ULTIMATE

WATER SMART INDUSTRIAL SYMBIOSIS

Factsheet:

Small Bioreactor Platform

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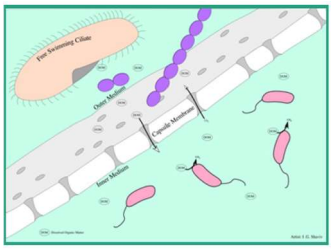
DATE: 05/08/2023

VERSION: V1

The project leading to this application has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 869318

Small Bioreactor Platform



Unique points:

- ✓ Achieves regulation compliance (organic matter, nitrogen, and more).
- ✓ Enables new treatment solutions
- ✓ Improves efficacy of treatment facilities without a significant investment in infrastructure
- ✓ Enhance existing platforms
- ✓ User pays per treatment (not for infrastructure)

Technology Overview

The Small Bioreactor Platform (SBP) technology (Menashe & Kurzbaum, 2013a) is an innovative patented technology (US Patent No. US 8,673,606 B2 / Europe Patent No. EP 2421544 / Australia Patent No. 2010240486 / Israel Patent No. 213072) integrating engineering and microbiology into a solution that enables us to adapt and accomplish a sufficient biomass of selective bacterial cultures. The SBP capsules (approx. 2.5 cm in length) are coated with a semi-permeable membrane (micro-filtration) which only allows dissolved molecules and compounds to traverse across the membrane, while keeping the microorganisms inside with favourable micro-cosmos conditions for weeks.
The physical barrier provides the exogenous bacterial culture protection from culture dilution and negative interactions with outer microorganisms, i.e protozoa. As a result, a significant reduction in the natural selection forces against the introduced culture is achieved, allowing the rapid growth of sufficient selective biomass. The SBP capsules are integrated inside the wastewater treatment plant bioreactor (host bioreactor) by using introduction devices. Bellow there is an explanatory video (figure 1).

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Figure 1. Video of the technology

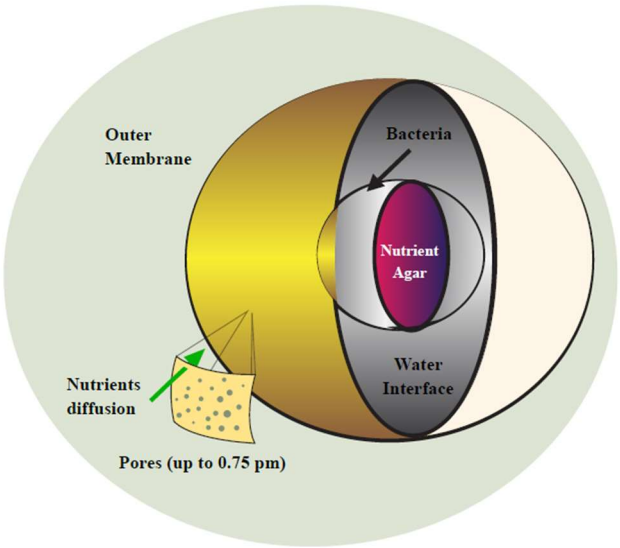

Figure 2. Small Bioreactor Platform capsule design: the patented technology enables to introduced selective microorganisms' culture to various types of water bodies to perform their biological cleaning processes.

Flow scheme of the technology

In the framework of the ULTIMATE project, in the Work Package 1, SPB is applied to treat the fruit processing water by-product. The industrial by-product goes through several treatment steps (filtration, coagulation, AOP) and end-up in a tank where SPB capsules are in place.
The aim of the overall process is to valorise the water and use it for agriculture and secondary uses and the aim of the SBP platform step, specifically, is to further degrade organic molecules surviving the AOP.

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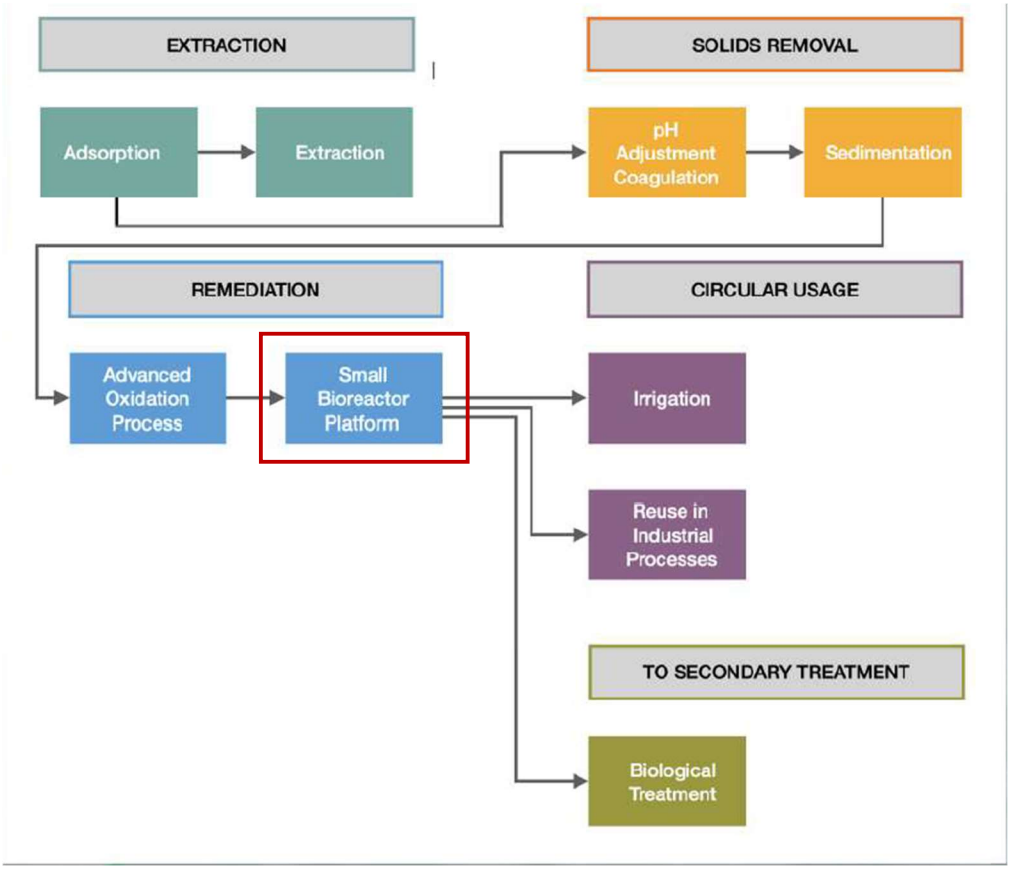

Figure 3: Flow diagram of the process

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Pictures of the technology and product

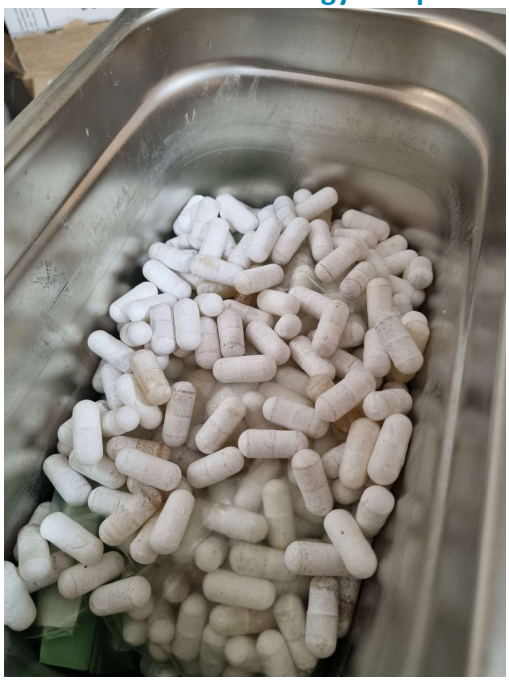

Figure 4: Picture of the capsules

Synergetic effects and motivation for the implementation of the technology

- ✓ ***SPB can be used as a wastewater additive treatment***

Due to the membrane film that separates the microorganisms, SPB allows the implementation of exogenous bacterial culture (bioaugmentation) within a host bioreactor thus allowing us to enhance a specific culture or to create a microbial blend. This addition improves the performance of the bioreactor and increases the stability under stressful incidents (Menashe & Kurzbaum, 2013b).

Requirements of the technology and operating conditions

The SBP technology in the ULTIMATE case study 4 is used as a standalone treatment step and requires relative steady flow and content, dissolved oxygen higher than 1mg/L and pH around 7.

Key performance indicators

Please, include main KPI for this technology.

Links to related topics and similar reference projects

Process/technologies	Reference
Phenol biodegradation	(Kurzbaum et al., 2020)
Olive wastewater treatment	(Bar Oz et al., 2018)

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References

Bar Oz, Y., Mamane, H., Menashe, O., Cohen-Yaniv, V., Kumar, R., Iasur Kruh, L., & Kurzbaum, E. (2018). Treatment of olive mill wastewater using ozonation followed by an encapsulated acclimated biomass. *Journal of Environmental Chemical Engineering*, *6*(4), 5014–5023. https://doi.org/https://doi.org/10.1016/j.jece.2018.07.003

Kurzbaum, E., Raizner, Y., Kuc, M. E., Kulikov, A., Hakimi, B., Kruh, L. I., & Menashe, O. (2020). Phenol biodegradation by bacterial cultures encapsulated in 3D microfiltration-membrane capsules. *Environmental Technology*, *41*(22), 2875–2883. https://doi.org/10.1080/09593330.2019.1587005

Menashe, O., & Kurzbaum, E. (2013b). Small-bioreactor platform technology as a municipal wastewater additive treatment. *Water Science and Technology*, *69*(3), 504–510. https://doi.org/10.2166/wst.2013.709

Outlook

Case study specific information will be provided, when the results of the other work packages are available:

- **Lessons learned from the case study**
- **Outcome of the assessments**
- **Legal and regulatory information concerning the whole value chain concerning the technology**
- **Business opportunities**

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