Next-Sand System Design & Application Guide

WHY PAY MORE AND FILTER LESS?

Pressure Vessel Operation & Backwash Specifications for Next-Sand Filter Media

Service Flow Rate

Next-Sand is a high-purity filter media that offers water filtration advantages over conventional sand, sand & anthracite, multimedia and other filter media products for pressure vessel applications. Next-Sand provides higher solids loading, longer running times, superior performance and long bed life. The granular media has high porosity, high surface area (~27m^2/gm) and surface, micro-mineral, projections (0.2-0.9µ spacing) that make it an ideal water filtration media. During filtration operation, the water and particles flow around and through the 14 x 40 mesh Next-Sand granules and the bed functions, with a 50% void volume.

Next-Sand is classified under 21CFR Part 182.2729 & 40 CFR Part 180. as GRAS (Generally Recognized As Safe) and is NSF/ANSI Standard 61 Listed.

Table I lists the feed water, flow rates recommended for the Next-Sand filter media. The surface loading rates are in the 10 to 20 gpm/ft^2 range depending on the water filtration application. Generally, a 36" bed height plus ~50% freeboard (above the media bed) is recommended. A step by step, selection process is provided below to assist in the vessel sizing and Next-Sand media volume determination.

First, select the optimum, filter bed flux rate (gpm/ft^2) based on the particular water filtration application as listed below.

Bed Flux Rate	Description	Application
10-12 gpm/ft^2	Conservative, slow bed flux to achieve maximum, fine particle removal.	Used for high performance filtration upstream to reverse osmosis and nano-filters and for drinking water plant application requiring strict SDI or/NTU.
14-16 gpm/ft^2	Moderate bed flux	Used for non-membrane, polishing, filtration for commercial, industrial and cooling tower applications.
18-20 gpm/ft^2	High bed flux operation	Used to filter well water, surface water or other water streams having low SDI, NTU or TSS. Used to achieve maximum throughput.

Second, refer to Table I and select the Bed Flux Rate (gpm/ft^2) that meets the specific, water filter application as outlined above (i.e., conservative for membranes or moderate vs high flux rate).

Third, using the Bed Flux Rate (gpm/ft^2) selected from Table I, then choose the Service Flow Rate (gpm) that meets or exceeds the maximum, feed water gpm. [Note: Adjust the Service Flow Rate design spec depending on the feed water SDI, NTU, TSS, where higher range, feed gpm can be tolerated at low values, whereas the feed gpm should be reduced for moderate SDI, NTU, TSS, etc].

Fourth, using Table I, then go down the table to read off the Tank diameter recommended for that gpm feed water rate.

Fifth, obtain the Bed Volume of Next-Sand media required for that pressure vessel based on a 36" bed height. [If the vessel height is too short to accommodate a 36" bed, with 50% free-board, then reduce the bed height to achieve the 50% free-board].

Sixth, make a note of the bed surface area (ft^2) shown in Table I or re-calculate bed volume for the reduced, bed height based on $V=\Pi r^2 h$, where r=vessel radius in ft and h bed height in ft.

Seventh, double check the Bed Flux Rate (gpm/ft^2) to insure that the design flux rate is in the conservative, moderate or high flux rate desired.

Table I. Pressure vessel, bed flux rates and recommended, service flow rates for Next-Sand filter media (14 x 40 mesh)* based on backwash water temperature of 70 to < 80°F .

Filter Bed **Flux Rate**[5]	**Service Flow Rate (gpm)**						
12 gpm/ft^2	9	21	38	59	85	150	340
15 gpm/ft^2	12	27	47	74	106	189	425
18 gpm/ft^2	14	32	56	89	127	227	509
20 gpm/ft^2	16	35	63	98	141	251	565
Tank Dia.	**12"**	**18"**	**24"**	**30"**	**36"**	**48"**	**72"**
Bed Vol	2.4ft^3	5.3 ft^3	9.4 ft^3	14.7 ft^3	21.2 ft^3	37.7 ft^3	84.8 ft^3
Surface Area	0.8ft^2	1.8 ft^2	3.1 ft^2	4.9 ft^2	7.1 ft^2	12.6 ft^2	28.3 ft^2

** The standard Next-Sand media bed depth is 3 ft. Reducing bed height proportionally reduces the solids loading capacity & increases the backwash frequency.*

Next-Sand Media Backwashing

Next-Sand filter media achieves approximately, twice the solids loading capacity per cubic ft. of media compared to conventional, granular, filter beds. This higher solids loading capacity translates to longer operational, running times, reduced backwash cycles and lower labor and energy costs.

Water Temperature Correction Factor

The bed expansion of Next-Sand during the backwash is dependent on water temperature. Water viscosity decreases with increasing temperature (reduces the bed lift) and increases with lower temperatures (enhances bed lift). Therefore, it is recommended to use a temperature correction factor or Water Viscosity Correction Factor. Table II lists the avg. Water Viscosity Correction Factor for various temperature ranges, where 1.00X represents water in the 70-80°F range.

Table II. Water viscosity, Correction Factor based on water viscosity (density) at 75°F.

[Multiply the Bed Backwash flow rate (shown above in Table III) by the Correction Factor to determine the backwash, water flow rate needed to achieve ~35% bed expansion].

Water Temperature	Water Viscosity Correction Factor[3]
32° to <40°F	0.51 X
40° to <50 °F	0.64 X
50° to <60°F	0.77 X
60° to <70 °F	0.86 X
70° to <80 °F	1.00 X
80° to <90 °F	1.12 X
90° to <100 °F	1.24 X
100° to <110 °F	1.35 X
110° to <120 °F	1.47 X

Example A. Back washing a 24” dia, pressure vessel, with a 36” bed ht, would have a Next-Sand media surface area of 3.1 ft^2 (shown in Table I). The backwash water flow rate using water at temperatures 70° to <80°F, would be 63 gpm (X) for 5-6 min duration. If the backwash water temperature was 93°F, then the Viscosity Correction Factor, would be 1.24X or 1.24 x 63 gpm = 78.1 gpm, due to the lower water viscosity (i.e., loss of media “lift” at the higher temperature.

Example B. Back washing a 24” dia, pressure vessel, with a 36” bed ht, would have a Next-Sand media surface area of 3.1 ft2 (shown I Table I). The backwash water flow rate using water at temperatures 70 to <80°F , would be 63 gpm (X) for 5-6 min duration. If the back wash water temperature was 45°F, then the Viscosity Correction Factor, would be 0.64X or 0.64 x 63 gpm = 40.3 gpm, due to the higher water viscosity (i.e., more “lift” capacity at the lower temperature).

Next-Sand Backwash to Achieve ~35% Bed Expansion at 75°F.

Generally, 20 gpm/ft^2 up-flow of 75°F water, will expand the Next-Sand media ~35%. Increasing the water temperature reduces the bed “lift” and cooler water temperatures increases the “lift” as described above. The backwash, water flow and air scour requirements are provided in Table III for 12” to 72” cylindrical vessels. To calculate the backwash water and/or air-scour specifications use the formulas provided below.

Backwash with water only:

- Backwash Flow = (Bed Surface Area ft^2) x (20 gpm/ft^2 Flow Rate) x (Water Viscosity Correction Factor in Table II)
- Backwash time 5-6 minutes.

Backwash with water plus air-scour (to conserve water):

- Generally, ~6 psig air is used for air scour supplied continuously, during backwash and the water flow is decreased to avoid excessive bed “lift”.
- Air scour is used to enhance the media, bed expansion and physical tumbling of Next-Sand granules and to conserve water. The “rule-of-thumb” for air scour is to use 3 cfm of air per ft^2 of Next-Sand, media bed area (A), where $A=\Pi r^2$.
- Backwash Flow w/ Air Scour = (Bed Surface Area ft^2) x (20 gpm/ft^2 Flow Rate) x (0.6) x (Water Viscosity Correction Factor in Table II)
- Note: This assumes the air supply is 3 cfm/Bed Surface Area of 90 psi.
- Backwash time 5-6 minutes.

Table III. Next-Sand media backwash water flow with and without air-scour required to achieve ~35% bed expansion. [Backwash time 5-6 min].

	Backwash Flow Rate (gpm)						
Tank Dia.	**12”**	**18”**	**24”**	**30”**	**36”**	**48”**	**72”**
Bed Vol	2.4 ft^3	5.3 ft^3	9.4 ft^3	14.7 ft^3	21.2 ft^3	37.7 ft^3	84.8 ft^3
Surface Area	0.8 ft^2	1.8 ft^2	3.1 ft^2	4.9 ft^2	7.1 ft^2	12.6 ft^2	28.3 ft^2
Bed Backwash (35% Expansion)**	16 gpm	36 gpm	63 gpm	98 gpm	140 gpm	252 gpm	565 gpm
Bed Backwash w/Air Scour* (35% Expansion)**	10 gpm w/ 2.4 cfm	22 gpm w/ 5.4 cfm	38 gpm w/ 9.3 cfm	63 gpm w/ 14.7 cfm	98 gpm w/ 21.3 cfm	140 gpm w/ 37.8 cfm	339 gpm w/ 84.9 cfm

Wet Density of Next-Sand Media

The wet density of Next-Sand when considering portable applications will be variable depending on how the filter vessel is drained. Next-Sand is hydrophilic and has a very high void volume, the water retention can vary from 15 to 30%. Using gravity only for draining we must consider up to 30% retention. Using an air blow-down, it would be 20 to 25%, leaving the media weighing approximately 65 pounds per cubic foot of material.

When conducting a spin dry test, the water retention was reduced to 15%. This feature is one of the reasons Next-Sand is so efficient as a depth filtration media. Even if you consider a full 30% retention in portable applications, the filtration efficiencies at 10 to 20 gallons per minute per square foot of surface area still offer dramatic increases in service flow capabilities at the portable weight limits. See Table 4.

Table IIII. Wet density of Next-Sand media with variable drainage techniques.

	Shipped	Drainage		
Next-Sand	**Dry**	**Gravity**	**Air Blow-Down**	**Spin Dry**
Approx. % of water retained	–	~ 15 – 30%	~ 20 – 25%	~ 15%
Weight in lbs/ft^3	55 lbs/ft^3	~ 72 lbs/ft^3	~ 66 lbs/ft^3	~ 63 lbs/ft^3

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