Membrane Filtration Plant Sizing from Pilot Data

Online production factor, recovery, feed flow, membrane area, modules and racks of a low-pressure membrane plant from pilot flux, backwash, testing and cleaning.

Input parameters

Unit system: SI

Parameter	Value	Unit
Net permeate production	20,000	m³/d
Design flux at the design temperature	45.000	L/(m²·h)
Filtration time per cycle	30.000	min
Backwash time per cycle	1.5000	min
Backwash volume per module	80.000	L
Membrane area per module	38.000	m²
Integrity test time per day	15.000	min
Duration of one clean-in-place	6.0000	h
Days between cleanings	21.000	
Maximum modules per rack	80.000	

Calculated results

Parameter	Value	Unit
Online production factor	93.006	%
System recovery	90.643	%
Feed flow	22,065	m³/d
Membrane area required	21,966	m²
Modules required	579.00	
Racks	8.0000	
Modules per rack (equal racks)	73.000	

Notes for this case

- Design flux at the lowest water temperature should govern. Add spare racks so the plant still meets demand with one rack in cleaning or repair.

Formula and method

$$\eta = \frac{1440 - t_{bw} - t_{dit} - t_{cip}}{1440}, \quad r = \frac{J a t_f - V_{bw}}{J a t_f}$$

$$Q_f = \frac{Q_p}{r}, \quad A = \frac{Q_f}{J \eta}$$

Variables

Q_p	Net permeate production	m³/s
J	Design flux at the design temperature	m/s
t_f	Filtration time per cycle	s
t_{bw}	Backwash time per cycle	s

V_{bw}	Backwash volume per module	m³
a_m	Membrane area per module	m²
t_{dit}	Integrity test time per day	s
t_{cip}	Duration of one clean-in-place	s
t_{int}	Days between cleanings	-
n_{rack}	Maximum modules per rack	-
η	Online production factor	-
r	System recovery	-
Q_f	Feed flow	m³/s
A	Membrane area required	m²
N_{mod}	Modules required	-
N_{rack}	Racks	-
n	Modules per rack (equal racks)	-

Method and standards

Time-averaged production and recovery of a backwashed membrane system.

Assumptions and limits

- Constant flux operation; backwash with permeate.

Report details

Report reference	FCC-E6FH-KZXA (the same inputs always give the same reference)
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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/membrane-filtration-system-sizing

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.