1. MOL®LIK technology

1.1 Short Description

MOL®LIK – a technical proven catalytic water treatment technology – is a biocide-free technology that reduces the risk of fouling, scaling and corrosion on surfaces, even at long distances. With this technology, there are entire cooling systems of power plants operated completely free of any biocide – with less than 0.01 EURO per m³ for OpEx + CapEx (by comparing with huger industrial applications).

After showing reliable results on areas with quite stable water quality, like tap, cooling and process water treatment, catalytic water treatment was successfully tested in challenging areas of industrial wastewater within the EU founded project INSPIREWATER. Within the INSPIREWATER project, the scope was investigating the potential for improving membrane performance with catalytic water treatment in the field of effluent water reuse.

1.2 Working Principle

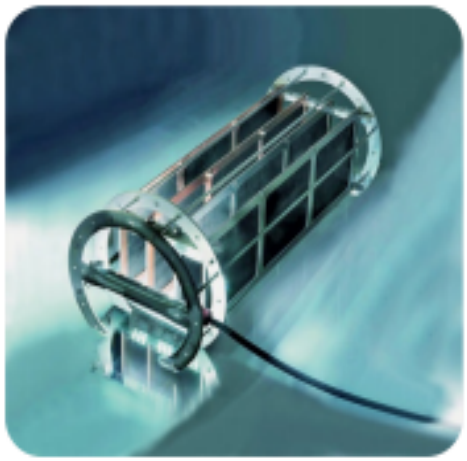


Figure 1: MOL®LIK catalyst module

The core element of the MOL®LIK-technology is a proprietary ultra-thin metal catalyst foil, made of nickel, chromium and iron. These catalysts are speeding up solubility by faster supply of molecular water. $H_2O_{molecular}$ is required for preparing the hydration shells. As faster, these shells are prepared as:

- *Better solubility of substances*
- *Better flux on filter units*
- *Better the natural evaporation of water*

As a side effect the risk of deposits formation is minimized and lower the infectivity of viruses is reduced. Occasional interaction of low-energy visible light can additionally facilitate this process. The usage of this special catalyst technology results in more efficient technical processes with optimized usage of chemicals.

1.3 Advantages

- ✓ ***Suppress*** *preventive formation of biofilms (no microbiological troubles)*
- ✓ ***Reduction*** *of fouling, scaling and corrosion*
- ✓ ***Improvement*** *on water evaporation (infectivity of viruses is reduced)*
- ✓ ***Cost cutting*** *on operational efforts by simple, plug and play technology*
- ✓ ***Rising performance*** *of conventional water treatment technologies*
  - *Extension of facility lifetime (trough improvement at cleaning intervals)*
  - *Minimization on negative effects of industrial facilities on environment through optimization of chemicals demand*

General Data

Typical applications	*Applications like cooling towers, process water supply, tap water systems, filter and membranes applications, humidifiers.*
Average electrical consumption	*0.001 till 5.0 Wh/m³ (day light LEDs)*
Average chemical consumption	*None*
Remarks	• *The process is limited by particular facility conditions (for example, challenging water with bad filtration or the presence of some special film formation substances in the water, which may block the catalyst – e.g.: silicates)* • *Efficiency can be enhanced by a little day-light (which can be reproduced by suitable LED-units)*

1.4 Key Performance Indicators

At industrial projects - where the catalyst is involved in - the focus is mostly on the development of defining performance parameters, which can be easily monitored and used for demonstrating the efficiency of catalytic water treatment. In attached table, examples of performance parameters are shown:

Overview of key performance indicators for demonstrating and monitoring the performance

Process	MOL®LIK effect	Measurand	Measured effect
Humidification	Speeding up evaporation	RH relative humidity	Archiving optimal indoor climate with RH ~ 45 % (area of lowest virus infectivity)
Dissolving	Speeding up dissolving processes	Δm/Δt (m= dissolved substance)	Dissolving process up to 10 times faster
Cooling Towers	Reducing scaling	Turbidity	Turbidity of cooling circuits less than 5 NTU
Heat exchange	Increasing heat transfer	k-value ΔT (T= temperature)	ΔT improved up to 2 K on industrial cooling circuits
Membranes	Reducing difference in pressure (at constant flow rate)	Δp (p= pressure)	Pressure drop improved up to 30 %
Filtration	Improving filters cleaning interval	Δp/Δt (t= time)	Cleaning interval improved from every 3 days to >> 30 days
Chlorination	Acceleration of chlorine disproportionation	Δredox potential Organochlorides (AOX) chloramine	Improved performance on public swimming pools achieved

1.5 Summary

Catalytic Water Treatment **–** a Smart Solution for:

- ✓ ***Acting*** *on the mounting effects of extreme weather events*
- ✓ ***Protecting*** *agricultural production*
- ✓ ***Efficient*** *water reuse to support a circular economy*
- ✓ ***Reducing*** *chemicals demand on water treatment*
- ✓ ***Improving*** *resilience of health and socioeconomic systems*

The technology is suitable for all application with a relatively stable water quality such as membrane and filtration systems, cooling water circulations, process water and potable water production. The smallest application is the MOL®LIK CUBE suitable for dish washers and washing machines, the biggest ones are installed in cooling circuits and power plants.

2. MOL®LIK catalyst units

The core element of MOL®LIK technology is represented by special mineral-metal catalysts foils containing nickel, chromium, and iron, so called NOAs (Nanostructured Oxygen Alloys). Occasional interaction of low-energy visible light can additionally facilitate the catalyst reaction with water. That is why our technique is usually delivered with special LED units. To control the functioning of the LEDs, we recommend our MOL®LIK LED control units.

Based on the specific technical situation and the different customer´s needs, MOL offers four main solutions.

- **MOL®LIK Module** (see section 3)
  Especially recommended for the installation into the basin of a cooling tower or, more generally, into a pressure-less water storage tank.
  Essential prerequisites of the customer´s facility:
  - a wide opening for installation, according to the specific dimensions of the module
  - the module must be fully covered by water and the water must flow through the interspaces of the module (not against the catalyst foils)
- **MOL®LIK TW unit** (see section 4)
  Especially recommended for treating small water flows (up to 2 m³/h).
- **MOL®LIK CUBE** (see section 5)
  Especially designed for domestic applications (water quantity/circulation rate up to 120 l/h).
- **MOL®LIK Vessel** (see section 6)
  Especially recommended when:
  - the customer wants to treat a specific part of the water system (e.g. downstream of the filter unit, upstream/downstream of the RO membranes)
  - there is no sufficient wide opening/installation space for a module
  Limitation: the maximum allowable working flow in the by-pass is 40 m³/h.
  However, the vessel works more efficiently than a module since the water is forced to passed through the installed catalyst module.

IMPORTANT NOTE: It is sufficient to treat only between 10% and 20% of the flow!

3.2 Selection of the right SIZE of the catalyst module

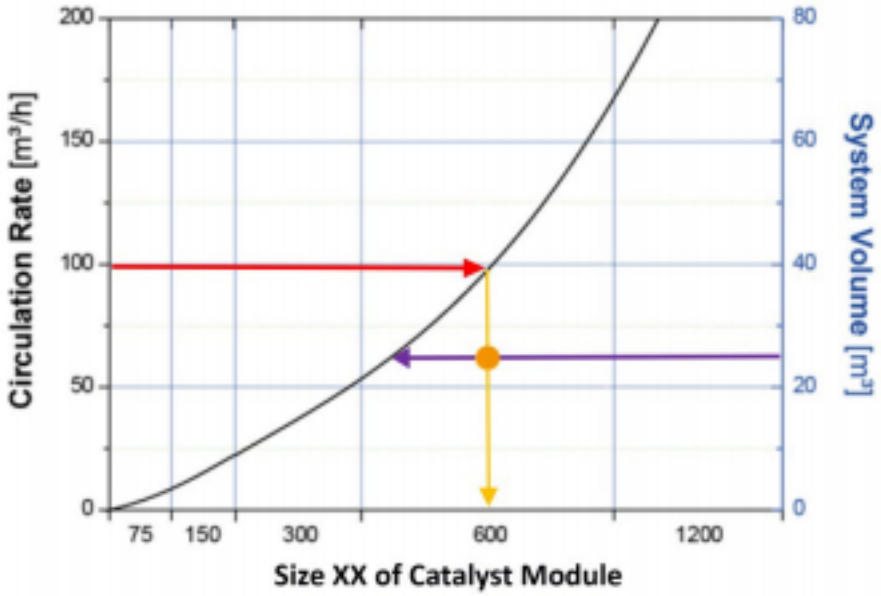
For the selection of the SIZE of the catalyst module, two data are mainly important: the system volume and the circulation rate.
MOL has prepared some selection charts to facilitate the choice of the right size of module.

Example:

Circulation rate: 100 m^3/h

System volume: 25 m^3

By selecting 100 m^3/h circulation rate on the left vertical axis and 25 m^3 system volume on the right vertical axis, it results that the suitable size of catalyst module on the horizontal axis is 600.
The important thing is that the size must be suitable for both values of circulation rate and system volume (even in the rare case when system volume is higher than circulation rate).
In case of proximity between a smaller and bigger size of catalyst module, it is always better to opt for a bigger module size.

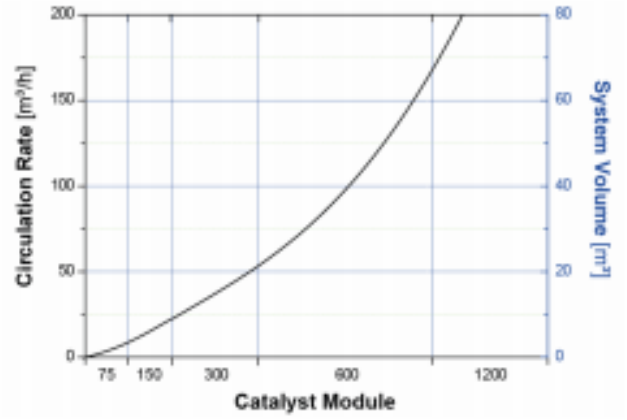


IMPORTANT NOTE:

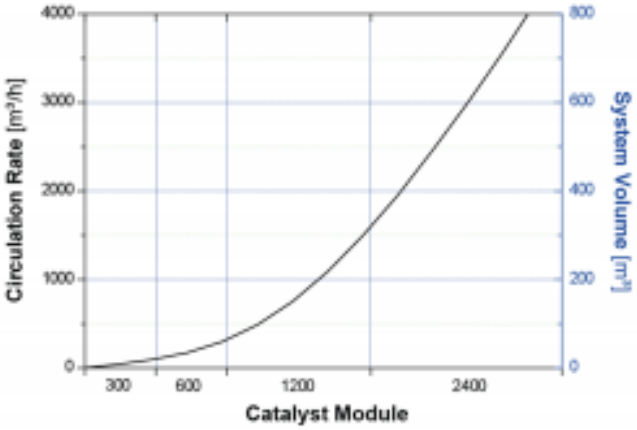
Other factors are also important in the selection of the right size of catalyst module. For example, the quality of water (that´s why it is important to obtain current water analysis of the make-up and circulation water and to have information about the current water treatment), type of filtration, etc. Please in case of any doubt, do not hesitate to contact the technical department of MOL.

○ For cooling tower applications

Selection chart for potable, demi and sea water
in cooling circuits, which are running along the European guidelines such as VDI 3803



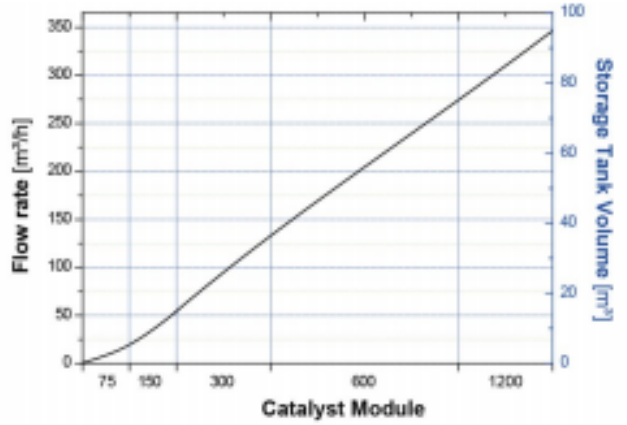
with circulation rate from **0 to 200 m³/h**
and volume **< 80 m³**



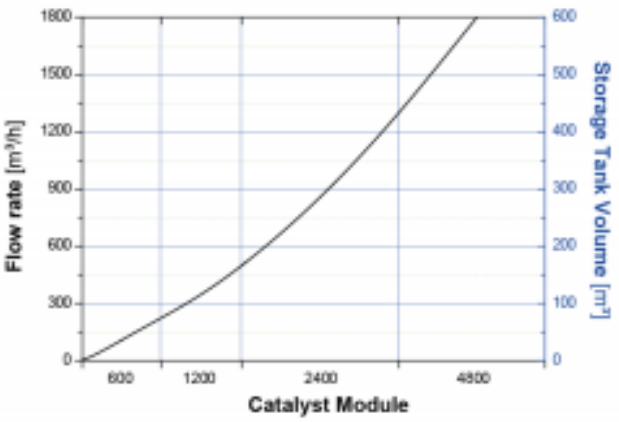
with circulation rate from **0 to 4000 m³/h**
and volume **< 800 m³**

○ For once through applications

Selection chart for potable, demi and sea water
for systems in combination with suitable prefiltration,



with flow rate from **0 to 350 m³/h**
and volume **< 100 m³**



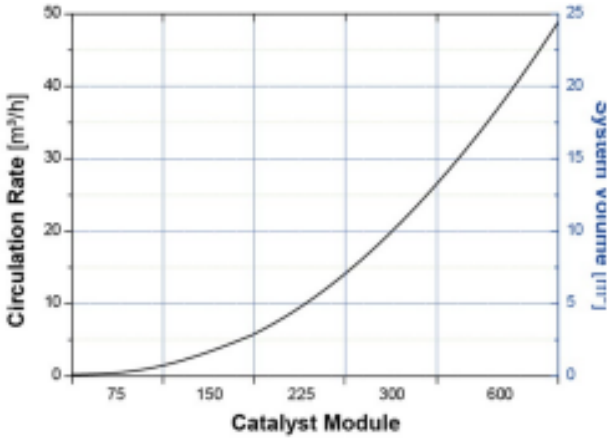
with flow rate from **0 to 1800 m³/h**
and volume **< 600 m³**

- **For applications with higher potential risk of deposits**

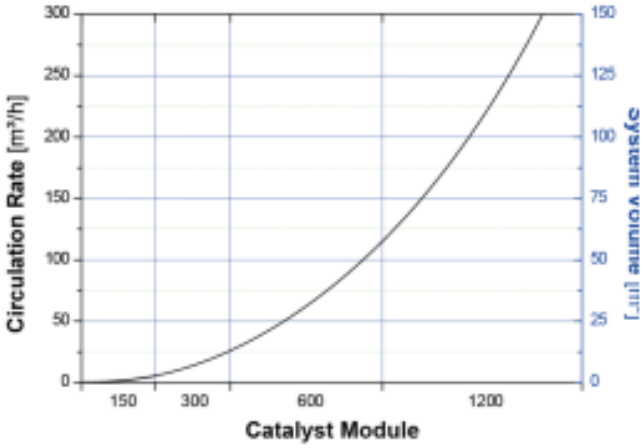
For example, in case of:

- water with organics
- river water/surface water
- process water loops with higher concentration of organic available substances, like pelletizing loops

and in combination with suitable prefiltration.

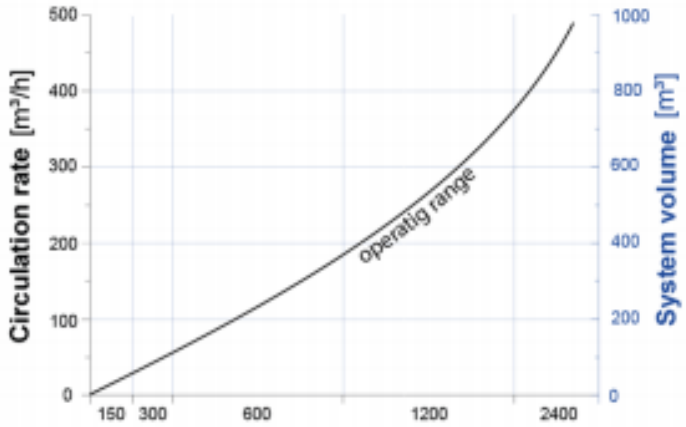


For systems with flow rate from **0 to 50 m³/h** and volume **< 25 m³**



For systems with flow rate from **0 to 300 m³/h** and volume **< 150 m³**

- **For swimming pools**



For public swimming pools which are running along the European guidelines, with circulation rate from **0 to 500 m³/h** and volume **< 1000 m³**

MOL®LIK GB 2400 RS

Ready-to-use active catalytic unit with integrated solid-state catalyst foils - NOA (Nanostructured Oxygen Alloys) and integrated MOL®LIK LED module for installation into a pressure-less water storage tank basin.

It consists of ***16 pieces of MOL®LIK Element E 150 S*** prepared in a ***stainless steel cage.*** The cage has 4 attachments points and is inclusive of a NIRO-chain kit to facilitate the installation.

Sample picture of MOL®LIK GB xxx Rx

Characteristics:

- ***MOL®LIK Element E 150 S:***
  - Size per element: 500 x 300 mm
  - Frame made of *stainless steel* with integrated solid-state catalyst foils
- Special 7 m cable & special connector plug type IP 67 for connecting the module with the MOL®LIK LED control unit
- Dimensions per module [cage] (L x W x H) 1250 x 800 x 910 mm
- Weight: ≤ 110 kg
- Protection class LED-lamp: IP 68
- Power consumption per module: ca. 15 Watt (12 V DC)
- HS number: 381 590
- KN number: 3815 9090

Subject to alterations due to technical advances.

Sample picture of MOL®LIK GB xxx RS with NIRO-chain kit

Sizes available	**No. of *MOL®LIK Element* E 150 S** (pieces)
GB 2400	16
GB 3600	24
GB 4800	32
GB 6000	40

MOL®LIK GB 2400 RC

Ready-to-use active catalytic unit with integrated solid-state catalyst foils - NOA (Nanostructured Oxygen Alloys) and integrated MOL®LIK LED module for installation into a pressure-less water storage tank basin.

It consists of ***16 pieces of MOL®LIK Element E 150 C*** prepared in a ***stainless steel cage.*** The cage has 4 attachments points and is inclusive of a NIRO-chain kit to facilitate the installation.

Sample picture of MOL®LIK GB xxx Rx

Characteristics:

- ***MOL®LIK Element E 150 C:***
  - Size per element: 500 x 300 mm
  - Frame made of *stainless steel & copper* with integrated solid-state catalyst foils
- Special 7 m cable & special connector plug type IP 67 for connecting the module with the MOL®LIK LED control unit
- Dimensions per module [cage] (L x W x H) 1250 x 800 x 910 mm
- Weight: ≤ 100 kg
- Protection class LED-lamp: IP 68
- Power consumption per module: ca. 15 Watt (12 V DC)
- HS number: 381 590
- KN number: 3815 9090

Subject to alterations due to technical advances.

Sizes available	No. of MOL®LIK Element E 150 C (pieces)
GB 2400	16
GB 3600	24
GB 4800	32
GB 6000	40

MOL®LIK GB 2400 RA for automotive sector

Ready-to-use active catalytic unit with integrated solid-state catalyst foils - NOA (Nanostructured Oxygen Alloys) and integrated MOL®LIK LED module for installation into a pressure-less water storage tank basin.

It consists of ***16 pieces of MOL®LIK Element E 150 RA*** prepared in a ***stainless steel cage.*** The cage has 4 attachments points and is inclusive of a NIRO-chain kit to facilitate the installation.

Sample picture of MOL®LIK GB xxx Rx

Characteristics:

- ***MOL®LIK Element E 150 RA:***
  - Size per element: 500 x 300 mm
  - Frame made of *stainless steel – silicon free* with integrated solid-state catalyst foils
- Special 7 m cable & special connector plug type IP 67 for connecting the module with the MOL®LIK LED control unit
- Dimensions per module [cage] (L x W x H) 1250 x 800 x 910 mm
- Weight: ≤ 100 kg
- Protection class LED-lamp: IP 68
- Power consumption per module: ca. 15 Watt (12 V DC)
- HS number: 381 590
- KN number: 3815 9090

Subject to alterations due to technical advances.

Sizes available	No. of MOL®LIK Element E 150 RA (pieces)
GB 2400	16
GB 3600	24
GB 4800	32
GB 6000	40

MOL®LIK GB 2400 SW - for water with high conductivity

Ready-to-use active catalytic unit with integrated solid-state catalyst foils - NOA (Nanostructured Oxygen Alloys) and integrated MOL®LIK LED module for installation into a pressure-less water storage tank basin.

It consists of ***16 pieces of MOL®LIK Element E 150 SW*** prepared in a ***plastic cage.***

Sample picture of MOL®LIK GB xxx Rx

Characteristics:

- ***MOL®LIK Element E 150 SW:***
  - Size per element: 500 x 300 mm
  - Frame made of *plastic with titanium connections* with integrated solid-state catalyst foils
- Special 7 m cable & special connector plug type IP 67 for connecting the module with the MOL®LIK LED control unit
- Dimensions per module [cage] (L x W x H) 1200 x 800 x 800 mm
- Weight: ≤ 100 kg
- Protection class LED-lamp: IP 68
- Power consumption per module: ca. 15 Watt (12 V DC)
- HS number: 381 590
- KN number: 3815 9090

Subject to alterations due to technical advances.

Sizes available	No. of MOL®LIK Element E 150 SW (pieces)
GB 2400	16
GB 3600	24
GB 4800	32
GB 6000	40

MOL®LIK GB 2400 RT - for food and beverage sector

Ready-to-use active catalytic unit with integrated solid-state catalyst foils - NOA (Nanostructured Oxygen Alloys) and integrated MOL®LIK LED module for installation into a pressure-less water storage tank basin.

It consists of ***16 pieces of MOL®LIK Element E 150 T*** prepared in a ***stainless steel cage.*** The cage has 4 attachments points and is inclusive of a NIRO-chain kit to facilitate the installation.

Sample picture of MOL®LIK GB xxx Rx

Characteristics:

- ***MOL®LIK Element E 150 T:***
  - Size per element: 500 x 300 mm
  - Frame made of *stainless steel & Teflon (suitable for F&B sector)* with integrated solid-state catalyst foils
- Special 7 m cable & special connector plug type IP 67 for connecting the module with the MOL®LIK LED control unit
- Dimensions per module [cage] (L x W x H) 1250 x 800 x 910 mm
- Weight: ≤ 100 kg
- Protection class LED-lamp: IP 68
- Power consumption per module: ca. 15 Watt (12 V DC)
- HS number: 381 590
- KN number: 3815 9090

Subject to alterations due to technical advances.

Sizes available	No. of MOL®LIK Element E 150 T (pieces)
GB 2400	16
GB 3600	24
GB 4800	32
GB 6000	40