Whey or Milk RO Concentration: Permeate and Retentate

Permeate and retentate flows, volume concentration factor and retentate solids of a reverse osmosis or nanofiltration plant from feed, solids and solids rejection.

Method: Mass and energy balances (definitions): solids balance with a solids rejection

Input parameters

Unit system: SI

Parameter	Value	Unit
Feed	20.000	m³/h
Feed total solids	6.0000	%
Target retentate solids	18.000	%
Solids rejection	99.000	%

Calculated results

Parameter	Value	Unit
Retentate	6.6221	m³/h
Permeate	13.378	m³/h
Volume concentration factor	3.0202	
Permeate solids	0.060000	%

Notes for this case

- Permeate solids are estimated from the rejection at feed concentration; real permeate gets richer as the retentate concentrates.

Formula and method

$$x_P = x_F(1-R), \quad \dot{V}_R = \dot{V}_F \frac{x_F - x_P}{x_R - x_P}, \quad VCF = \frac{\dot{V}_F}{\dot{V}_R}$$

Variables

$\dot{V}_F$	Feed	m³/s
x_F	Feed total solids	-
x_R	Target retentate solids	-
R	Solids rejection	-
$\dot{V}_R$	Retentate	m³/s
$\dot{V}_P$	Permeate	m³/s
VCF	Volume concentration factor	-
x_P	Permeate solids	-

Method and standards

Solids balance (densities taken equal).

Assumptions and limits

- Equal densities; constant rejection. An 18 % concentrate is several per cent denser than permeate, so the retentate volume is slightly overstated.
- Retentate solids above about 22 %, the practical RO limit for whey quoted in the FAQ, are flagged.

References

- Mass and energy balances (definitions): solids balance with a solids rejection

Report details

Report reference	FCC-EGEZ-RMDM (the same inputs always give the same reference)
Generated	17 November 2026, 19:50 UTC
Calculator	Whey or Milk RO Concentration: Permeate and Retentate
Method last reviewed	13 November 2026
Software release	FireCAD Calc, release of 17 November 2026
Release checks	2 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/chemical/food-dairy/whey-ro-concentration

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.