



# Likuid-CBR® Filtration systems for MBRs

Robust and compact MBRs that require minimum maintenance.

# Why MBR technology?

## ► Limitations of Conventional Activated Sludge Process

1. High footprint (decanters, lower MLSS)
2. Discharge requirements: more demanding (sensible areas, bathing water...)
3. Decanter defficiencies (*Bulking*)

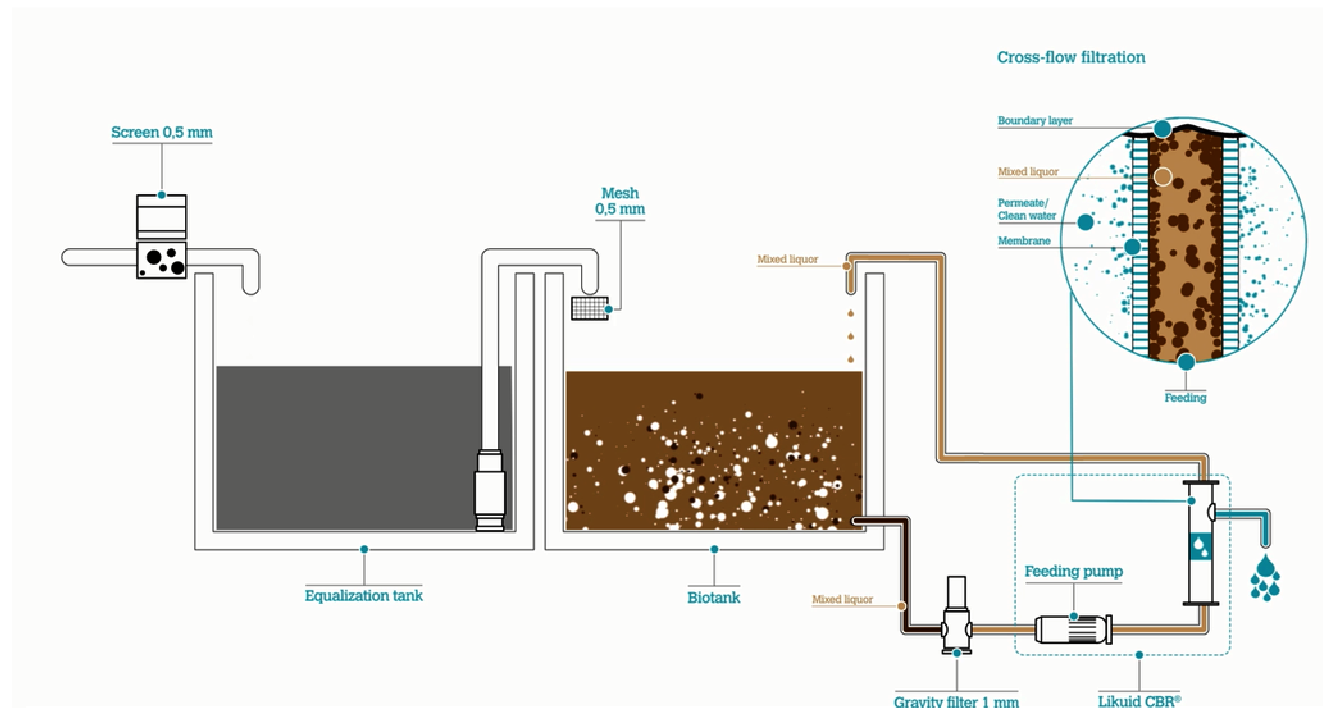
## ► IMPLICACIONES of installing membranes instead of decanters

- High effluent quality (total solids retention and disinfection)
- Higher biomass concentration in the biological reactor (MLSS x 4)
- Lower footprint (NO decanters and higher MLSS)
- Higher SRT → lower excess sludge production
- Stable effluent quality
- Effluent suitable for reuse or post-treatment (RO)



# Likuid-CBR®

1. Likuid Ceramic Bioreactor. Tangential filtration system based on ceramic membranes.
2. The system is coupled directly to the biological reactor, creating a closed loop with the biotank, obtaining a **high-quality solids free and disinfected permeate**, suitable for reuse.



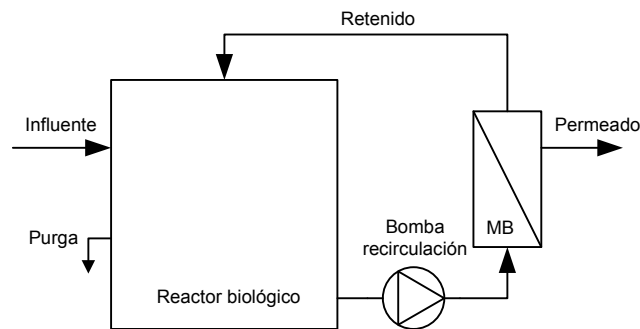
# CBR®: Advantages for MBR

## 1. **Quality of treated water.** High quality effluent without SS nor bacteria, suitable for reuse.

- SS ~ 0 mg/L
- Turbidity < 1 NTU
- Removal of bacteria, nematodes, etc.
- Reduction > 6log of virus
- Optimum quality for water reuse, according to different regulations (RD 1620/2007 in Spain)
- Increased biodegradability due to complete retention of biomass

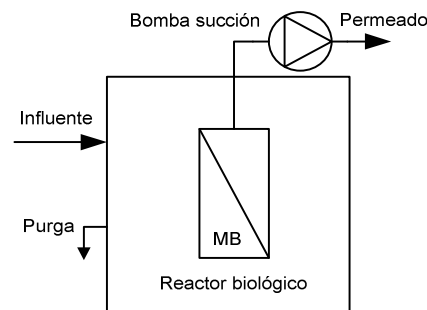
# CBR®: Advantages for MBR

1. **Quality of treated water.** High quality effluent without SS nor bacteria, suitable for reuse.
2. **Compactness.** With Likuid-CBR filtration system, the membrane bioreactor is highly compact, because the membranes are external to the bioreactor and the high fluxes allow to minimize the membrane surface installed.



## INTENSIVE operation

- Permeate through pressure
- 2 flows: permeate + retentate
- Fouling prevention: VELOCITY
- Higher flux (90-120 L/hm<sup>2</sup>)
- High MLSS allowed (up to 30 g/L)
- High pressure (~2-3 bar)
- Higher energy consumption
- More compact systems



## EXTENSIVE operation

- Permeate through suction
- One flow: permeate
- Fouling prevention: AERATION
- Moderate flux (20-30 L/hm<sup>2</sup>)
- SSLM ~ 10 g/L
- Low pressure (< 0.5 bar)
- Additional membrane tank required
- More complex maintenance

CASP

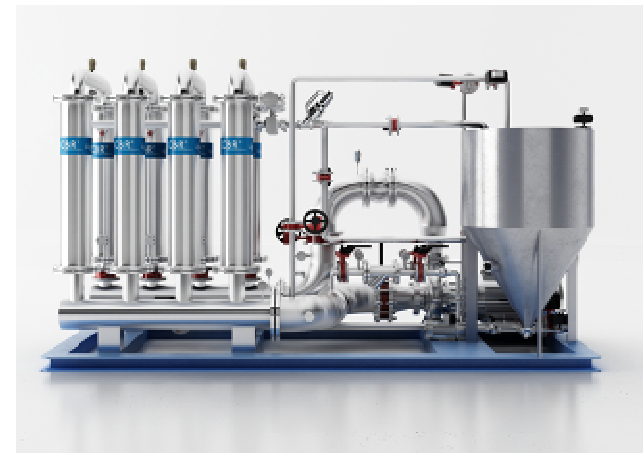
Submerged MBR  
(50%)

Likuid-CBR  
(25%)

## CBR®: Advantages for MBR

1. **Quality of treated water.** High quality effluent without SS nor bacteria, able to be reused.
2. **Compactness.** With Likuid-CBR filtration system, the membrane bioreactor is the most compact of the market.
3. **Robustness.** The membranes of the Likuid-CBR® series allow to work with a wide range of MLSS, up to 30.000 mg/L, without loss of performance, low fouling and low maintenance. These membranes support the presence of solvents in the water as well as high concentrations of oxidizers, oils and greases.

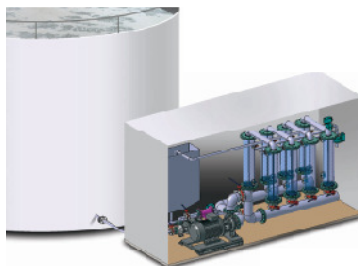
- Long lifetime (2-4 times more than organic membranes )
- Wide range of MLSS concentration (up to 30.000 mg/L)
- Minimal fouling (High hydrophilicity)
- Not affected by solvents and oxidizers
- High O&G concentrations allowed
- Temperature up to 90°C
- pH 0-14
- Aggressive chemical cleaning allowed



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  - 3. Robustness.** The membranes of the series Likuid-CBR allow to with a wide range of MLSS, up to 30.000 mg/L, without loss of performance.
  - 4. Modularity.** As it is a modular system , it is possible to increase the treatment capacity by placing new modules in parallel without having to expand the bioreactor.
- Operational conditions adapted to treatment requirements
  - Flow and load can be changed without modifying the biological reactor

Load (kgCOD/day)	1.000	2.000	4.000
Flow (m3/day)	250	250	750



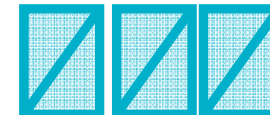
Bioreactor  
SSL: 5 g/L



Bioreactor  
SSL: 10 g/L

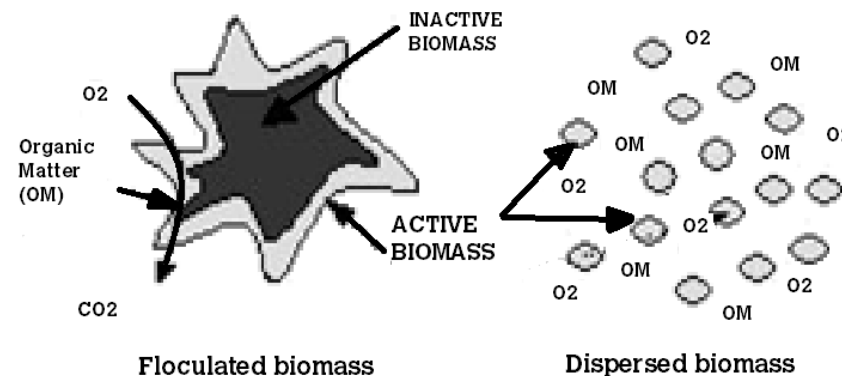


Bioreactor  
SSL: 20 g/L



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4. **Modularity.** It is a modular system and it is possible to increase the treatment capacity by placing new modules in parallel without having to expand the bioreactor.
5. **Minimum sludge production.** The cross-flow filtration allows to work with small 15-30  $\mu\text{m}$  flocs, achieving a very high concentration of active biomass because of the enhanced nutrient/oxygen flow through the floc surface. That supposes low F/M ratios and minimum sludge production, which can be zero under certain conditions.





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3. **Robustness.** The membranes of the series Likuid-CBR allow to work under highly variable MLSS and at concentrations up to 30 g/l without loss of performance.
4. **Modularity.** It is a modular system and it is possible to increase the treatment capacity by placing new modules in parallel without having to expand the bioreactor.
5. **Minimum production of biological sludge.** The cross-flow filtration allows to work with 15-30 µm flocs which achieves a very high concentration of active biomass.
6. **Reliability and durability.** Ceramic membranes are inert to chemical attack and their average life doubles that of organic membranes. Maintenance requirements are significantly reduce.

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7. **Ease of maintenance.** External membranes make the chemical cleaning easier, as the filtration circuit is easily isolated from the bioreactor. The accessibility to the membranes is significantly better and the modules can be easily opened so that tasks of monitoring and maintenance are facilitated.

# CBR®: Operating conditions

## Bioreactor

1. **MLSS.** Standard concentration 10-15 g/L.  
However, it can be operated over the range from 0 to 30 g/L with slight changes in the permeability, which makes easier the start-up and running of a plant as well as the performance under punctual peaks of load.
2. **Temperature.** It can be designed in all the meso (up to 38-40°C) and thermophilic (up to 65°C) ranges.
3. **Volumetric load.** Up to 8-10 kgCOD/m<sup>3</sup>day.

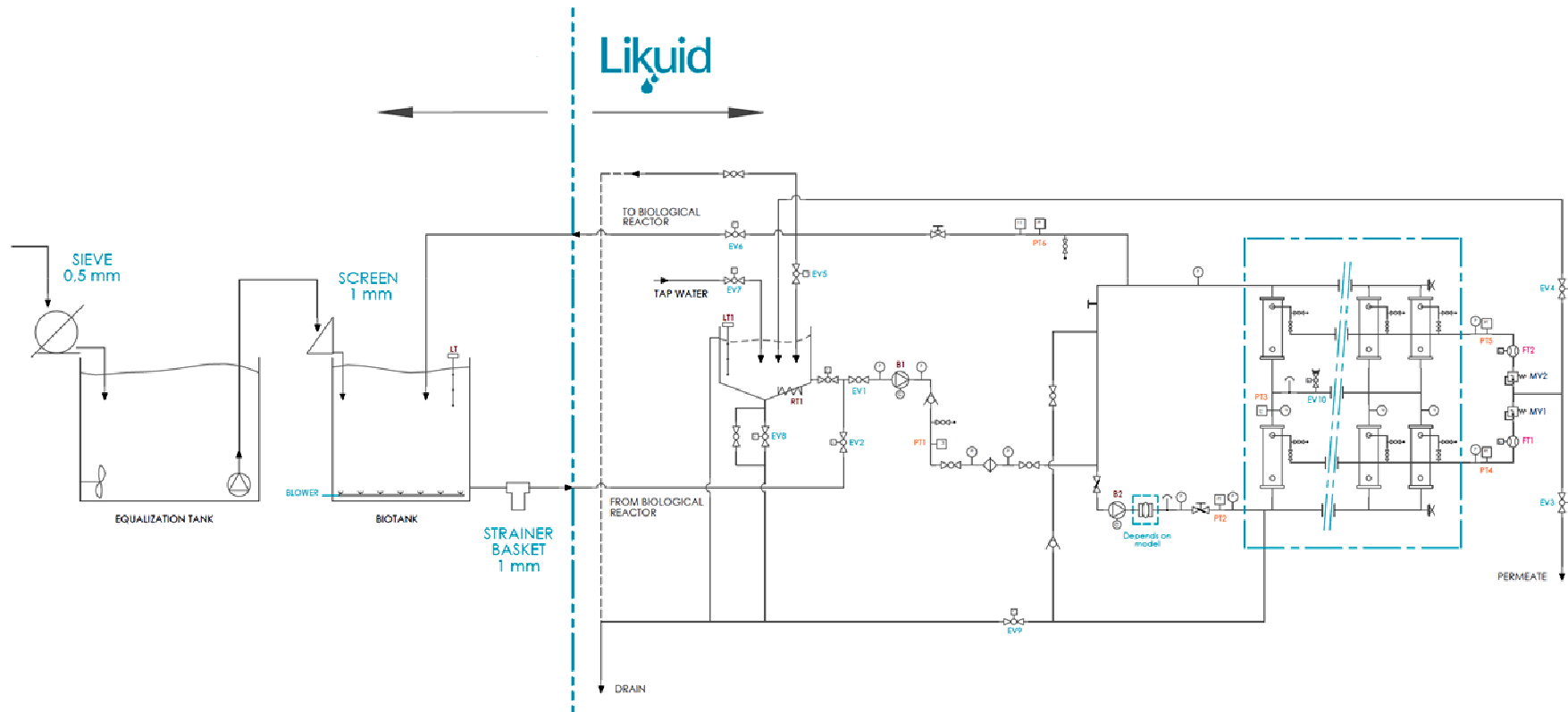
## Likuid-CBR® filtration System

1. **Filtration type.** Cross-flow without backwashing.
2. **TMP.** Up to 2,5 bar.
3. **Flow.** Between 90 and 120 LMH.
4. **Energy.** 2,8-3,5 kWh/m<sup>3</sup> permeate.
5. **Frequency of chemical cleaning.** 2-6 months, depending on the operational conditions and the composition of the wastewater.

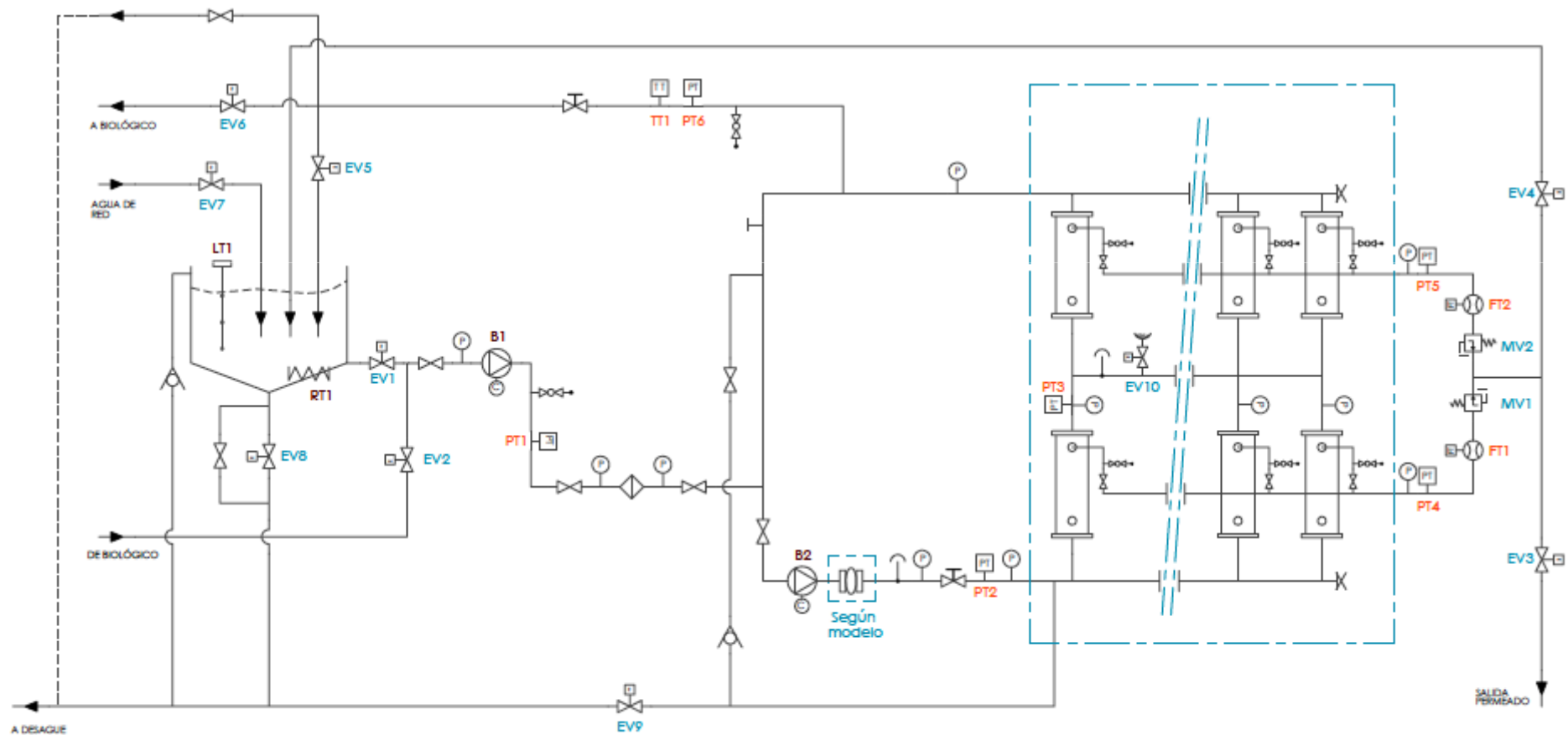
## CBR®: When and where

1. **Small-medium size industrial installations** (CBR500-12L91: 636 m<sup>3</sup>/d. For higher capacities: skids in parallel). Higher energy requirements are compensated by robustness, compactness, minimal sludge production and longer membrane life.
2. **Medium-high organic loads.** CBR system is more competitive when moderate flows of high loaded wastewaters are treated, as the additional energy consumption for filtration is less significant when compared to the energy requirements for aeration.
3. **Low space availability.** CBR process is the most compact, due to the reduced bioreactor volume and the highest permeate flux.
4. **High water quality requirements.** Effluent is free of suspended solids, turbidity and SDI are very low (< 1 NTU, SDI<3). It can be directly reused for many applications or post-treated with RO.
5. **Minimum need for support and maintenance.** Robust ceramic membranes allow to reduce drastically the maintenance time and cost.
6. **Difficult wastewaters.** Presence of oxidants, solvents, high O&G concentration...
7. **Retrofits and upgrading of existing plants.** CASP or SBR can be easily converted in MBR system and thus the system capacity increases.
8. **Decentralized urban WW treatment.** Small MBRs for the treatment of WW in small communities demand a robust process, with limited maintenance, not highly qualified personal required and minimum failure possibilities.

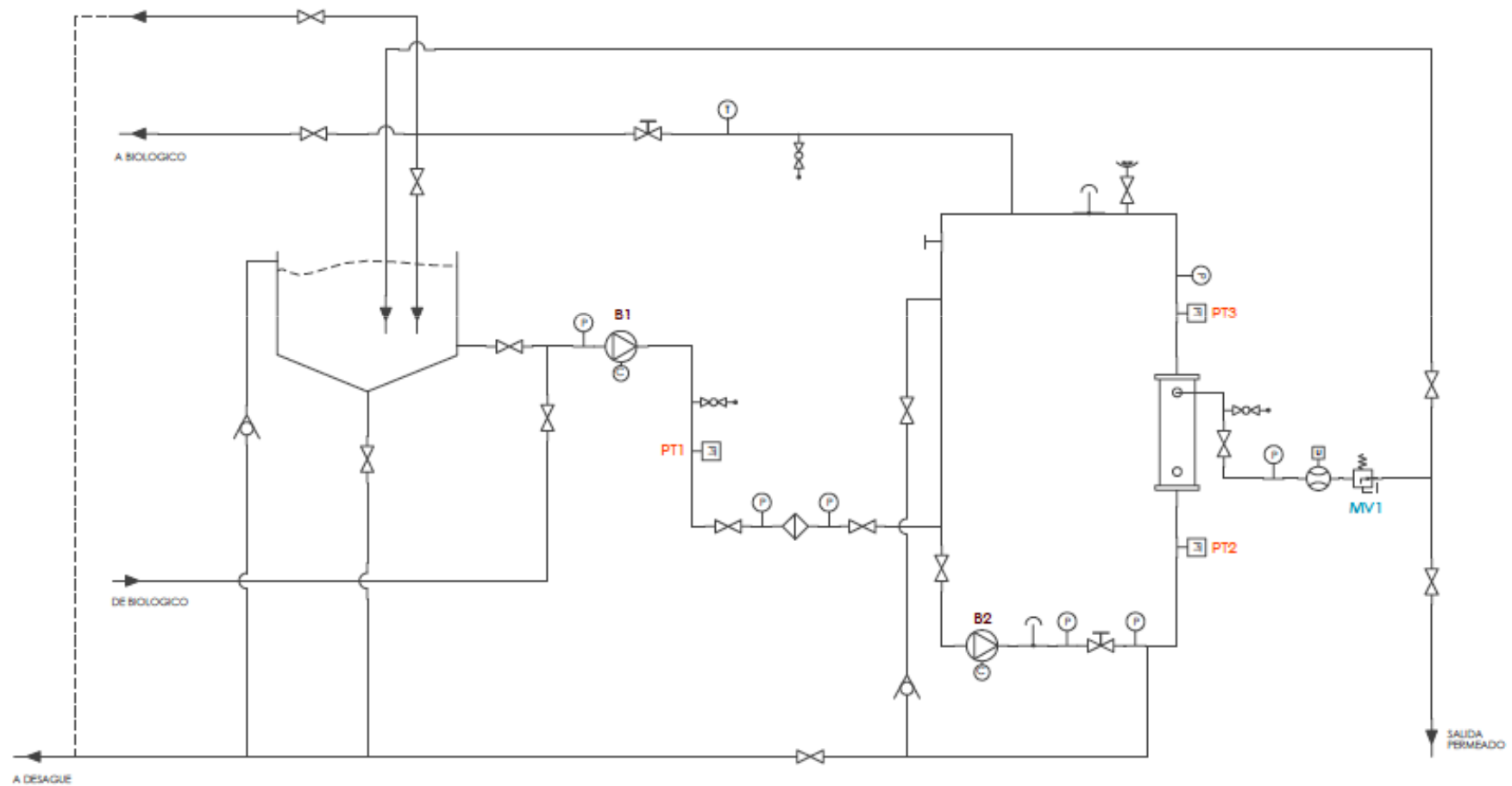
# CBR®: General scheme of the MBR process



## Likuid-CBR standard Skid Units (Automatic)

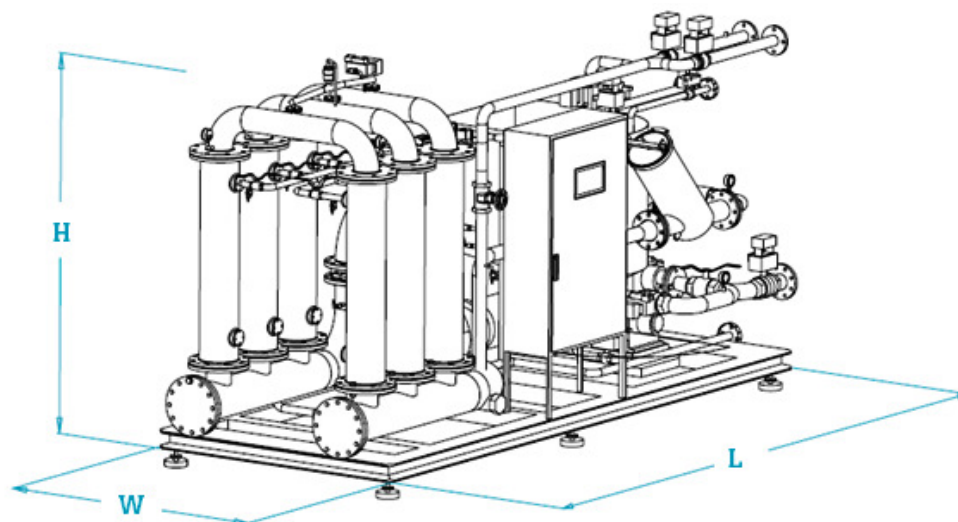


## Likuid-CBR standard Skid Units (Semi-Automatic)



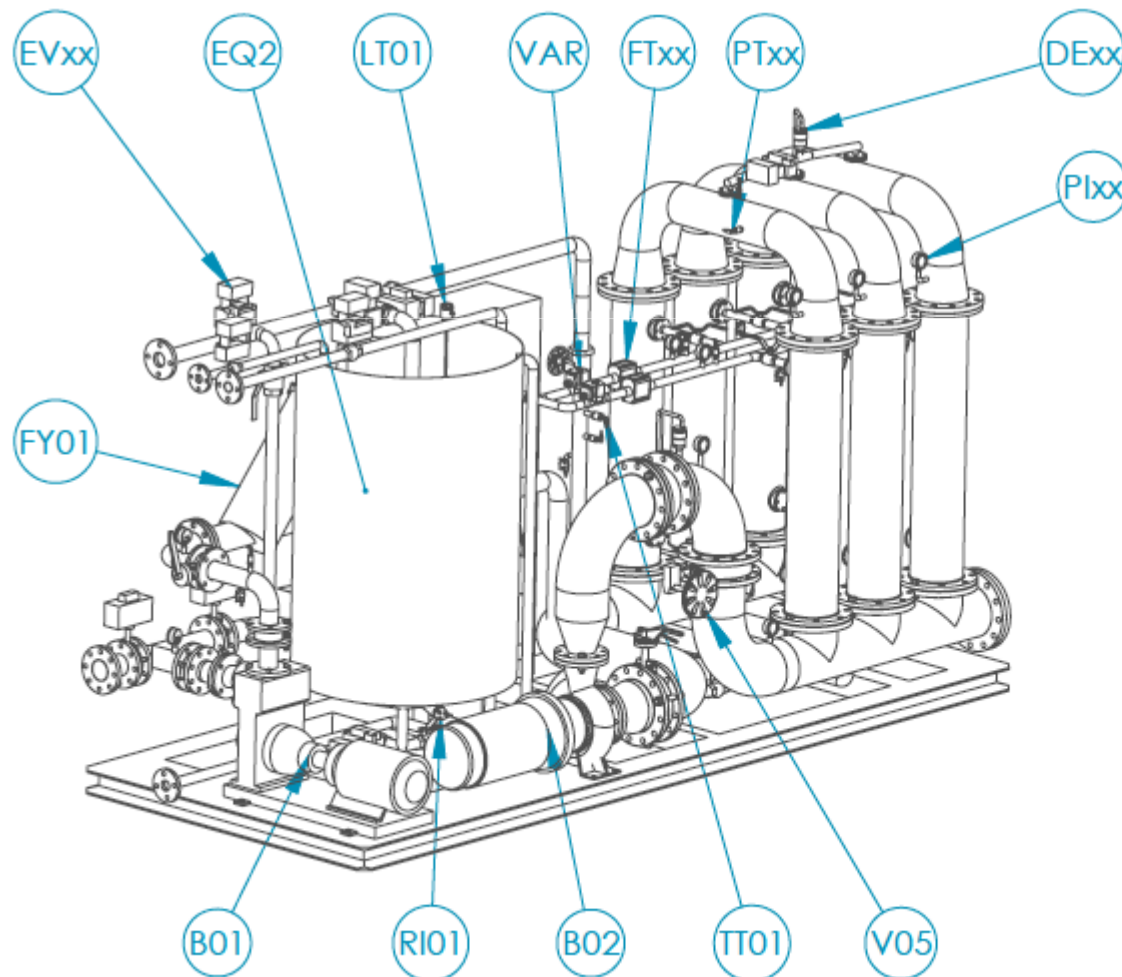
# CBR®: Models and Capacities

SKIDS		MODULES				DIMENSIONS			
Model	Capacity m <sup>3</sup> /d	Module	N. membr.	N. module	Surface m <sup>2</sup>	Length mm	Width mm	Height mm	Weight kg
CBR20-01L07	4	L7	7	1	1,7	1 500	1 000	2 100	325
CBR20-01L19	11	L19	19	1	4,7	1 900	1 200	2 100	500
CBR50-01L37	22	L37	37	1	9,1	2 000	1 200	2 200	950
CBR50-02L37	43	L37	37	2	18,1	2 200	1 500	2 200	1 250
CBR100-06L19	66	L19	19	6	27,9	2 900	1 500	2 200	1 525
CBR100-04L37	86	L37	37	4	36,3	3 300	1 700	2 500	1 700
CBR200-06L37	129	L37	37	6	54,4	3 900	1 600	2 500	2 150
CBR200-08L37	172	L37	37	8	72,5	4 300	1 600	2 500	2 850
CBR200-06L61	213	L61	61	6	89,7	4 500	1 800	2 700	2 950
CBR500-08L61	284	L61	61	8	119,6	5 200	1 800	2 800	3 300
CBR500-06L91	318	L91	91	6	133,8	5 200	2 000	2 900	3 500
CBR500-10L61	355	L61	61	10	149,5	6 000	2 000	3 000	3 900
CBR500-08L91	424	L91	91	8	178,4	6 600	2 100	3 100	4 200
CBR500-14L61	497	L61	61	14	209,2	7 500	2 200	3 100	4 800
CBR500-10L91	530	L91	91	10	223,0	7 500	2 200	3 200	5 100
CBR500-16L61	568	L61	61	16	239,1	8 000	2 200	3 200	5 400
CBR500-12L91	636	L91	91	12	267,5	8 000	2 100	3 200	5 700





# CBR®: Main components of the Skid



- B01 - Feed pump
- B02 - Recirculation pump
- FTxx - Flowmeter
- EQ2 - CIP tank
- LT01 - Level sensor
- DExx - Deaeration valve
- Plxx - Manometer
- PTxx - Pressure transducer
- TT01 - Temperature transducer
- V05 - Handwheel valve
- RI01 - Resistance
- VARxx - Regulation electrovalve
- EVxx - Pneumatic electrovalve
- FY01 - Security prefilter

# Case study 1. NOVAPET

Industrial wastewater– 250 m<sup>3</sup>/d

Site:	NOVAPET (Brilen, Spain)
Activity:	PET production
Wastewater:	Industrial WW
Application:	MBR 250 m <sup>3</sup> /day Discharge to the river



- **COD influent**      13 000 mg/L
- **COD effluent:**    <300 mg/L
- **Performance:**    >97 % COD removal
- **MLSS:**            10-12.000 mg/L
- **VL:**                2.9 kgCOD/m<sup>3</sup>d
- **F/M:**                0.4 kgCOD/kgVSS·d



# Case study 2. ALCALIBER

Industrial wastewater– 300 m<sup>3</sup>/d

Site:	ALCALIBER (Toledo, Spain)
Activity:	Narcotics production
Wastewater:	Industrial WW
Application:	MBR 300 m <sup>3</sup> /day Discharge to sewer

- **COD influent** 18 000mg/L
- **COD effluent:** < 1500 mg/L
- **Performance:** >92 % COD removal
- **MLSS:** 15-25.000 mg/L
- **VL:** 4.5 kgCOD/m<sup>3</sup>d
- **F/M:** 0.3 kgCOD/kgVSS·d



# Case study 3. COLMEX

Domestic wastewater– 50 m<sup>3</sup>/d

Site:	COLMEX (Mexico)
Activity:	School
Wastewater:	High-load domestic WW
Application:	MBR 50 m <sup>3</sup> /day Reuse of treated water

- **COD influent** 1500 mg/L
- **COD effluent:** <40 mg/L
- **Performance:** >97 % COD removal
- **MLSS:** 12-15.000 mg/L
- **VL:** 1.5 kgCOD/m<sup>3</sup>d
- **F/M:** 0.15 kgCOD/kgVSS·d



# Case study 4. AIRPORT

Domestic wastewater– 38 m<sup>3</sup>/d

Site:	AIRPORT (Mexico D.F.)
Activity:	Police station
Wastewater:	Domestic WW
Application:	MBR 38 m <sup>3</sup> /day. Reuse of treated water

- **COD influent** 600 mg/L
- **COD effluent:** <30 mg/L
- **Performance:** >95 % COD removal
- **MLSS:** 12 000 mg/L
- **VL:** 2.5 kgCOD/m<sup>3</sup>d
- **F/M:** 0.3 kgCOD/kgVSS·d





# Case study 5. COOSUR

Industrial wastewater– 100 m<sup>3</sup>/d

Site: COOSUR (Jaén, Spain)  
Activity: Olive oil production  
Wastewater: Food industry WW  
Application: MBR 100 m<sup>3</sup>/day  
(SBR upgrading)  
Reuse of treated water



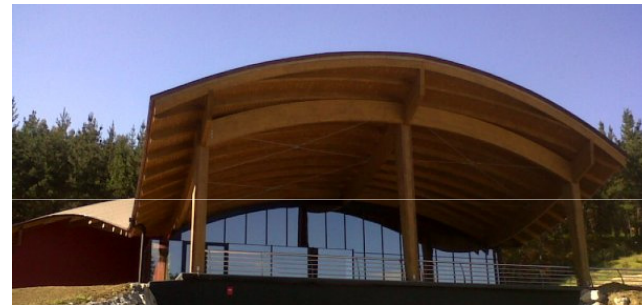
- COD influent 4000 mg/L
- COD effluent: <50 mg/L
- SDI permeate: 1
- Performance: >98 % COD removal
- MLSS: 8 000 mg/L



# Case study 6. TALLERI

Industrial wastewater– 3 m<sup>3</sup>/d

Site:	TALLERI (Morga, Spain)
Activity:	Wine production
Wastewater:	Winery WW
Application:	MBR 3 m <sup>3</sup> /day River discharge



- **COD influent**      20000 mg/L
- **COD effluent:**    <100 mg/L
- **Performance:**    >98 % COD removal
- **MLSS:**              12 000 mg/L



# Laboratorios Maverick

Cosmetics production – 36 m<sup>3</sup>/d

Site:	Laboratorios Maverick- Ulldecona (Spain)
Activity:	Cosmetics production
Wastewater:	High-load industrial water
Application:	UF + MBR 36 m <sup>3</sup> /day Discharge to sewer

- **COD influent**      160.000 – 200.000  
mg/L
- **COD effluent:**    <500 mg/L
- **Performance:**    >99 % COD removal
- **UF recovery:**      >80%
- **MBR MLSS:**        12-15.000 mg/L
- **MBR F/M:**          0.3 kgCOD/kgVSS·d

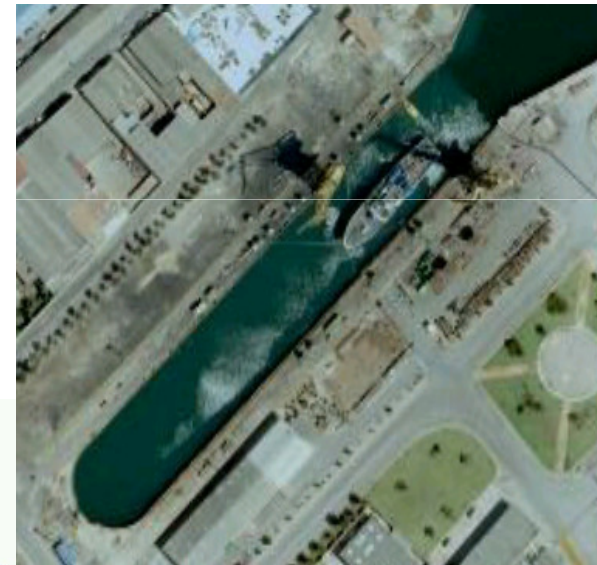




# Navantia

Shipyard– 36 m<sup>3</sup>/d

Site:	Navantia Cadiz(Spain)
Activity:	Shipyard
Wastewater:	Marpol. Oils, hydrocarbons,...
Application:	MBR- 36 m <sup>3</sup> /d Water reuse. Tank cleanings



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