

CORROSION EVALUATION



**HOP-ADBR-00001A/B & 2A/B (HLW)
Activated Carbon Adsorber**

- Design Temperature (°F): 250
- Design Pressure (in-WG): -82
- Location: Room H-A123; outcell

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:

- Equipment is maintainable.
- The moisture during operation is 15% by volume.
- Design to include a cool down mode that will prevent condensation of acid gasses
- A preheater will be used to prevent condensation from forming in the activated carbon media during start-up or after replacement.

Materials Considered:

Material (UNS No.)	Acceptable Material	Unacceptable Material
Type 304L (S30403)		X
Type 316L (S31603)	X	
6% Mo (N08367/N08926)	X	
Hastelloy® C-22® (N06022)	X	

Recommended Material: Type 316 (max 0.030% C; dual certified)

Recommended Corrosion Allowance: 0.010 inch (includes 0.00 inch erosion allowance)

Process & Operations Limitations:

- None

Concurrence NA
Operations

1	7/18/11	Incorporate revised PCDS Incorporate revised design temp Revise corrosion allowance Add "AEA" notice Format and editorial changes	<i>[Signature]</i> DLAdler	<i>[Signature]</i> RBDavis	NA	<i>[Signature]</i> SWVail
0	6/24/04	Initial Issue	DLAdler	JRDivine	APR	APRangus
REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	MET	APPROVER

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Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

This bound document contains a total of 7 sheets.

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Corrosion Considerations:

The sulfur-impregnated activated carbon column removes volatile mercury compounds from the offgas at a mildly elevated temperature, 197 to 239 °F. During normal operation air atomized demineralized water is injected into the inlet piping to cool the offgas to operating temperature. Temperatures are not high enough to have concern for oxidation.

a General Corrosion

The anticipated dry-air conditions are not conducive to general corrosion and none is expected.

Conclusion

Either Type 304L or 316L would be satisfactory.

b Pitting Corrosion

Pitting corrosion will only be a concern if moisture is present. It is assumed that there will be no condensation in the unit. For safety, Type 316L is recommended.

Conclusion

At the stated operating conditions, pitting corrosion is not a significant concern. Type 316L is recommended.

c End Grain Corrosion

End grain corrosion only occurs in high acid conditions and is not a concern.

Conclusion:

Not a concern

d Stress Corrosion Cracking

At operations at the stated temperatures, stress corrosion cracking will only be a concern in the presence of moisture. It is assumed that there will be no condensation in the unit. Also see Pitting.

Conclusion

At the stated operating conditions, stress corrosion cracking is not a concern.

e Crevice Corrosion

Crevice corrosion will only be a concern if moisture is present. The offgas humidity is controlled so that there will be no condensation.

Conclusion

At the stated operating conditions, crevice corrosion is not a concern.

f Corrosion at Welds

Assuming dry air and proper welding procedures, corrosion at welds is not anticipated.

Conclusion

At the stated operating conditions, weld corrosion is not a concern.

g Microbiologically Induced Corrosion (MIC)

The stated operating conditions are not suitable for microbial growth.

Conclusion

At the stated operating conditions, MIC is not a concern.

h Fatigue/Corrosion Fatigue

Extreme temperature cycling or fluctuations are not expected.

Conclusion

At the expected operating conditions, corrosion fatigue is not a concern.

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i Vapor Phase Corrosion

Components essential consist entirely of vapor space so general corrosion comments apply.

Conclusion:

See comments under general corrosion.

j Erosion

The velocity and solids content are sufficiently low that erosion is not a concern.

Conclusion

Erosion is not a concern.

k Galling of Moving Surfaces

There are no unlubricated moving surfaces present.

Conclusion:

Galling is not a concern.

l Fretting/Wear

No metal/metal contacting surfaces are expected.

Conclusion:

Fretting is not a concern.

m Galvanic Corrosion

No significantly dissimilar metals are present, and it is assumed that condensation is controlled by design.

Conclusion:

Galvanic corrosion is not a concern because no fluids are present.

n Cavitation

Cavitation is not expected in an off-gas system

Conclusion:

Cavitation is not a concern.

o Creep

Stated operating temperatures are too low for creep to occur.

Conclusion

Creep is not a concern.

p. Inadvertent Addition of Nitric Acid

Addition of nitric acid to the offgas lines is not a plausible scenario.

Conclusion

Not applicable

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References:

1. 24590-WTP-RPT-PR-04-0001, Rev. 0CD, *WTP Process Corrosion Data*

Bibliography

1. 24590-HLW-MVD-HOP-00015, *Mechanical Data Sheet for 24590-HLW-MV-HOP-ADBR-00001A, 24590-HLW-MV-HOP-ADBR-00001B - Activated Carbon Adsorber For Mercury Abatement*

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24590-WTP-RPT-PR-04-0001, Rev. 0CD
WTP Process Corrosion Data

PROCESS CORROSION DATA SHEET

Component(s) (Name/ID #) Activated carbon adsorber (HOP-ADBR-00001A/B, HOP-ADBR-00002A/B)

Facility HLW

In Black Cell? No

Chemicals	Unit ¹	Contract Maximum ²		Non-Routine		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/m ³	5.16E-15	9.07E-15			
HCl	g/m ³	1.7E-03	1.7E-03			Note 4
HF	g/m ³	1.1E-03	1.1E-03			Note 4
Iron	g/m ³	3.21E-14	2.20E-14			
NO	g/m ³	6.28E-01	6.52E-01			
NO ₂	g/m ³	1.71E-01	1.84E-01			
Phosphate	g/m ³	6.92E-16	2.20E-15			
SO ₂	g/m ³	1.8E-03	1.8E-03			Note 4
Mercury	g/m ³	3.3E-02	3.3E-02			Note 4
Carbonate	g/m ³	6.41E-16	8.34E-16			
Particulate	g/m ³	0	0			
Pb	g/m ³	1.19E-16	8.27E-16			
HNO ₃	g/m ³	5.0E-03	5.0E-03			Assumption 1
HNO ₂	g/m ³	9.1E-03	9.1E-03			Assumption 1
Humidity	%	41%	41%			
Temperature	°F					Note 3
List of Organic Species:						
References						
System Description: 24590-HLW-3YD-HOP-00001						
Mass Balance Document: 24590-WTP-M4C-V11T-00005, Rev A						
Normally Associated Streams: HOP22, HOP33						
Off Normal Streams (e.g., overflow from other vessels): N/A						
P&ID: N/A						
PFD: 24590-HLW-M5-V17T-00004; 24590-HLW-M5-V17T-20004						
Technical Reports: N/A						
Notes:						
1. Deleted						
2. Data developed from a mass balance model which has constituents in the plant feed which are important to corrosion, adjusted to contract maximum values, except as noted.						
3. The normal operating temperature is 197 °F at the inlet, and 197 °F at the outlet (page A-6, 24590-HLW-M4C-HOP-00011, Rev 1) The maximum operating temperature is 230 °F at the inlet, and 239 °F at the outlet (page A-10, 24590-HLW-M4C-HOP-00011, Rev 1)						
4. Source: 24590-HLW-M4C-HOP-00011, Rev 1, pages A-10 through A-13						
Assumptions						
1. Based on empirical data from testing per Attachment 28 of 24590-HLW-M4E-HOP-00005, pages 3 and 4.						

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WTP Process Corrosion Data**5.3.2 Activated Carbon Adsorber (HOP-ADBR-00001A/B, HOP-ADBR-00002A/B)****Routine Operations**

The activated carbon (AC) adsorber removes volatile mercury from the offgas at a mildly elevated temperature. The AC column consists of two sulfur-impregnated activated charcoal beds. Each bed is contained inside a vessel that is insulated. The piping and valving are arranged to operate the beds in series (normal), in parallel, or individually. Connections are provided on each vessel to load the AC through isolation valves from multiple lines using a manual gravity feed chute supplied from a feed hopper located above the vessel(s). Spent AC is removed from a bed by gravity draining through multiple line isolation valves and using a screw conveyor system to route the AC to a vessel for packaging. The second bed can continue operation during bed changeout. A manual water deluge (by manual hose connection) of the vessel containing carbon filtration material is activated by operators based on vessel temperature and CO indications. CO monitors before and after the pressure vessel containing carbon filtration material, actuate an interlock to close the isolation valves and open the offgas bypass valve on high CO differential. The vessel inlet isolation valve provides a seal intended to be adequate to starve the fire of oxygen and limits the amount of offgas that can enter the pressure vessel. The system is activated based on differential inlet to exit CO concentration. The offgas inlet isolation valve is automatically closed on system activation. A water overflow valve is automatically activated in each vessel in case of fire to prevent overflowing with water. A water drain system is also provided.

Non-Routine Operations that Could Affect Corrosion or Erosion

None identified.