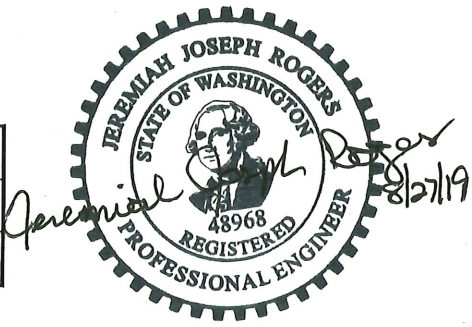
AVANTech
INCORPORATED

AVANTech COVER SHEET



DOCUMENT ID NUMBER	RPP-CALC-62499
REVISION NUMBER	2
PROJECT NUMBER	18-13

TITLE	TSCR Media Trap Sizing

	Name	Initials	Date
Preparer	Jaclyn Siewert	JS	6/13/19
Title	Engineer		
Reviewer	Rob Wilson	RW	6/13/19
Title	Sr. Engineer		
Approver	Jeremiah Rogers	JR	6/12/19
Title	Sr. Engineering Specialist		

Revision Notes	2 – Updated References

CALCULATION REVIEW CHECKLIST

CALCULATION ID NUMBER	RPP-CALC-62499
REVISION NUMBER	2

	Item	Yes	N/A*
1.	Design Inputs such as design bases, regulatory requirements, codes, and standards are identified and documented, verified against customer specifications including edition and addenda.	✓	
2.	Effect of design package on compliance with the Safety Analysis Report or Certificate of Compliance identified and documented.	✓	
3.	Revision numbers correct on the list of drawings?	✓	
4.	Assumptions reasonable?	✓	
5.	Appropriate analysis method used?	✓	
6.	Correct values used from drawings?	✓	
7.	Answers and units correct?	✓	
8.	Summary of results matches calculations?	✓	
9.	Material properties properly taken from credible references?	✓	
10.	Figures match design drawings?	✓	
11.	Computer input complete and properly identified?		✓
12.	Documentation of all hand calculations attached?	✓	
13.	Reference to Verification / Validation for software?		✓

* N/A, Explain	11., 13. No computer software used in calculation.

	Name	Initials	Date
Reviewed	Rob Wilson	RW	6/13/19

Table of Contents

1.0 PURPOSE

This calculation justifies the size and loading capacity of the TSCR Media Trap. This vessel's purpose is to catch any ion exchange media that may have entered the product stream. The key design parameters for the media trap are the screen size and maximum volume of media that can be collected.

2.0 REFERENCES

2.1. UOP IONSIV™ R9120 Selective Media. Honeywell UOP. May 2017. (ATTACHMENT 1)

2.2. H-14-111257 Rev. 1, Fabrication Drawing Media Trap, AVANTech, Inc.

2.3. Wellgrow Industries Corp. "Stainless & Carbon Steel Butt-Welding Fittings: Pipe Cap." 2018. http://www.pipefittingweb.com/butt-weld/pdf/Pipe-Cap.pdf

2.4. Dow Water Solutions, "DOWEX™ Ion Exchange Resins Water Conditioning Manual," p. 70.

2.5. Baker Tankhead Inc. "Tank Heads: Standard & A.S.M.E. ® Tank Heads For Industry." 2018. https://www.bakertankhead.com/products/tank-heads.htm

2.6. H-14-111253 Rev. 2, General Arrangement Media Trap, AVANTech, Inc.

3.0 DESIGN INPUTS

3.1. SCREEN SIZE

CST media size = 20x40 Mesh Beads
Ref. 2.1.

Wedge Wire Screen Slot Size = 0.003 in. ± 0.001 in.
Ref. 2.2.

3.2. MAXIMUM VOLUME

ID_{pipe} *= 2.469 in.*
2-1/2" Sch. 40 NPS used as the Media Trap shell (Ref. 2.2).

OD_{screen} *= 1.05 in.*
Per Ref. 2.2.

Usable Screen Length, L_1 *= 8 in.*
Per Ref. 2.6.

Pipe Length, L_{pipe} *= 9.5 in.*
Per Ref. 2.2.

Pipe cap is modeled as ellipsoidal and conforms to the shape requirements as given in the ASME boiler and pressure vessel code (Ref. 2.3).

4.0 APPROACH/METHODOLOGY

The approach for determining the screen size for the TSCR Media Trap includes knowledge of the particle size distribution of the CST media and a conservative estimate for the screen to particle ratio. The IXC-150 screens are approximately 50% the size of the smallest CST particles. The Media Trap screen should be sized so that a significantly smaller size particle can be collected. The maximum volume of media that can accumulate is equal to the volume of the Media Trap, not including the screen.

5.0 COMPUTATION

5.1. SCREEN SIZE

The 20x40 mesh CST media has a particle size distribution of 0.42-0.84 mm (Ref. 2.4). The nominal slot size on the media trap screen is 0.003 ± 0.001 inches, as shown in Ref. 2.2, "Fabrication Drawing Media Trap". The maximum screen opening is therefore 0.004 inches.

$$Screen\ to\ Particle\ Ratio = \frac{Maximum\ Screen\ Opening}{Smallest\ Particle\ Size} = \frac{0.004\ in. \times \left(25.4 \frac{mm}{in.}\right)}{0.42\ mm} = 0.242$$

The screen openings are less than one quarter of the smallest particle size.

5.2. MAXIMUM VOLUME

The maximum volume of media that can be contained in the Media Trap impacts the required shielding for the vessel. The available volume for accumulation of media is the sum of the volume around the screen and the volume below the screen. The volume around the screen is calculated as follows:

$$V_1 = \pi \times \left(\left(\frac{ID_{pipe}}{2}\right)^2 - \left(\frac{OD_{screen}}{2}\right)^2\right) \times L_1$$

$$V_1 = \pi \times \left(\left(\frac{2.469\ in.}{2}\right)^2 - \left(\frac{1.05\ in.}{2}\right)^2\right) \times 8\ in. = 31.37\ in.^3$$

The volume below the screen is calculated as follows:

$$L_2 = L_{pipe} - L_1 = 9.5\ in. - 8\ in. = 1.5\ in.$$

$$V_2 = \frac{\pi}{4} \times ID_{pipe}^2 \times L_2 = \frac{\pi}{4} \times (2.469\ in.)^2 \times 1.5\ in. = 7.18\ in.^3$$

The volume of the bottom pipe cap is calculated using the equation for a 2:1 semi-elliptical head (Ref. 2.5):

$$V_3(gal.) = 0.000586 \times {ID_{pipe}}^3(in.) = 0.000586 \times (2.469\ in.)^3 = 0.00882\ gal.$$

$$V_3(in.^3) = 0.00882\ gal. \times \frac{231\ in.^3}{1\ gal.} = 2.04\ in.^3$$

Therefore, the maximum volume of media that can accumulate in the Media Trap is:

$$V = V_1 + V_2 + V_3 = 31.37\ in.^3 + 7.18\ in.^3 + 2.04\ in.^3 = 40.59\ in.^3$$

$$V = 40.59\ in.^3 \times \left(\frac{16.387\ mL}{1\ in.^3}\right) = 665.1\ mL$$

6.0 CONCLUSIONS

AVANTech engineers used the methodology in Section 4 to determine a conservative screen size and the maximum accumulation capacity for trapping loose media in the product stream. The screen openings are less than one quarter the size of the theoretical smallest particle. This screen size will ensure that, in the unlikely event of ion exchange media entering the product stream, none will migrate with treated effluent to AP-106. The maximum volume of media that can accumulate in the Media Trap is 665.1 mL.

ATTACHMENT 1 - UOP IONSIV™ R9120 SELECTIVE MEDIA DATA SHEET

Honeywell UOP

ADSORBENTS

UOP IONSIV™ R9120 Selective Media

Crystalline silicotitanate for removal of radioactive ions

Description

UOP IONSIV R9120 Selective Media is a crystalline silicotitanate available as a bead or powder supplied in the sodium (Na^+) form.

Typical Application Areas

UOP IONSIV R9120 Selective Media is effective for the following applications:

- Removal of Cs and Sr from highly alkaline radioactive wastes and processing solutions.
- Removal of Cs from acidic radioactive waste solutions.
- Removal of Cs and Sr from groundwater and sea water that has been radioactively contaminated.
- Removal of Cs, Sr and radionuclides from fuel storage and cooling ponds.

Media Use

UOP IONSIV R9120 Selective Media can be applied as a single use media in a packed bed or slurry configuration. Routine backwashing of a packed bed can be performed to remove any accumulated solids and resettle the bed.

Typical Physical Properties (nominal)

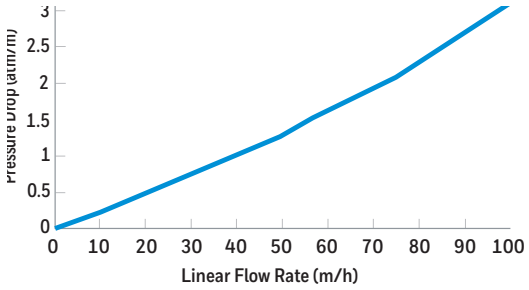
	20x40 Mesh Beads	Powder
Bulk density (kg/m^3) (lb/ft^3)	 900 (Min) 56 (Min)	
Moisture (Wt%) typical max	 16-17 25	 16-17 25
Screen (+18) (Wt%)	2.5	
Screen (-50) (Wt%)	5	
Nominal particle size (µm)		<1
Operating pH Range	Full pH range	4 to 9

UOP IONSIV Ion Exchangers combine high capacity and high selectivity to achieve efficient radioactive ion removal.

FEATURES & BENEFITS

High capacity	Minimal volumes of loaded media for subsequent storage/disposal
High selectivity	Excellent performance in highly saline streams, improved downstream process performance, lower liquid waste and sludge volumes
Single use media	No regeneration required and no generation of secondary wastes
Excellent mechanical, chemical and radiological stability	Applicable under a wide range of operating conditions

Calculated Pressure drop



Safety and Handling

See the UOP brochure “Precautions and Safe Practices for Handling Molecular Sieves in Process Units” or contact your Sales Engineer.

Shipping information

UOP IONSIV R9120-B Selective Media is shipped in 150kg (55-gallon) steel drums. R9120-P is shipped in 135kg (55-gallon) steel drums.

For more information
www.uop.com

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