Hollow-Fibre Membrane Module: Area and Flow, Inside-Out or Outside-In

Membrane area of a hollow-fibre module on the outside or inside fibre surface, the permeate flow at a given flux and the packing density.

Input parameters

Unit system: SI

Parameter	Value	Unit
Number of fibres	10,000	
Fibre length	2.0000	m
Fibre outside diameter	1.3000	mm
Fibre inside diameter	0.80000	mm
Flux	60.000	L/(m²·h)
Module inside diameter (0 if unknown)	250.00	mm

Calculated results

Parameter	Value	Unit
Membrane area on the outside surface	81.681	m²
Membrane area on the inside surface	50.265	m²
Permeate flow, outside-in	4,900.9	L/h
Permeate flow, inside-out	3,015.9	L/h
Flow ratio at equal flux	1.6250	
Packing density on the outside area	832.00	m²/m³
Fibre fill fraction of the module cross-section	27.040	%

Notes for this case

- Flux is quoted on the surface that faces the feed: the outside for outside-in (submerged or pressurised) and the inside for inside-out operation, so modules must be compared on flow, not flux.

Formula and method

$$A_{out} = n\pi d_o L, \quad A_{in} = n\pi d_i L, \quad Q = JA$$

$$\frac{A_{out}}{V} = \frac{4nd_o}{D_m^2}, \quad \phi = n\left(\frac{d_o}{D_m}\right)^2$$

Variables

n	Number of fibres	-
L	Fibre length	m
d_o	Fibre outside diameter	m
d_i	Fibre inside diameter	m
J	Flux	m/s
D_m	Module inside diameter (0 if unknown)	m
A_{out}	Membrane area on the outside surface	m²
A_{in}	Membrane area on the inside surface	m²
Q_{out-in}	Permeate flow, outside-in	m³/s

Q_{in-out}	Permeate flow, inside-out	m³/s
Q_{out}/Q_{in}	Flow ratio at equal flux	-
A_{out}/V	Packing density on the outside area	m²/m³
ϕ	Fibre fill fraction of the module cross-section	-

Method and standards

Membrane area of a hollow-fibre bundle on either fibre surface.

Assumptions and limits

- Active length equals the fibre length entered.

Report details

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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/hollow-fibre-module-flow

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.