Reverse Osmosis Data Normalisation: Standard Flow and Salt Passage

Normalises RO permeate flow and salt passage to standard conditions with the temperature correction, net driving pressure and feed-concentrate osmotic pressure.

Input parameters

Unit system: SI

Parameter	Value	Unit
Permeate flow (actual)	12,000	m^3/d
Feed pressure (actual)	62.000	bar
Concentrate pressure (actual)	60.000	bar
Permeate pressure (actual)	1.0000	bar
Feed TDS (actual)	38,000	mg/L
Permeate TDS (actual)	250.00	mg/L
Recovery (actual)	45.000	%
Water temperature (actual)	30.000	°C
Standard temperature	25.000	°C
Standard feed pressure	55.000	bar
Standard permeate pressure	0	bar
Standard feed-to-concentrate pressure drop	1.0000	bar
Standard feed TDS	32,000	mg/L
Standard permeate TDS	200.00	mg/L
Standard recovery	50.000	%
Ions per formula unit (NaCl 2)	2.0000	
Molar mass of the salt (NaCl 58.44)	58.440	kg/kmol

Calculated results

Parameter	Value	Unit
Temperature correction factor	0.86261	
Mean feed-concentrate TDS (actual)	50,484	mg/L
Feed-concentrate osmotic pressure (actual)	43.548	bar
Net driving pressure (actual)	16.668	bar
Net driving pressure (standard)	17.034	bar
Normalised permeate flow	10,579	m^3/d
Salt passage (actual)	0.65789	%
Normalised salt passage	0.67173	%

Notes for this case

- Pressures are gauge. Osmotic pressure by van 't Hoff with full dissociation; the feed-concentrate concentration is the log-mean C_F ln[1/(1 − r)]/r. A drop of 10–15 % in normalised flow or a rise in normalised salt passage signals cleaning.

Formula and method

$$TCF = 1.03^{(T_s - T)}, \quad C_{FC} = C_F \frac{\ln[1/(1-r)]}{r}, \quad \pi = iCRT$$

$$NDP = \frac{P_F + P_C}{2} - P_P - (\pi_{FC} - \pi_P), \quad Q_{p,s} = Q_p \, TCF \frac{NDP_s}{NDP}$$

$$SP_s = SP \frac{NDP}{NDP_s} \frac{C_{FC,s}/C_{F,s}}{C_{FC}/C_F}$$

Variables

Q_p	Permeate flow (actual)	m³/s
P_F	Feed pressure (actual)	Pa
P_C	Concentrate pressure (actual)	Pa
P_P	Permeate pressure (actual)	Pa
C_F	Feed TDS (actual)	kg/m³
C_P	Permeate TDS (actual)	kg/m³
r	Recovery (actual)	-
T	Water temperature (actual)	K
T_s	Standard temperature	K
$P_{F,s}$	Standard feed pressure	Pa
$P_{P,s}$	Standard permeate pressure	Pa
ΔP_s	Standard feed-to-concentrate pressure drop	Pa
$C_{F,s}$	Standard feed TDS	kg/m³
$C_{P,s}$	Standard permeate TDS	kg/m³
r_s	Standard recovery	-
i	Ions per formula unit (NaCl 2)	-
M	Molar mass of the salt (NaCl 58.44)	kg/kmol
TCF	Temperature correction factor	-
C_{FC}	Mean feed-concentrate TDS (actual)	kg/m³
π_{FC}	Feed-concentrate osmotic pressure (actual)	Pa
NDP	Net driving pressure (actual)	Pa
NDP_s	Net driving pressure (standard)	Pa
$Q_{p,s}$	Normalised permeate flow	m³/s
SP	Salt passage (actual)	-
SP_s	Normalised salt passage	-

Method and standards

Standardisation of RO operating data.

Assumptions and limits

- Van 't Hoff osmotic pressure (dilute, single salt); temperature correction 3 % per °C.

Report details

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Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

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Reopens the calculator with the inputs of this report.