BIOPOLUS

The Living Technology Alliance

IN THE HUNGARIAN WATER SECTOR

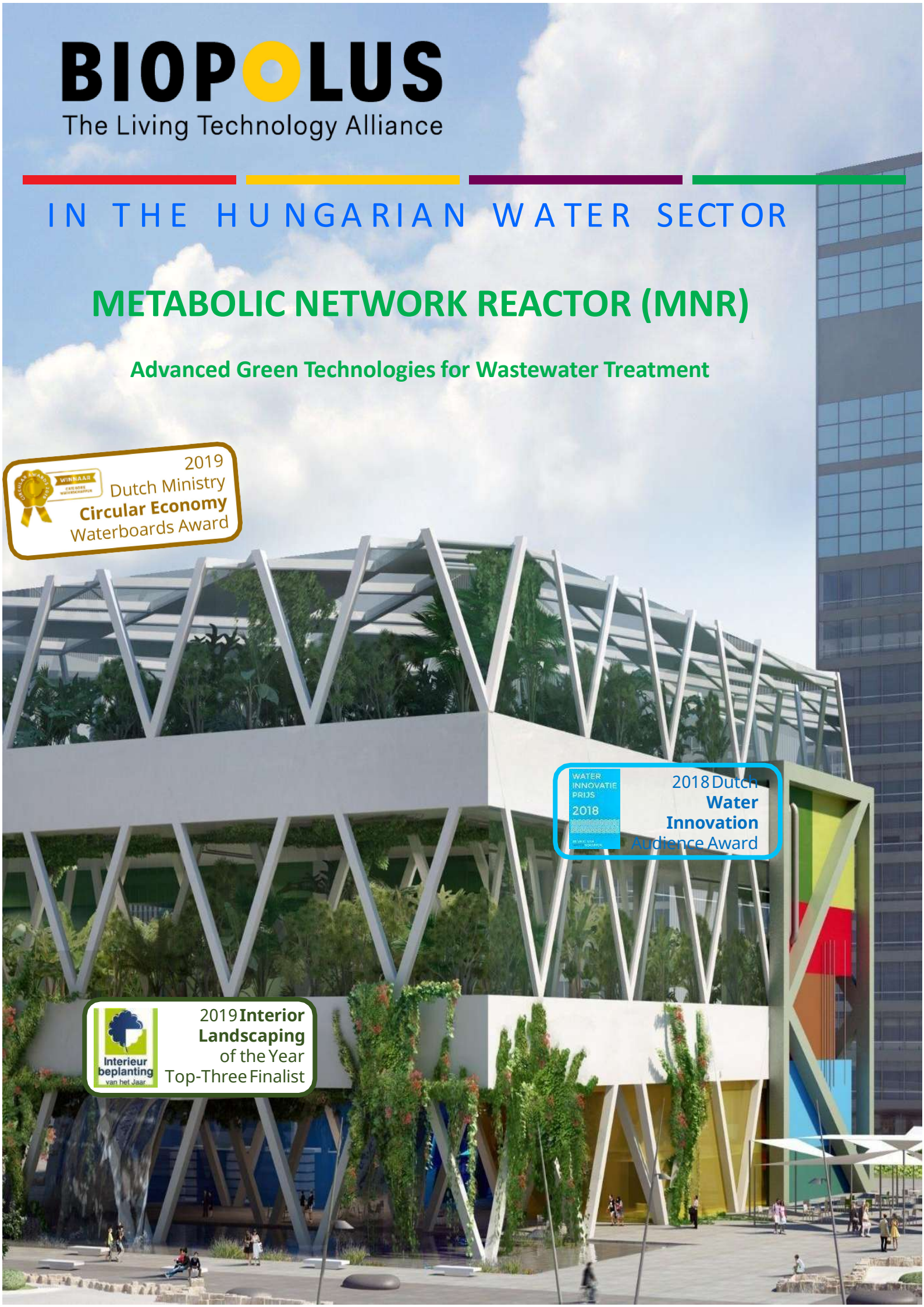
METABOLIC NETWORK REACTOR (MNR)

Advanced Green Technologies for Wastewater Treatment

2019 Dutch Ministry **Circular Economy** Waterboards Award

2018 Dutch **Water Innovation** Audience Award

2019 **Interior Landscaping** of the Year Top-Three Finalist



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METABOLIC HUBS

INTEGRATING WATER TREATMENT AND REUSE INTO URBAN ENVIRONMENT

FUTURE-PROOF

Engineered ecosystems, interconnected into a decentralized network of high tech infrastructure solutions, transforming urban areas into smart, sustainable, circular economies.

MODULAR IN FUNCTION

- ✓ **WATER TREATMENT**
- ✓ **WATER RECYCLING & REUSE**
- ✓ **ENERGY RECOVERY**
- ✓ **RESOURCE RECOVERY**
- ✓ **FOOD PRODUCTION**
- ✓ **COMMUNITY**

VARIABLE SHAPE & FORM

SCALABLE & EXTENDABLE

- ✓ **CAPACITY INCREASE**
- ✓ **XS-XL SIZES** (1,500-300,000 PS)
- ✓ **DE-CENTRALIZED & INTER-CONNECTABLE**

WASTEWATER TREATMENT

Smaller, nicer, and more efficient.
Fits into any urban area

RETROFIT

Free up High Value Land
for Redevelopment

URBAN SURFACE WATERS

Rehabilitation and
maintenance

PLATFORM TECHNOLOGY

Integrated, waterbased
Urban Circularity

GLOBAL PARTNERSHIP NETWORK

Headquartered in the European Union

ENGINEERING ▪ EQUIPMENT ▪ RESEARCH

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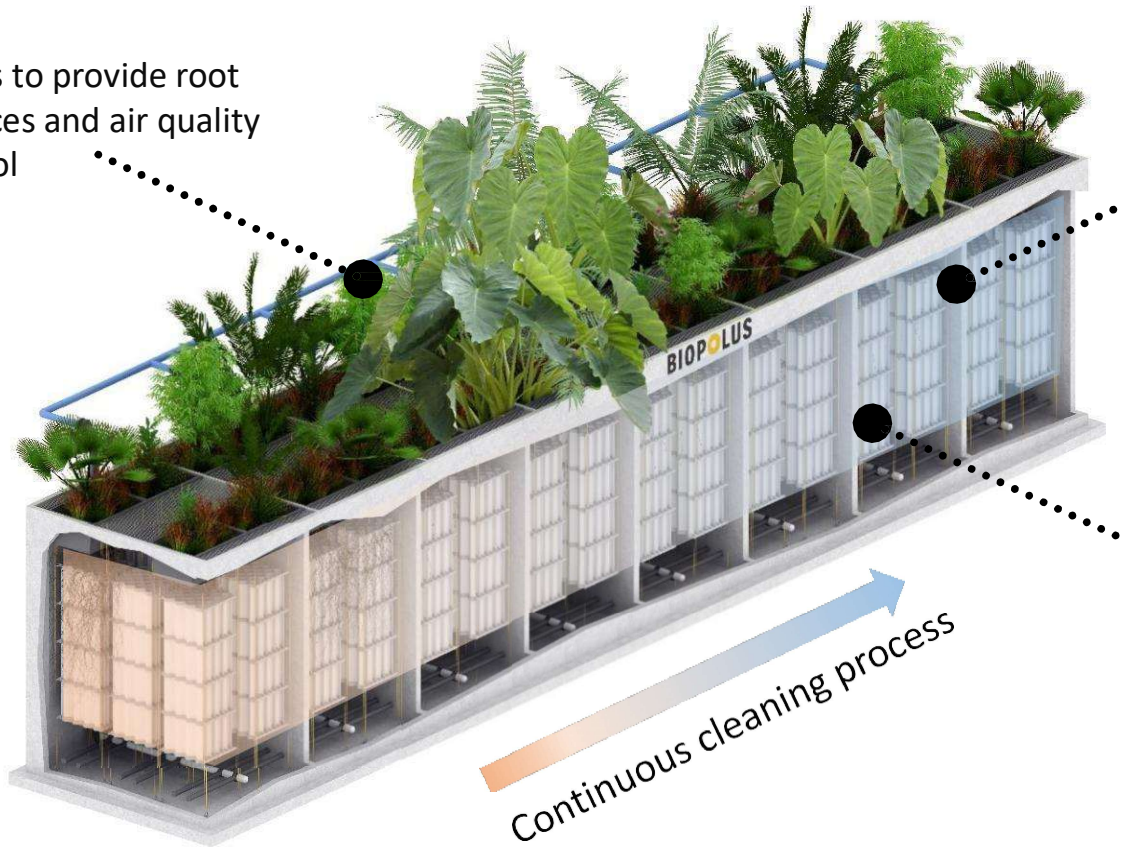
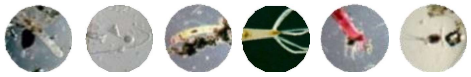
WASTEWATER TREATMENT TECHNOLOGY

METABOLIC NETWORK REACTOR (MNR) WASTEWATER TREATMENT SYSTEMS

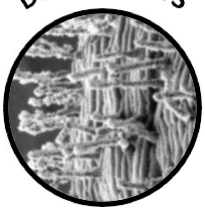
Patented 3rd generation integrated fixed-film activated sludge (IFAS)

Plants to provide root surfaces and air quality control





DENSE ROOTS



ARTIFICIAL MEDIA

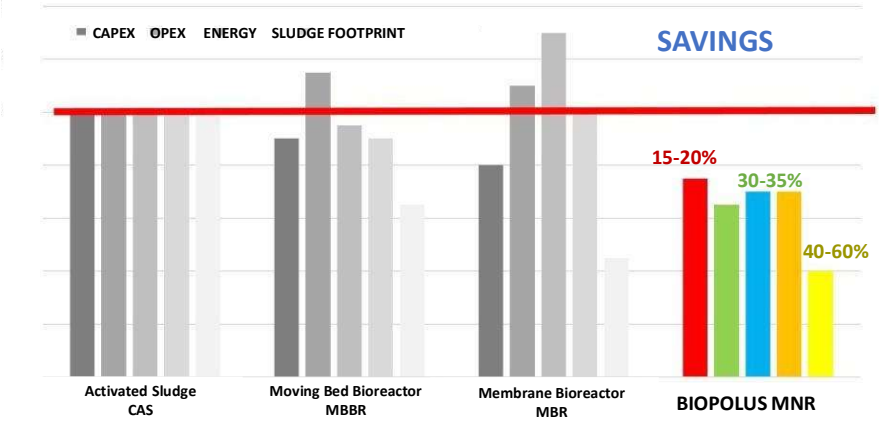
BIOFILM ON MEDIA

Engineered ecosystem using 2-3,000 species

NATURAL AND SYNTHETIC PLANT ROOTS TO PROVIDE SUFFICIENT SURFACE FOR MICROBIAL GROWTH

- ✓ Small physical footprint
- ✓ Financial savings
- ✓ Energy efficient (low TSS, high α-factor)
- ✓ Looks & smells like a garden
- ✓ Large amount of biomass
- ✓ High SRT, efficient NH4 removal
- ✓ Resilient to shock loading

COMPETITIVE IN EVERY ASPECT



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ABOUT BIOPOLUS MNR TECHNOLOGY

In a typical Biopolus MNR system, as the influent travels through the cascade, the available nutrient quantity is consumed and as a result, the composition of the ecosystem fixed in the biofilm changes from reactor to reactor, gradually adapting itself to the decreasing nutrient concentrations. In each cascade stage a specially adapted ecosystem will form, thus maximizing the decomposition of contaminants.

Biodegradation of influent contaminants takes place mainly with the help of fixed and suspended biological cultures, where plant roots are used as biofilm carriers. Additional biofiber media is used in the reactors as artificial plant roots to provide more surface area for biofilm to form and grow on.

Biological wastewater treatment is a common treatment method, that uses different types of microorganisms to treat and purify polluted water. In creating the Metabolic Network Reactor (MNR), Biopolus has optimized this natural phenomenon, and through smart design, developed a technology to maximize the efficiency of microorganisms to degrade organic waste.

Wastewater Treatment Systems using MNR Technology

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The full treatment process takes place in an array of MNR reactors. This separation makes it possible to fine-tune the environmental conditions in each section, allowing for the development of separate, specialized ecologies to mature in the different tanks. As the water flows from reactor to reactor, it is continually cleaned, as various species break down the different contaminants. The path and volumetric distribution of wastewater between the reactors is controlled by process management software and can dynamically adapt to the changing loads, thereby optimizing the process.

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ADVANTAGES

Understanding the disadvantages of other media on the market such as: using dense fabric which is susceptible to fouling and clogging leading to sludge accumulation and the formation of anaerobic zones and require heavy and expensive support system structure for the media

Biopolus experts have continuously researched and improved and launched the most advanced MNR Biomodule artificial roots filter media (patened) which eliminates all the above disadvantages of other media on the market:

The MNR Biomodule artificial roots filter media is made of a lightweight knitted base that is held in place by an injection-molded plastic structure. This type of carrier can support the same amount of biomass, while being lighter and sparser. The lighter structure is easier to install while the stiffer plastic core is less susceptible to deformation than the rope structure. The sparser textile avoids fouling issues and promotes the growth of a healthier, more active biomass.

Thanks to this special design and structure of the MNR Biomodule artificial roots filter media, the installation and operation process becomes extremely simple, economical and convenient. The operator can slide up, slide down or pull each Biomodule out of the tank flexibly without having to drain the water in the tank, making it easy to check and maintain the Biomodule at any time without affecting the microbiological system in the reactor as well as the operation process.

As the inventor of Metabolic Network Reactor (MNR) technology and the manufacturer of the primary equipment for the WWTP using the MNR reactor system, BIOPOLUS ensures the supply of the core component of the MNR technology – MNR Biomodule Artificial Roots Filter Media for every wastewater treatment project, to ensure successful performance for each WWTP.

In addition to supplying the primary equipment - MNR Biomodule Artificial Roots Filter Media, BIOPOLUS also allows customers to integrate certain locally sourced auxiliary components into the wastewater treatment systems using MNR technology, enabling significant savings in overall investment costs.

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TECHNICAL DATASHEET

MNR Biomodule Artificial Roots Filter Media

(Main part for Wastewater Treatment Systems using MNR Technology)

The underlying principle behind the MNR technology is a well-known natural phenomenon, where microbial biofilm develops on the roots of aquatic plants. The technology is characterized by a large quantity of biomass that is attached to submerged "carriers" – either to the natural root system of specially selected plants, or to artificial roots, developed by Biopolus, for this specific purpose.

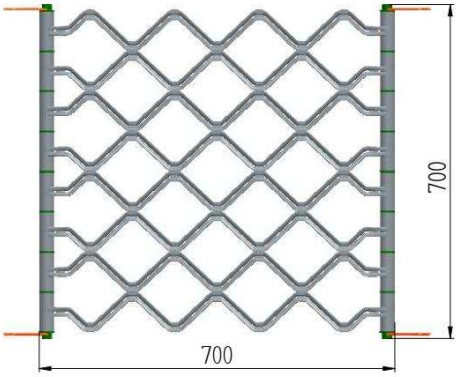
Technical Specification:

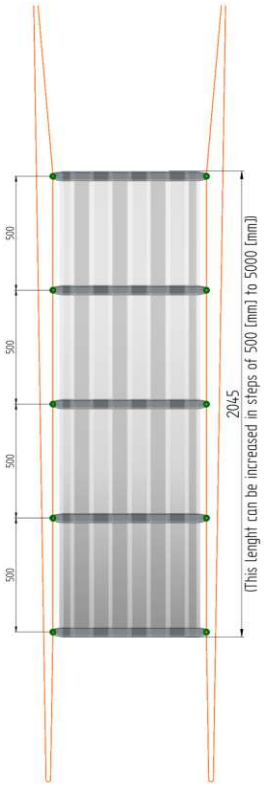
- Specific surface area : > 500 m^2/m^3
- Biotextile material: Polypropylene (100% PP), 3D shape
- Biotextile color: white
- Porosity : 40 – 50 %
- Biomass density capacity*: 8 – 18 kg/m^3
- Support frame: PP (optional: PP in combine with support rob in SS304 for the top layer)
- The MNR Biomodule artificial roots filter media are made of a light knitted textile base fixed by an injection-molded plastic structure.
- The MNR Biomodule artificial roots filter media installation simply, can slide up/down/pull out flexibly without draining water.
- Status: brand new products, without any microorganisms.

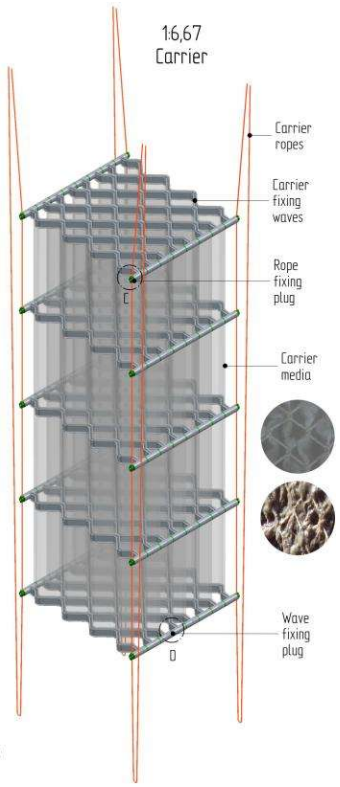
*Note: * biofilm holding capacity depends on wastewater characteristics and reactor configuration*

Effective size (L x W x H):

- ✓ 700 x 700 x 2000mm
- ✓ 700 x 700 x 2500mm
- ✓ 700 x 700 x 3000mm
- ✓ 700 x 700 x 3500mm
- ✓ 700 x 700 x 4000mm
- ✓ 700 x 700 x 4200mm
- ✓ 700 x 700 x 5000mm
- ✓ Other sizes on request







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METABOLIC NETWORK REACTOR (MNR TECHNOLOGY)

Introduction

Istvan KENYERES Chemical Engineer & Biotechnologist

Over 15 years as a University Researcher, Scientist and Inventor
Over 25 years as a Serial Entrepreneur building several successful companies
Now - Creative Ecologist combining Business, Science, Arts and Social Responsibility

PROFESSIONAL EXPERIENCE

2012- President, Biopolus Institute
2011-2012: Chairman, Organica Water, Inc.
1998-2012: President & CEO, Organica Technologies, Inc.
2006-2009: CEO, Member of the Board, Organica-VWS, Inc.
1991-1998: Owner, KENYERES Engineering & Consulting
1989-1991: Chief Technology Officer, Turbulenta Engineering, Ltd.

MEMBERSHIPS

2012-2016: Lifeboat Foundation, Member of the Complex Systems Scientific Advisory Board
2012-2016: Szent István University, Member of the Advisory Council, Faculty of Agricultural and Environmental Sciences
2012-2013: European Institute of Innovation and Technology - EIT, Member of the Bio-economy Platform Preparatory Team

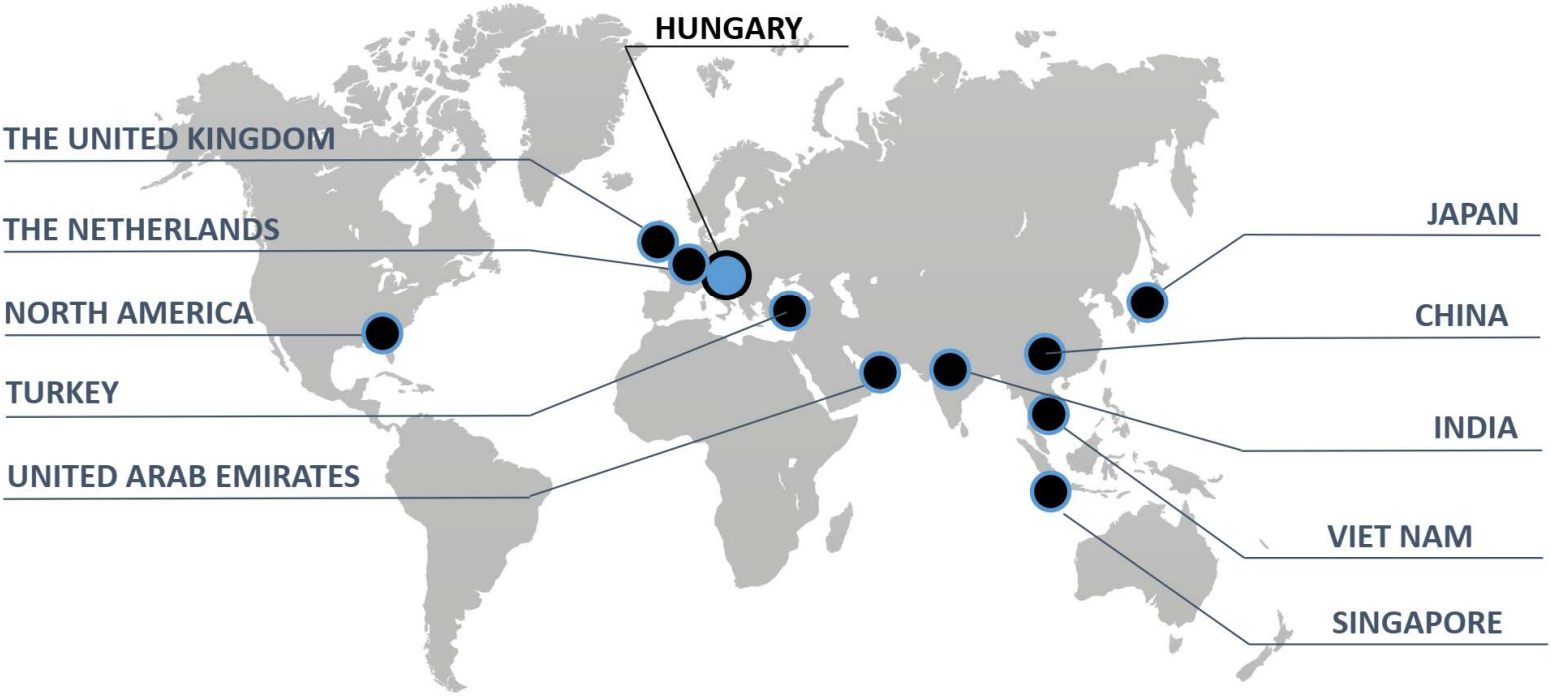
PATENTS

2016: Biofilm Carrier (MNR v2)
2014: Biofilm Carrier (MNR v1)
2010: Carrier insert for accommodating and maintaining the biofilm culture of fluid cleaning structures (FCR)
2004: Method and apparatus for the biological activated sludge treatment of wastewater (FBR)
1989: Process for contacting gases with liquids (Turbulenta)

AWARDS

2005: Silver Merit Cross of the President of the Republic of Hungary for the pioneering role in the modernization of the Hungarian Environmental Industry.

STRATEGIC PARTNERS



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