustic scrubber (PVP-SCB-00002) via the vessel vent header.

Non-Routine Operations that Could Affect Corrosion/Erosion

- Vessel PWD-VSL-00033 initially overflows to PWD-VSL-00043 and ultimately to PWD-SUMP-00040. Ejectors are used to transfer the sump contents to vessel PWD-VSL-00043 or back to PWD-VSL-00033.
- During flooding of the hot cell, vessel PWD-VSL-00033 receives discharge from hot cell east cell floor drain PWD-FD-00006.
- A vessel-emptying ejector is used for non-routine transfers to the plant wash vessel (PWD-VSL-00044) via PWD-BRKPT-00008. This ejector uses process condensate as a motive force instead
- of steam.
- During abnormal operations, vessel PWD-VSL-00033 receives overflow material from the following sources. Most of these sources will enter PWD-VSL-00033 via one of two headers, either the C5 overflow header or the C3 overflow header.
  - Waste feed receipt vessels (FRP-VSL-00002A/B/C/D)
  - Waste feed evaporator feed vessels (FEP-VSL-00017A/B)
  - Waste feed evaporator condensate vessel (FEP-VSL-00005)
  - HLW effluent transfer vessel (PWD-VSL-00043)

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- Ultrafiltration feed preparation vessels (UFP-VSL-00001A/B)
- Ultrafiltration feed vessels (UFP-VSL-00002A/B)*
- Ultrafilter permeate collection vessels (UFP-VSL-00062A/B/C)
- Cs IX feed vessel (CXP-VSL-00001)
- Cs IX caustic rinse collection vessel (CXP-VSL-00004)
- Cs IX reagent vessel (CXP-VSL-00005)
- Eluate contingency storage vessel (CNP-VSL-00003)
- Cs evaporator recovered nitric acid vessel (CNP-VSL-00004)
- Acidic/alkaline effluent vessels (PWD-VSL-00015/PWD-VSL-00016)
- Plant wash vessel (PWD-VSL-00044)
- LAW SBS condensate receipt vessels (TLP-VSL-00009A/B)
- Treated LAW concentrate storage vessel (TCP-VSL-00001)
- Treated LAW evaporator condensate vessel (TLP-VSL-00002)
- HLW feed receipt vessel (HLP-VSL-00022)
- HLW lag storage vessels (HLP-VSL-00027A/B)*
- HLW feed blend vessel (HLP-VSL-00028)*
- Spent resin slurry vessels (RDP-VSL-00002A/B/C)
- Vessel vent caustic scrubber (PVP-SCB-00002)
- Vessel vent HEME drain collection vessel (PVP-VSL-00001)
- Alkaline effluent vessels (RLD-VSL-00017A/B)
- PJV drain collection vessel (PJV-VSL-00002)
- Cs IX treated LAW collection vessels (CXP-VSL-00026A/B/C)
- Hot cell east berm floor drain (PWD-FD-00006)
- Waste feed evaporator separator vessels (FEP-SEP-00001A/B) (in case of loss of circulation in the evaporators)

Overflows from non-Newtonian vessels (marked with *) will be diluted with water as soon as normal operation is achieved/recovered. Minimum dilution ratio (water/fluid) of 1.5 is expected.

During abnormal operations, vessel PWD-VSL-00033 could also receive material from PWD-SUMP-00040 via PWD-EJCTR-00062.