Membrane Bioreactor: Membrane Area and Modules

Membrane area and module count of a membrane bioreactor (MBR) from flow, design flux and the relaxation or backwash time lost, with the net flux and peak check.

Method: Metcalf & Eddy; Wastewater Engineering: Treatment and Resource Recovery; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Average flow	2,000.0	m^3/d
Peak flow factor	1.5000	
Design net flux at average flow (L/(m²·h))	20.000	
Maximum sustainable peak flux (L/(m²·h))	35.000	
Time lost to relaxation and backwash	10.000	%
Membrane area per module	35.000	m^2

Calculated results

Parameter	Value	Unit
Membrane area	4,200.0	m^2
Modules (rounded up)	120.00	
Gross flux while filtering (L/(m²·h))	22.222	
Net flux at peak flow (L/(m²·h))	29.762	

Notes for this case

- Typical municipal MBR net flux: 15–25 L/(m²·h) average; industrial wastes often lower. Follow the membrane supplier's design flux.

Formula and method

$$A_0 = \frac{Q}{J}, \quad n = \left\lceil \frac{A_0}{A_m} \right\rceil, \quad A = nA_m, \quad J_g = \frac{J}{1 - f_{off}}, \quad J_{peak} = \frac{PF \cdot Q}{nA_m}$$

Variables

Q	Average flow	m^3/s
PF	Peak flow factor	-
J	Design net flux at average flow (L/(m²·h))	-
$J_{p,max}$	Maximum sustainable peak flux (L/(m²·h))	-
f_{off}	Time lost to relaxation and backwash	-
A_m	Membrane area per module	m^2
A	Membrane area	m^2
n	Modules (rounded up)	-
J_g	Gross flux while filtering (L/(m²·h))	-
J_{peak}	Net flux at peak flow (L/(m²·h))	-

Method and standards

Flux definitions.

Assumptions and limits

- Net flux design: the area is sized on the net flux J; the downtime share f_off only raises the gross flux while filtering. A is the installed area n A_m (slightly above Q/J).

References

• Metcalf & Eddy
• Wastewater Engineering: Treatment and Resource Recovery
• 5th ed. (McGraw-Hill, 2014)
• ch. 8 (membrane bioreactors: flux and membrane area)

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

https://calc.firecad.com/environmental/wastewater/mbr-membrane-area

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.