

Water Softener

Water softening is the removal of calcium, magnesium, and certain other metal cations in hard water. Soft water also extends the lifetime of plumbing by reducing or eliminating scale build-up in pipes and fittings. Water softening is usually achieved using lime softening or ion-exchange resins. When water is referred to as 'hard' this simply means, that it contains more minerals than ordinary water. These are especially the minerals calcium and magnesium. The degree of hardness of the water increases, when more calcium and magnesium dissolves.



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Magnesium and calcium are positively charged ions. Because of their presence, other positively charged ions will dissolve less easily in hard water than in water that does not contain calcium and magnesium.

Water softeners are specific ion exchangers that are designed to remove ions, which are positively charged. Softeners mainly remove calcium (Ca^{2+}) and magnesium (Mg^{2+}) ions. Calcium and magnesium are often referred to as 'hardness minerals'. Softeners are sometimes even applied to remove iron. The softening devices are able to remove up to five milligrams per liter (5 mg/L) of dissolved iron. Softeners can operate automatic, semi-automatic, or manual. Each type is rated on the amount of hardness it can remove before regeneration is necessary. A water softener collects hardness minerals within its conditioning tank and from time to time flushes them away to drain. Ion exchangers are often used for water softening. When an ion exchanger is applied for water softening, it will replace the calcium and magnesium ions in the water with other ions, for instance sodium or potassium. The exchanger ions are added to the ion exchanger reservoir as sodium and potassium salts (NaCl and KCl).

After a period of time, the resin beads become coated with minerals and must be cleaned or "recharged" to become effective again. The water softener's timer and/or controls automatically run the appliance through cycles to backwash, recharge, and rinse the beads. A control that is designed to recharge based on the amount of water processed is better than a timer that cycles the unit on a schedule because it operates based on need, not time. The result is a savings in energy, salt, and water.

During a backwash cycle, the flow of water is reversed so that water is forced down the riser tube to the bottom of the tank so that it will flow up through the resin beads in the tank. The unit flushes and expands the resin, washing off the beads and then carrying the minerals out through a drainpipe. A "brine tank" is paired with the mineral tank to help with the regeneration process. During the "brine draw" cycle, salty water (brine) is pumped from the brine tank into the resin tank. As the water flows down through the resin beads, it exchanges sodium with the hard-water ions, regenerating the electrical attraction of the resin beads. Then, when the brine tank is empty, a slow rinse begins, followed by a more forceful fast rinse. With both of these cycles, fresh water rinses excess brine from the resin and expels it down the drain. Then the brine tank is refilled.

PACKMAN water softener Properties

PACKMAN Water Softeners are made of steel plate of ST37 grade (recommended for the manufacture of pressure vessels-no direct fire contact). In the case of customer request, the filters can be made of 17MN4 (suitable for boiler construction) without any changing in product price. The Water Softeners are vertical cylinders in different capacities and two types of single and double.

The installed geyser on top of the water softeners, uniform the water flow and cause the water to pass in a balanced manner.

Manufacturing Standards

ASME Sec VIII, Div. 1 is used in the construction of water softener tanks.

Torispherical/Elliptical Head

PACKMAN's water softener tank head is Torispherical. This type of head has a longer life and a higher pressure strength at the same thickness against other shapes. The production price/per kilo of these heads is even up to two times the size of the usual heads on the market.

Welding Procedure

Welding is done by using the Swedish ISBU submerged arc welding equipment. After constructing the tank and welding the lugs, the body of the tank is connected to the heads by welding with a submerged welding method. In addition, the head is welded internally and externally, which increases the time life and the strength of the heads. In the welding root pass, the TIG, argon or welding methods with the 6010 cellulose electrode is used. The EW7018 electrode is used in welding fill pass. The submerged method using EW7018 electrodes in the welding cover pass.

Nozzles

The nozzles used in PACKMAN sand filters are all made of brass, and for each square meter of sand surface, about 50 nozzles are placed, which makes the optimum washing procedure.

Silica and Resin of water softener

The Brand of PACKMAN water softener resin is the PUROLITE with a high ion exchange rate coefficient and a high quality silica with a purity of 98% which is used at the bottom part of the tank.

Product Capacity Calculation & Selection:

The volume of resin required for a given flow rate can be determined two ways: 1) By the volume of resin which concerns contact time, and 2) by the resin bed (the tank) cross section area that concerns pressure drop in the resin bed. By contact time: Use 5 gallons per minute per cubic foot (gpm/ft³), for continuous flow and 7.5 gpm/ft³ for peak flow. To achieve low hardness leakage as required in applications like boiler water treatment, the flow rate should be limited to 3 gpm/ft³. By resin bed area—Use 10 gpm per square foot (ft²), for continuous flow and 15 gpm/ft² for peak flow. To assure low hardness leakage, limit the area flow to 8 gpm/ft².

To size the softener, the total water hardness must be determined in grains per gallons. If the analysis report is in terms of parts per million or milligrams per liter (these are equal),

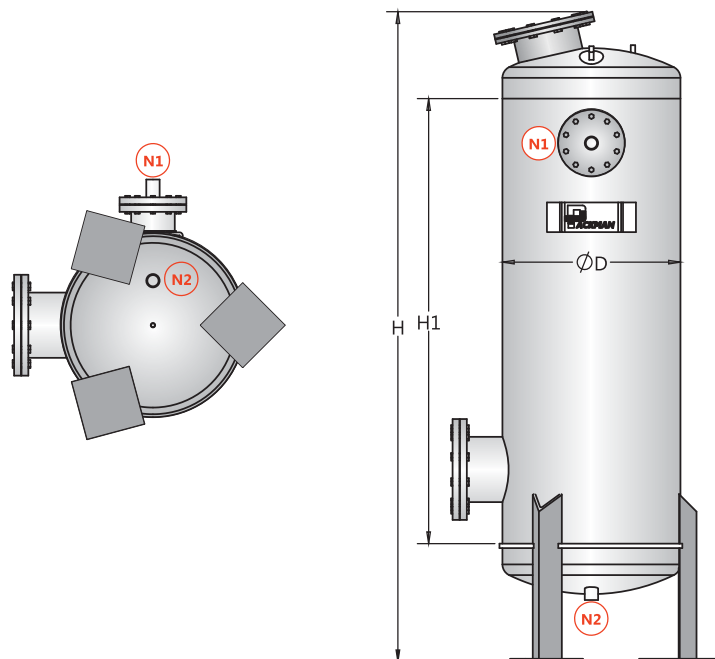
divide by 17.1 to convert to grains per gallon. When the flow rate is constant, multiply the flow rate (gpm) by minutes on line. For example, 50 gpm for 480 minutes (8 hours) = 24,000 gallons. When the flow rate is not in constant use, use actual gallons used, or calculate gallons used based on boiler make-up rates.

Exchange rate is expressed in grains, and varies with salt dosage as follows:

- 15 pounds of salt per cu-ft = 30,000 grains capacity (best water quality, least efficient).
- 10 pounds of salt per cu-ft. = 25,000 grains capacity (good water quality, medium efficiency).
- 6 pounds of salt per cu-ft. = 20,000 grains capacity (poorest water quality, most efficient). For boiler make-up water, the higher water quality - 15 pounds salt dosage per cu-ft. - is recommended.

For Single Softener: Water usage per day x water hardness = capacity required. In other words one can use the following formulation by assuming 24 hours for back wash period:

$$\text{Water Softener Capacity (grain)} = \frac{\text{GPM} \times \text{PPM} \times 60 \times 24}{17.1}$$



MODEL		PWS	PWS	PWS	PWS	PWS	PWS	PWS	PWS	PWS	PWS	PWS	
SPECIFICATIONS		-3	-6	-9	-12	-15	-18	-21	-24	-30	-36	-45	
Capacity(Grain)		30,000	60,000	90,000	120,000	150,000	180,000	210,000	240,000	300,000	360,000	450,000	
Vessel Diameter(mm)		270	270	300	400	450	500	500	550	600	600	650	
Inlet/Outlet Size(in.)		¾"	¾"	¾"	1"	1"	1½"	1½"	1½"	1½"	1½"	2"	
Flow Data	Service Flow Rates	Medium (gpm)	2.7	5.3	8.1	10.6	13.3	15.9	18.6	21.2	26.5	31.8	39.8
		Maximum (gpm)	4.4	8.8	13.3	17.7	22.1	26.5	30.9	35.3	44.2	53.1	66.3
	Regeneration (NaCl Injection)	Brine Flow Rate (gpm)	0.4	0.9	1.3	1.8	2.2	2.7	3.1	3.5	4.4	5.3	6.6
		Min. Req. Duration (min.)	22	22	22	22	22	22	22	22	22	22	22
	Rinse	Flow Rate (gpm)	1.6	3.2	4.8	6.4	8.1	9.5	11.1	12.7	15.9	19.1	23.9
		Min. Req. Duration (min.)	17	17	17	17	17	17	17	17	17	17	17
Rinse	Bed Height (mm)	440	870	1,060	800	790	760	890	840	890	1,060	1,130	
	Volume (lit)	25	50	75	100	125	150	175	200	250	300	375	
Silica Sand	Bed Height (mm)	3 x 70	3 x 70	3 x 70	3 x 70	3 x 70	3 x 70	3 x 70	3 x 70	3 x 70	3 x 100	3 x 100	
	Weight (lit)	21	21	24	45	54	69	69	81	99	138	165	
Brine (10% NaCl Solution)	NaCl (kg)	4	8	11	15	19	23	26	30	38	45	56	
	Water (lit)	34	68	101	135	169	203	236	270	338	405	506	
	Tank Volume (lit)	70	100	220	220	220	300	300	350	500	600	600	
General Dimensions	Height (Cap top) (mm)	1,220	1,740	2,010	1,690	1,690	1,690	1,860	1,800	1,910	2,140	2,320	
	Total Height (mm)	1,350	1,900	2,150	1,850	1,850	1,850	2,000	1,950	2,050	2,250	2,450	
	Occupied Space (mm x mm)	560x450	560x450	580x500	790x650	830x700	880x740	880x740	960x790	950x780	950x780	1300x890	
Total Pressure Drop(kPa)		8.2	31.2	44.3	26.7	25.5	23.8	32.8	29.8	32.3	47.8	53.8	
Charging Port(Type, in.)		4	4	5	6	6	6	6	6	8	8	8	
Collectors Access Port (Type, in.)		4	4	5	6	6	6	6	8	8	8	8	

MODEL		PWS	PWS	PWS	PWS	PWS	PWS	PWS	PWS	PWS	PWS	PWS	
SPECIFICATIONS		-54	-75	-96	-120	-150	-180	-200	-220	-250	-300	-360	
Capacity(Grain)		540,000	750,000	960,000	1,200,000	1,500,000	1,800,000	2,000,000	2,200,000	2,500,000	3,000,000	3,600,000	
Vessel Diameter(mm)		750	800	900	1000	1150	1250	1300	1350	1400	1500	1600	
Inlet/Outlet Size(in.)		2"	2"	2"	2½"	2½"	4"	4"	4"	4"	4"	4"	
Flow Data	Service Flow Rates	Medium (gpm)	47.7	66.3	84.8	106.1	132.5	159.2	177.6	193.5	220.8	265.1	318.2
		Maximum (gpm)	79.5	110.4	141.3	176.7	220.8	265.1	295.9	322.4	368.1	441.7	530.1
	Regeneration (NaCl Injection)	Brine Flow Rate (gpm)	8.1	11.1	14.1	17.7	22.1	26.5	29.6	32.2	36.8	44.2	53.1
		Min. Req. Duration (min.)	22	22	22	22	22	22	22	22	22	22	22
	Rinse	Flow Rate (gpm)	28.6	39.8	50.9	63.6	79.5	95.4	106.5	116.1	132.5	159.1	190.8
		Min. Req. Duration (min.)	17	17	17	17	17	17	17	17	17	17	17
Rinse	Bed Height (mm)	1,020	1,240	1,260	1,270	1,200	1,220	1,260	1,280	1,350	1,420	1,490	
	Volume (lit)	450	625	800	1000	1250	1500	1675	1825	2075	2500	3000	
Silica Sand	Bed Height (mm)	3 x 100	3 x 100	3 x 100	3 x 100	3 x 100	3 x 100	3 x 100	3 x 100	3 x 100	3 x 100	3 x 100	
	Weight (lit)	219	249	315	390	513	606	657	708	762	876	995	
Brine (10% NaCl Solution)	NaCl (kg)	68	94	120	150	188	225	251	274	313	375	450	
	Water (lit)	608	844	1,080	1,350	1,688	2,025	2,261	2,464	2,813	3,375	4,050	
	Tank Volume (lit)	800	1,000	1,500	1,700	2,000	3,000	3,000	3,000	3,300	4,200	5,000	
General Dimensions	Height (Cap top) (mm)	2,250	2,530	2,600	2,700	2,700	2,830	2,930	2,930	3,030	3,150	3,300	
	Total Height (mm)	2,400	2,650	2,750	2,800	2,800	2,950	3,050	3,050	3,150	3,300	3,450	
	Occupied Space (mm x mm)	1380 x 1000	1510 x 1060	1600 x 1150	1770 x 1240	1900 x 1360	2230 x 1470	2280 x 1500	2330 x 1560	2380 x 1610	2480 x 1710	2580 x 1810	
Total Pressure Drop(kPa)		43.9	65.3	67.0	67.5	60.8	62.3	66.3	68.6	76.5	83.2	92.7	
Charging Port(Type, in.)		8	8	8	10	10	10	12	12	12	12	12	
Collectors Access Port (Type, in.)		10	10	10	16	16	16	16	16	16	16	16	