Dayton Water Systems

Advanced Solutions Since 1939

SIZING A WATER SOFTENING SYSTEM

The following must be considered when sizing a water softening system:

1. Flow rate (gallons per minute) _____
2. Influent water hardness (grains per gallons) _____
3. Usage (gallons per day) _____
4. Hours per day that the system will be called upon to produce soft water _____

Flow Rate

In general, it is best to base the size of your water softening system on continuous flow rather than peak flow rates. During peak flow rates the jeopardy of hardness break through is present. If flow rates are not known, helpful charts are included to approximate flow rates.

The following information has been prepared as a guide for estimating maximum flow rates for private and public buildings. The numbers assigned the various fixtures are based on a combination of flow rate and probability of use.

1. Count and total the number of each type of fixture to be serviced by the water softening system.

2. Multiply the number of each type of fixture by the UNIT COUNT given in the Fixture Unit Table.
   PRIVATE - motels
   apartment buildings
   trailer parks
   group homes
   PUBLIC - office buildings
   hospitals
   country clubs
   schools

3. Find the total FIXTURE COUNT by adding up the values found in step 2.

4. Using the correct table below, find the FIXTURE COUNT closest to the calculated value. The figure given in the right hand column is the approximate maximum GPM required.

EXAMPLE:

Type of Fixture	Qty.		Unit Count		Total
Water Closet (FV)	8	x	10	=	80
Shower	10	x	4	=	40
Lavatory	15	x	2	=	30
TOTAL FIXTURE UNIT COUNT				=	150

ESTIMATED FLOW RATE = 80 GPM

Fixture Unit Table

Type of Fixture	Units -Private-	Units -Public-
Bar Sink	1	2
Bathtub	2	4
Bedpan Washer	-	10
Bidet	2	4
Combination Sink & Tray	3	-
Dental Unit or Cuspidor	-	1
Dental Laboratory	1	2
Drinking Fountain	1	2
House Bib or Sill Cock (Std)	3	5
House Trailer (each)	6	6
Laundry Tub or Washer	2	4
Lavatory	1	2
Lawn Sprinkler (each head)	1	1
Shower	2	4
Sink; Service (Janitor's)	2	4
Sink or Dishwasher	2	4
Sink (flushing rim, clinic)	-	10
Sink (wash up, each set)	-	2
Sink (circular spray)	-	4
Urinal (wall or stall)	-	5
Urinal (flush tank)	-	3
Water Closet:		
Flushometer Valve	6	10*
Tank Type	3	5*

*Double this amount for schools

Water supply outlets for items not listed above shall be computed at their maximum demand, but in no case less than:

3/8 inch pipe	1	2
1/2 inch pipe	2	4
3/4 inch pipe	3	6
1 inch pipe	6	10

Water Hardness, Water Quality and Daily Use

Hardness is present in the water supply as calcium and magnesium bicarbonate, $CaCO_3$. Other water quality factors will influence the way the water softening system works. Dissolved iron, if present, must be taken into account when sizing the water softening system. Maximum allowable iron is 2 ppm.

To calculate the required capacity of a water softening system take a water sample and have it analyzed for hardness and iron content, or call the local municipal water treatment facility. Hardness, as $CaCO_3$, if expressed in parts per million (ppm) or milligrams per liter (mg/l) is converted to grains per gallon (gpg) by dividing ppm or mg/l by 17.1. If iron is present, multiply the amount of dissolved iron (ppm) X 4 and add it to the total grains of hardness. At this point, your total grains per gallon has been determined.

By multiplying the gallons of usage per day by grains per gallon will determine the capacity per day. If daily usage is not known, a helpful chart has been included to assist you in estimating the daily usage of many types of facilities.

Water softening systems are typically rated at 30,000 grains of removal per cubic foot of resin. However, the systems are typically operated at 20,000 grains of removal per cubic foot of resin for economy salt dosing.

EXAMPLE:

Hardness	250 ppm
Convert to grains per gallon divide by	17.1
Hardness in grains per gallon	14.6
Iron	1 ppm
Convert to grains per gallon	4
Iron in grains per gallon	4
Total grains per gallon - add iron + hardness	18.6 grains
Daily Usage	1000 gallons
Daily Capacity - multiply usage by total grains per gallon	18,600 grains

DAILY WATER USAGE ESTIMATIONS

Facility	Daily Water Usage	Facility	Daily Water Usage
Assembly Halls	2 gals/seat	Food Service Operations	
Apartment Buildings	150-200 gals/unit	Average Restaurant	70 gals/seat
Barber Shops	55 gals/chair	24 Hour Restaurant	100 gals/seat
Beauty Salons	270 gals/station	Curb Service	50 gals/car space
Bowling Alleys	75 gal/lane	Hotels	.256 gals/sq ft
Camps		Institutions	
Day (no meals)	15 gals/person	Hospitals	250 gals/bed
Resorts (day & night with limited plumbing)	50 gals/person	Rest Homes	100 gals/bed
		Laundries	
Tourist (with central bath & toilet facilities)	35 gals/person	Coin Operated	2.17 gals/sq ft
		Commercial	.253 gals/sq. ft.
Country Club		Motels	100 gals/unit
per resident member	100 gals	Office Building	20 gals/employee
per non-resident member	25 gals	Schools	
Dance Halls	2 gals/person	Boarding	80 gals/student
Department Store	.216 gals/sq ft of sales area	Day (with cafeteria, gym and showers)	25 gals/student
Factories		Day (with cafeteria only)	20 gals/student
(excluding process water)		Day (no cafeteria or gym)	15 gals/student
without showers	25 gals/person/shift	Service Stations	1000 gal-- first bay
with showers	35 gals/person/shift		500 gal/add'l bay
Farms			or 10 gal/vehicle
Cow, beef	12 gal/head	Shopping Center	.160 gal/sp ft
Cow, dairy	20 gal/head	Stores	400 gal/toilet rm
Goat	2 gal/head	Theatres	
Hog	12 gal/head	Drive-In	5 gals/car space
Horse	12 gal/head	Movie	2 gals/seat/movie
Mule	12 gal/head	Trailer Parks	100 gals/space
Sheep	2 gals/head		
Chickens	10 gals/100		
Turkeys	18 gals/100		

NOTE: For hot only, use 60% of above figures

Hours of Service

One of the most important factors in determining the size and configuration of a water softening system is the hours of service the system will be called upon to produce soft water. If the system will be required to produce soft water 24 hours per day and no down time can be determined, a dual system will be required. If the system is only required to produce soft water part of the day and down time can be determined, a single tank water softening system may be used. However, in certain circumstances when capacity greatly exceeds flow rate requirements, a dual system can provide a cost savings.

Water Softening System Sizing Worksheet

Hardness (ppm)		_____
	divide by	17.1
Hardness (gpg)		_____
Iron (ppm) X 4	add	_____
Total grains per gallon		_____
Usage per day (gallons)	multiply	_____
Capacity per day (grains)		_____
Required flow rate (gpm)		_____
Peak flow rate (gpm)		_____
Hours of service		_____
Down time		_____

Grains Per Day vs. Flow Rate

Water softener must meet or exceed both:
- --Flow rate specified by the water softening system and
- --Total capacity in grains per day specified by the water softening system

Single-Tank Water Softening System vs Dual Tank Water Softening System

Down-time of water softening system is known.

Soft water requirement is for 24 hours or exact down time is not known.

Capacity requirement greatly exceeds flow rate requirement (i.e., softener needed to satisfy capacity requirement is much larger than the softener required to satisfy the flow rate)

Daily usage requirements fluctuate or actual daily usage cannot be determined.