Condensate Polishing Unit: Permeate and Reject

Permeate and reject flows and COD of a condensate polishing (RO) unit from the condensate flow, the recovery, the feed COD and the membrane rejection.

Method: Flow and solute balance across a membrane stage with a rejection

Input parameters

Unit system: SI

Parameter	Value	Unit
Process condensate	650.00	m³/d
Recovery (permeate / feed)	85.000	%
Feed COD	1,500.0	mg/L
COD rejection by the membranes	95.000	%

Calculated results

Parameter	Value	Unit
Permeate	552.50	m³/d
Reject	97.500	m³/d
Permeate COD	75.000	mg/L
Reject COD	9,575.0	mg/L

Notes for this case

- The reject usually returns to the evaporator; check its COD against what the evaporator can take.

Formula and method

$$\dot{V}_p = \dot{V}R, \quad c_p = c_f(1-\rho_r), \quad c_r = \frac{\dot{V}c_f - \dot{V}_p c_p}{\dot{V} - \dot{V}_p}$$

Variables

$\dot{V}$	Process condensate	m³/s
R	Recovery (permeate / feed)	-
c_f	Feed COD	kg/m³
ρ_r	COD rejection by the membranes	-
$\dot{V}_p$	Permeate	m³/s
$\dot{V}_r$	Reject	m³/s
c_p	Permeate COD	kg/m³
c_r	Reject COD	kg/m³

Method and standards

Mass balance.

Assumptions and limits

- Single stage.
- The rejection is applied to the feed COD. In a real RO stage the permeate follows the mean feed-side concentration, which rises with recovery, so at high recovery the permeate COD here is understated and the reject COD overstated.

References

- Flow and solute balance across a membrane stage with a rejection

Report details

Report reference	FCC-RF17-AR51 (the same inputs always give the same reference)
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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/sugar-ethanol/spent-wash-zld/condensate-polishing-unit

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.