Calculations for Elution Study

Area of Vessels Cross Section:

\[ A = \pi r^2 \]

Where:
- \( A \) = area of the vessel in square feet
- \( \pi \approx 3.1415 \)
- \( r \) = 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:
\[ \text{Total BD}_{\text{flow}} = 1.9 \times 12.6 = 24 \text{ GPM} \]
Calculations for Elution Study

Flow of Brine During Brine Draw:

\[ \text{BD}_{\text{flow}} = 0.385 \times \text{Total BD}_{\text{flow}} \]

Where: \( \text{BD}_{\text{flow}} = \) flow of brine in GPM  
\( \text{Total BD}_{\text{flow}} = \) 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 \( \text{BD}_{\text{flow}} = 0.385 \times 24.0 = 9.2 \text{ GPM} \)

Amount of Brine Needed:

\[ \text{Brine} = \frac{\text{Total Salt}}{2.6} \]

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

Note: Total salt is determined by Dosdage 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 \( \text{Brine} = \frac{(37.8 \times 10)}{2.6} = 145.4 \text{ gallons} \)

Time For Brining:

\[ \text{Time} = \frac{\text{Brine}}{\text{BD}_{\text{flow}}} \]

Where \( \text{Time} = \) time for brining in minutes  
\( \text{Brine} = \) amount of 100% saturated brine in gallons  
\( \text{BD}_{\text{flow}} = \) flow of brine in GPM

Example \( \text{Time} = \frac{145.4}{9.2} = 15.8 \text{ minutes} \)
Flow of Dilution Water in Slow Rinse:

\[ \text{DW}_{\text{flow}} = \text{Total BD}_{\text{flow}} - \text{BD}_{\text{flow}} \]

Where

- \( \text{DW}_{\text{flow}} \) = flow of dilution water in GPM
- \( \text{Total BD}_{\text{flow}} \) = total flow of brine and dilution water in GPM
- \( \text{BD}_{\text{flow}} \) = flow of brine in GPM

Example

\[ \text{DW}_{\text{flow}} = 24.0 \times 9.2 = 14.8 \text{ GPM} \]

Run Length of Softener:

\[ \text{Run Length} = \frac{(\text{SCap} \times V)}{\text{Hardness}} \]

Where

- Run Length = run length of softener in gallons
- \( \text{SCap} \) = 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

\[ \text{Run Length} = \frac{(30,000 \times 37.8)}{10.0} = 113,400 \text{ gallons} \]