PLANT ITEM MATERIAL SELECTION DATA SHEET

R10682506

UFP-PP-00001A/B, 2A/B, 3A/B (PTF)
Ultrafilter Pulsepots

ISSUED BY
RPP-WTP PDC

- Design Temperature (°F): 200
- Design Pressure (psig) (max/min): 200/-15
- 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:
- The vessels are always alkaline, pH > 12, at the normal operating temperature.
- Pulsepots will backpulse during cleaning operations with 2M nitric acid and 2M caustic.
- Process condensate will be supplied to flush reagents between uses.

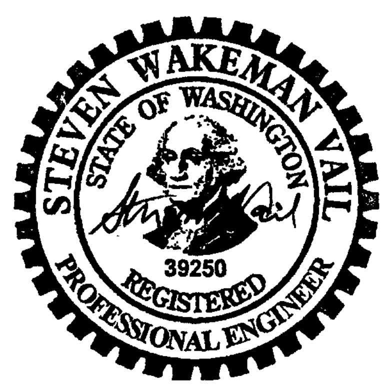
Materials Considered:

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 0.016 inch erosion allowance)

Process & Operations Limitations:
- Develop rinsing/flushing procedure



5/24/06

EXPIRES: 12/07/07

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This bound document contains a total of 6 sheets.

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	APPROVER
2	5/24/06	Issued for Permitting Use			
1	3/10/05	Issued for Permitting Use	DLA	JRD	APR
0	10/9/03	Issued for Permitting Use	DLA	JRD	SWV

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Corrosion Considerations:

Pulse-pots are used to perform back-pulsing on the ultrafilter tube units. Back-pulsing may involve adding cleaning chemicals such as 2 M HNO_3, 2 M NaOH or process condensate.

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 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 stainless steels 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 & 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.

In this system, the hydroxide concentrations and temperatures are such that 304L stainless steel will be acceptable. It must be noted the amount of fluoride is expected to be relatively small except for the contract maximum. The amount of dilution of fluoride when acid is added is unknown but is generally assumed to be normally well diluted. 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 kept as low as 5 mpy by the use of Al^{+++}. Additionally, Sedriks (1996) has noted with 10% (≈2N) nitric acid and 3,000 ppm fluoride at 158°F, the corrosion rate of 304L is over 4,000 mpy. Therefore, there is a concern about excessive corrosion rates during acid cleaning. Keeping the vessel as cool as possible when acid is present would reduce the extent of attack by chloride (pitting and crevice corrosion) and, with the presence of Al^{+++}, general corrosion due to fluoride. Properly protected by temperature and fluoride complexants such as Al^{+++}, 304L will be suitable.

Conclusion:
304L is expected to be sufficiently resistant with a probable general corrosion rate of less than 1 mpy. A procedure will be necessary to minimize the presence of fluorides during acid cleaning.

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 both of the opinion that fluoride will have little effect in an alkaline media. Jenkins (1998) has stated that localized corrosion can occur under the deposits on heat transfer surfaces, probably due to the chlorides. Further, Revie (2000) and Uhlig (1948) note nitrate inhibits chloride pitting.

Normally the vessel is to operate between 77 and 194°F. At the normal temperature, based on the work of Zapp (1998) and others, 304L stainless steel would be acceptable in the proposed alkaline conditions. Under acidic conditions, 304L is still expected to be acceptable.

Conclusion:
Based on the expected operating conditions, 304L 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 believed likely 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 stated temperature and alkaline conditions, 304L is expected to be satisfactory. However, if acid cleaning is to be used and the halide concentration cannot be controlled, 316 L will be the minimum acceptable alloy and it may be necessary to use a more resistant alloy.

Conclusion:
Because of the normal operating environment that will include periodic acid cleaning, the minimum alloy recommended is a 304L stainless steel.

e Crevice Corrosion
See Pitting.

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 conditions are not conducive to microbial growth – the temperature is approximately correct but the pH is either too alkaline or too acid. Further, the system is sufficiently far downstream of the main entry points of microbes that infection is unlikely.

Conclusion:
MIC is not considered a problem.

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

Conclusions
Not a concern.

i Vapor Phase Corrosion
Not expected to be a concern.

Conclusion:
Not 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% at velocities less than 4 mps.

Conclusion:
Not believed to be a concern.

k Galling of Moving Surfaces
Not applicable.

Conclusion:
Not applicable.

l Fretting/Wear
None expected.

Conclusion:
Not considered a problem.

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 2 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 2 M nitric acid.

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References:

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PLANT ITEM MATERIAL SELECTION DATA SHEET

CCN 110849
Revised Process Corrosion Data Sheet

PROCESS CORROSION DATA SHEET

Component(s) (Name/ID #) Ultrafiltration feed vessels (UFP-VSL-00002 A/B)
Ultrafilter (UFP-FILT-00001,2,3 A/B), Ultrafiltration pulse pot (UFP-PP-00001,2,3,A/B
Ultrafilter Heat Exchangers (UFP-HX-00001A/B)

Facility PTF

In Black Cell? Yes (UFP-VSL-00002A/B only)

Chemicals	Unit[1]	Contract Maximum		Non-Routine		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/l	3.61E+01	4.79E+01			
Chloride	g/l	1 20E+01	1 44E+01			
Fluoride	g/l	1 43E+01	1 72E+01			
Iron	g/l	1 69E+02	1 15E+02			
Nitrate	g/l	2 29E+02	2 63E+02			
Nitrite	g/l	6 66E+01	7 97E+01			
Phosphate	g/l	4 81E+01	5.63E+01			
Sulfate	g/l	2 56E+01	3 06E+01			
Mercury	g/l	1 18E+00	1 67E+00			
Carbonate	g/l	1 05E+02	1 06E+02			
Undissolved solids	wt%	25%	25%			
Other (NaMnO4, Pb,...)	g/l	1 00E-02				Note 4
Other	g/l					
pH	N/A					Note 3
Temperature	°F					Note 2

List of Organic Species:

References
System Description· 24590-PTF-3YD-UFP-00001, Rev 0
Mass Balance Document 24590-WTP-M4C-V11T-00005, Rev A
Normal Input Stream #· UFP04, UFP17, UFP39, UFP07
Off Normal Input Stream # (e.g , overflow from other vessels)· N/A
P&ID. 24590-PTF-M6-UFP-P0002,3, Rev 1
PFD· 24590-PTF-M5-V17T-P0010, Rev 1
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 normal operation 77 °F to 194 °F (24590-PTF-MVC-UFP-00002, Rev 0)
3 Alkaline streams with pH range from approximately 12 to 14
4 NaMnO4 is added for oxidative leaching. The other chemicals should not be effected by oxidative leaching.
Concentrations may be lowered, but for conservatism did not change in this datasheet

Assumptions:
Assume the NaMnO4 addition was 1 1 Mole per mole of Cr

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

4.14.3 Ultrafiltration Feed Vessels (UFP-VSL-00002A/B), Ultra Filters (UFP-FILT-00001,2,3 A/B), Ultrafiltration Pulse Pots (UFP-PP-00001A/B, 2A/B, 3A/B)

Routine Operations

These two vessels receive the feed from the ultrafiltration feed preparation vessels (UFP-VSL-00001A/B). The feed is then concentrated to 20 % solids by being pumped and recirculated through an ultrafiltration loop. The liquid fraction of the filtered feed is sent to the LAW vitrification facility. The feed containing the 20 % solids is sampled to determine the appropriate treatment steps. Treatment of the solids may include solids washing to remove excess sodium through dilution and ultrafiltration, and/or caustic leaching by adding 19 M NaOH until the solution reaches 3 M, allowing a period of 8 hours for digestion, during which the solution is heated to between 176 °F to 194 °F, and then cooled back to ambient temperature (77 °F). After cooling, the contents are reconcentrated to 20 % solids by ultrafiltration. Ultrafiltration pulse-pots (UFP-PP-00001A/B, UFP-PP-00002A/B, and UFP-PP-00003A/B) are used to perform back-pulsing on the ultrafilter tube units. Back-pulsing may involve adding cleaning chemicals (2 M HNO3, 2 M NaOH, and process condensate).

Non-Routine Operations that Could Affect Corrosion/Erosion

There is the option to transfer the Sr/TRU solids directly to the HLW blending vessel (HLP-VSL-00028), if necessary.