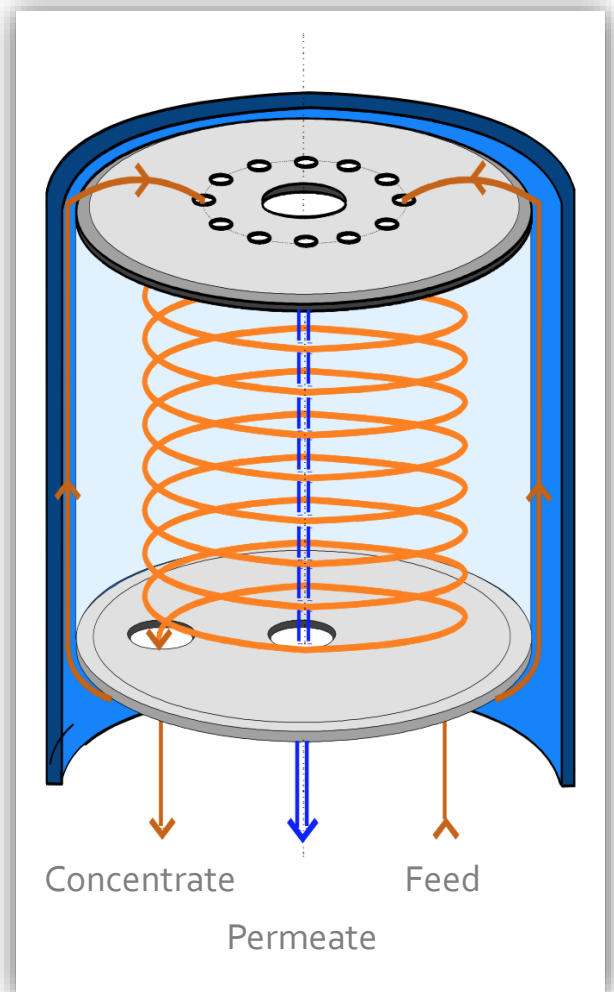
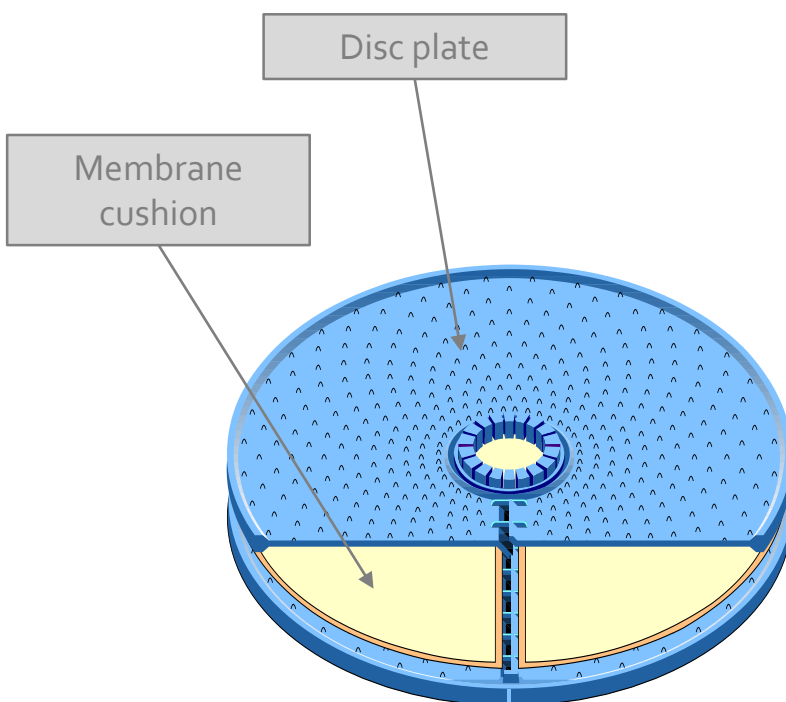


Processes such as MLD (Minimal Liquid Discharge) and ZLD (Zero Liquid Discharge) to minimize or avoid wastewater discharge are one of the outstanding challenges in the field of environmental protection. Our plate-and-frame reverse osmosis, the CD-g module, allows wastewater to be concentrated to such an extent that its disposal or further treatment (crystallization or evaporation) are economically feasible and acceptable.

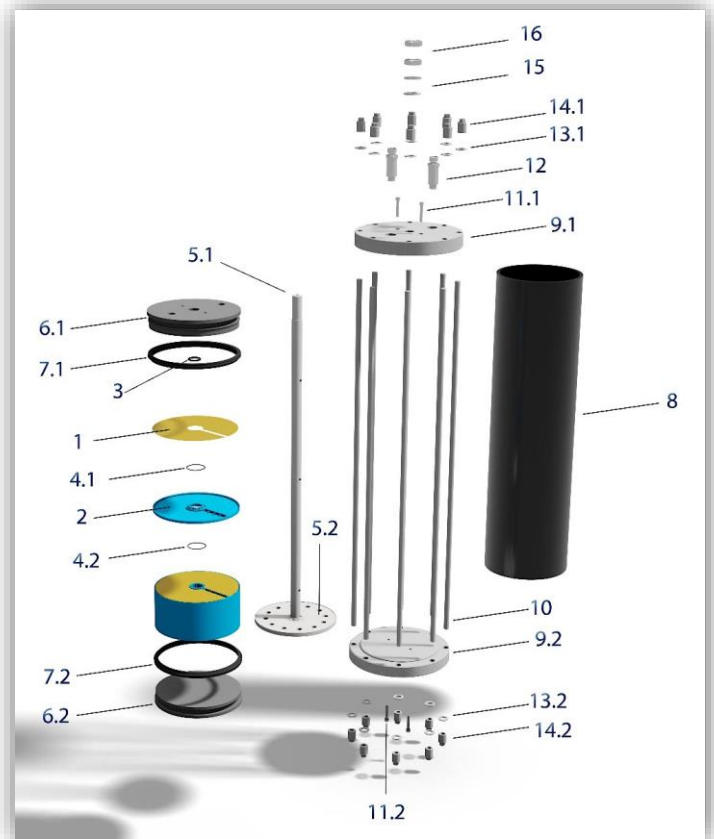
By directing the feed flow along a helical pattern through the stack of disc plates, we get a steady and well-defined flow regimen on all the membrane surface. The permeate crosses the membrane into the membrane cushion and leaves the disc plate to the center of the module.



The stack of disc plates is installed within a pressure vessel sealed with end plates and tie rods.

O-rings on the disc plates separate the permeate extracted through the membrane cushions from the raw water.

The pressure vessel is connected via hoses to the feed water, concentrate and permeate manifolds.



Applications of CD-9 modules:

- concentration of tough-to-treat wastewater (produced water; mine drainage; landfill and composting leachate; F&B, pharma, distillery, textile, tannery and metal working effluents);
- wastewater reuse;
- process water recycling (metal industry; deionization wastes; chemical baths);
- brine concentration;
- Minimum and Zero Liquid Discharge (MLD/ZLD).

CD-9 module specific advantages:

- wide applicability since it is possible to use any membrane material (as long as it can be thermally welded)
- high water recovery thanks to the high operating pressures and optimized hydraulic regimen
- simpler pre-treatments are requested (compared to spiral-wound RO elements)
- low energy consumption because of low crossflow requirements (compared to tubular RO modules) and of low pressure losses (compared to other plate-and-frame RO modules)
- longer membrane lifetime thanks to the optimized hydraulic regimen (lower mechanical stress, cake layer and concentration polarization control)
- ease of cleaning due to the optimized hydraulic regimen
- ease of maintenance due to the simple module construction
- clusterization capability to reduce CapEx and OpEx

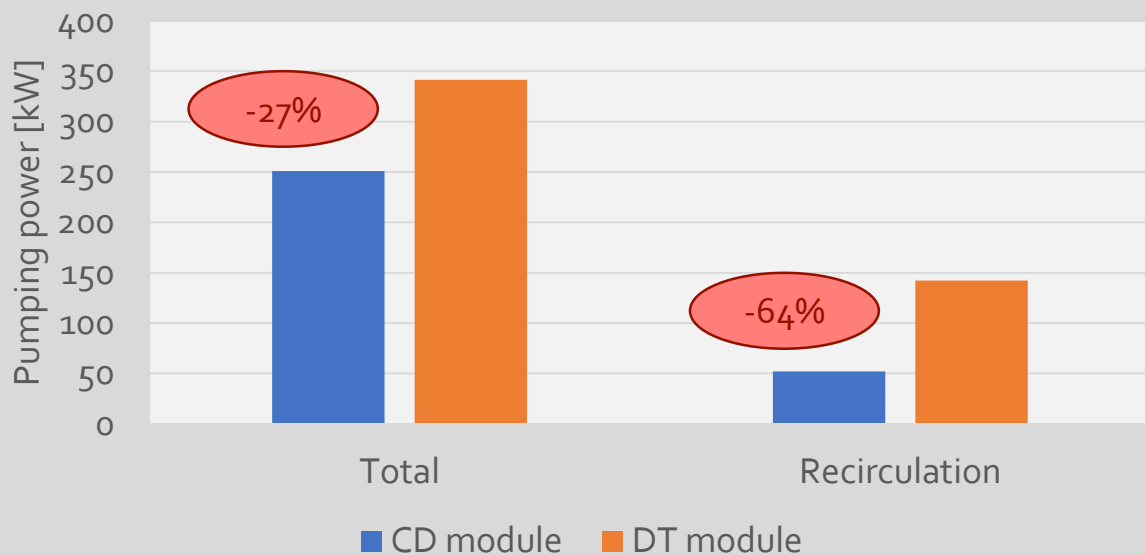


Compared to other plate-and-frame solutions, the unique CD-9 module design avoids:

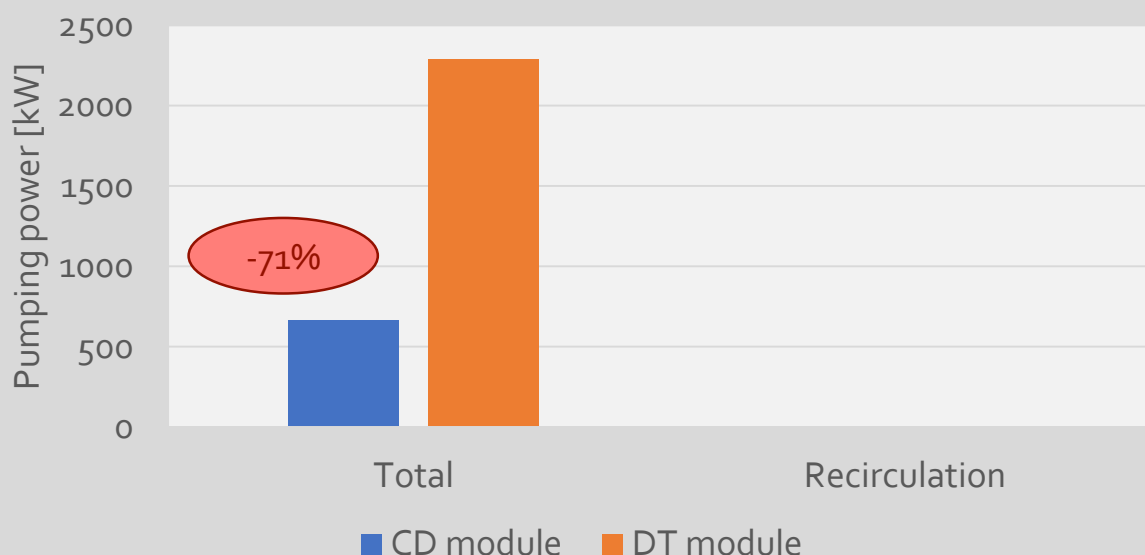
- sharp 180° turns since the flow from one disc to the next follows a 35° flat ramp;
- changes in the size of the flow channel and thus in the flow velocity ( $\pm 10\%$ ).

Therefore, pressure loss across the module is equal to only 1.5 ÷ 2.5 bar and concentration polarization phenomena are reduced as well.

## Landfill leachate treatment example



## Brine concentration example



Parameter	Value
Flow direction	Out-to-in
Membrane manufacturer	DOW Filmtec
Membrane type (RO applications)	BW30LE or SW30ULE
Membrane material	PA
Cushions per module	115
Disc plate material	Proprietary
Casing material	FRP, PVC, coated SS 1.0577 and SS 1.4571
Membrane area	9.0 m <sup>2</sup>
Packing density	94.5 m <sup>2</sup> /m <sup>3</sup>
Feed flow channel width	2.5 mm
Feed flow velocity	0.5 m/s
Feed flow length	50 m
Feed flow Reynolds number	2,700
Nominal NaCl rejection rate	99.2 ÷ 99.6%
Nominal feed flow	750 ÷ 900 L/h
Maximum feed flow	1,200 L/h
Operating temperature range	5 ÷ 40°C
Maximum cleaning temperature	45°C
Maximum operating pressure	140 bar
Pressure drop per module	1.9 bar
Unit pressure drop	0.21 bar/m <sup>2</sup>
Operating pH range	4 ÷ 11
Cleaning pH range	2 ÷ 13
Maximum inlet SDI	15
Length	1,170 mm
Maximum external diameter	322 mm
Weight (empty)	120 kg
Weight (full)	150 kg
Feed connection	G1/2"
Permeate connection	G1/4"
Concentrate connection	G1/2"