

Calculations for Elution Study

Area of Vessels Cross Section:

$$A = \pi r^2$$

Where: A = area of the vessel in square feet
 $\pi = 3.1415$
r = radius of vessel in feet

Example: $A = 3.1415 \times 2^2 = 12.6 \text{ ft}^2$

Volume of Resin:

$$V = A \times D$$

Where: V = volume of resin in cubic feet
A = area of vessel in square feet
D = depth of resin bed in feet

Example: $V = 12.6 \times 3 = 37.8 \text{ ft}^3$

Maximum Flow Rate of Backwash:

$$\text{Max BW}_{\text{flow}} = 6.0 \times A$$

Where: $\text{Max BW}_{\text{flow}}$ = max flow of backwash in GPM
A = area of vessel in square feet

Example: $\text{Max BW}_{\text{flow}} = 6.0 \times 12.6 = 75 \text{ GPM}$

Total Flow of Brine and Dilution Water During Brine Draw:

$$\text{Total BD}_{\text{flow}} = 1.9 \times A_{\text{softener}}$$

Where: $\text{Total BD}_{\text{flow}}$ = total flow of brine and dilution water in GPM
A = area of vessel in square feet

Example $\text{Total BD}_{\text{flow}} = 1.9 \times 12.6 = 24 \text{ GPM}$

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Flow of Brine During Brine Draw:

$$BD_{\text{flow}} = 0.385 \times \text{Total } BD_{\text{flow}}$$

Where: BD_{flow} = flow of brine in GPM
Total BD_{flow} = total flow of brine and dilution water in GPM

Note: The eductor drive water ideally dilutes the brine in a 1.6 to 1.0 ratio (1/2.6 = 0.385)

Example $BD_{\text{flow}} = 0.385 \times 24.0 = 9.2$ GPM

Amount of Brine Needed:

$$\text{Brine} = \text{Total Salt} / 2.6$$

Where Brine = amount of 100% saturated brine in gallons
Total Salt = total salt needed
2.6 = lbs of salt in one gallon of 100% saturated brine at 70 °F

Note: Total salt is determined by Dosage X Volume of Resin. Dosages range from 6 to 15 lbs per cubic foot of resin. For this example, use 10 lb dosage per cubic foot of resin.

Example $\text{Brine} = (37.8 \times 10) / 2.6 = 145.4$ gallons

Time For Brining:

$$\text{Time} = \text{Brine} / BD_{\text{flow}}$$

Where Time = time for brining in minutes
 Brine = amount of 100% saturated brine in gallons
 BD_{flow} = flow of brine in GPM

Example $\text{Time} = 145.4 / 9.2 = 15.8$ minutes

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Flow of Dilution Water in Slow Rinse:

$$DW_{\text{flow}} = \text{Total } BD_{\text{flow}} - BD_{\text{flow}}$$

Where DW_{flow} = flow of dilution water in GPM
Total BD_{flow} = total flow of brine and dilution water in GPM
 BD_{flow} = flow of brine in GPM

Example $DW_{\text{flow}} = 24.0 \times 9.2 = 14.8$ GPM

Run Length of Softener:

$$\text{Run Length} = (\text{SCap} \times V) / \text{Hardness}$$

Where Run Length = run length of softener in gallons
SCap = softening capacity of resin for the salt dosage used in brine draw
in kilograins per cubic foot resin
V = volume of resin in cubic feet
Hardness = hardness of raw water in grains per gallon

Note: 17.1 ppm = 1 grain per gallon

Example Run Length = $(30,000 \times 37.8) / 10.0 = 113,400$ gallons