RO Concentration Polarisation Factor and Membrane Wall Concentration

Mass transfer coefficient in a spiral-wound feed channel, the concentration polarisation factor and the solute concentration at the membrane surface.

Input parameters

Unit system: SI

Parameter	Value	Unit
Feed channel velocity	0.10000	m/s
Feed channel height (spacer)	0.71000	mm
Permeate flux	30.000	L/(m²·h)
Bulk solute concentration	2,000.0	mg/L
Solute diffusivity in water	1.5000e-09	m²/s
Correlation coefficient	0.47000	
Water density	998.00	kg/m³
Water viscosity	1.0000	mPa·s

Calculated results

Parameter	Value	Unit
Hydraulic diameter (2h)	1.4200	mm
Reynolds number	141.72	
Schmidt number	668.00	
Mass transfer coefficient	0.051666	mm/s
Concentration polarisation factor	1.1750	
Concentration at the membrane surface	2,350.1	mg/L

Notes for this case

• High-rejection form β = exp(J_w/k). Manufacturers limit β to about 1.2 per element to control scaling and fouling at the membrane surface.

Formula and method

$$Re = \frac{\rho v d_H}{\mu}, \quad Sc = \frac{\mu}{\rho D_L}, \quad k_{CP} = a \frac{D_L}{d_H} Re^{0.5} Sc^{1/3}$$

$$\beta = \frac{C_M}{C_F} = \exp\left(\frac{J_w}{k_{CP}}\right)$$

Variables

v	Feed channel velocity	m/s
h	Feed channel height (spacer)	m
J_w	Permeate flux	m/s
C_F	Bulk solute concentration	kg/m³
D_L	Solute diffusivity in water	m²/s
a	Correlation coefficient	-
ρ	Water density	kg/m³

μ	Water viscosity	Pa·s
d_H	Hydraulic diameter (2h)	m
Re	Reynolds number	-
Sc	Schmidt number	-
k_{CP}	Mass transfer coefficient	m/s
β	Concentration polarisation factor	-
C_M	Concentration at the membrane surface	kg/m³

Method and standards

Film theory of concentration polarisation with a spacer-channel mass transfer correlation.

Report details

Report reference	FCC-SV2Z-8MM1 (the same inputs always give the same reference)
Generated	23 November 2026, 17:34 UTC
Calculator	RO Concentration Polarisation Factor and Membrane Wall Concentration
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 22 November 2026
Release checks	3 reference cases of this calculator, computed independently, are checked on every release

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

This calculator online

https://calc.firecad.com/environmental/drinking-water/ro-concentration-polarisation

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.