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INSIGHT INTO THE GRANULAR ACTIVATED ALGAE TECHNOLOGY DESIGNED FOR MUNICIPAL WASTEWATER TREATMENT

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ABSTRACT

The cost and energy requirements of microalgae harvesting have long been important barriers to advancing microalgae biotechnology beyond the laboratory, and there is a sound reason to reduce, or ideally eliminate, these constraints for the scalability and economic viability of such technology. Although nature has provided us with a valuable, renewable resource in microalgae since the dawn of life on Earth, their cellular properties have proven more difficult to harness efficiently. Achieving effective harvesting requires extensive research efforts, and while numerous experimental attempts have yielded promising and important results, overcoming these hurdles remains one of the goals of the field, with nearly half of the scientific publications on microalgae discussing this issue.
As a team of environmental science researchers, this challenge has driven our curiosity and efforts for over a decade, leading to the development of granular activated algae technology. A key feature of this concept is the structural stability of the granulated biomass, where a balanced ecosystem of microalgae and bacteria develops in a nutrient-rich environment, allowing efficient microalgae harvesting with almost 99% performance within minutes of settling.
However, beyond its original context and scope, the principle of microalgae-bacteria granulation has evolved into a promising solution for the municipal wastewater treatment sector. In spite of their critical role, traditional wastewater systems, based on century-old technology, are among the most energy-intensive components of municipal infrastructure. Not only do these systems produce significant greenhouse gas emissions, exceeding those of some entire nations, but they also continuously generate large volumes of waste that are difficult to manage.
Granular activated algae technology offers a solution by combining microalgae and bacteria within granular structures to promote a self-sustaining aerobic process, eliminating the need for energy-intensive aeration stages in biological wastewater treatment, while sequestering carbon and producing a high-value waste stream with over 40% microalgae, rich in nitrogen, carbon and phosphorus, with multiple potential applications that have yet to be fully exploited. The presented study aims to provide an insight into years of intensive research, outlining the technology roadmap, basic principles, risks and key features to unite efforts in microalgae research for a sustainable future.

KEYWORDS
Granular activated algae, microalgae harvesting, wastewater treatment, nutrient recovery

REFERENCES
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PRESENTER INFORMATION

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BIOGRAPHY

Dr. Olga Tiron - a Research Scientist at the National Research and Development Institute for Industrial Ecology - ECOIND (Romania) addressing the research on harnessing renewable resources of microalgae biomass in sustainable environmental biotechnologies and production of bio-products, with a particular emphasis on microalgae application for wastewater treatment and microalgae low-cost harvesting; inventor of microalgae-bacteria granulation procedure (RO130247/EP4361111A1) and principal investigator of the Graalrecovery technology grant aimed at developing a microalgae-based technology for the treatment of wastewater discharged into sewerage networks and wastewater treatment plants (www.graalrecovery.com), with a research experience in more than 20 projects in environmental science; member of the editorial boards, joint inventor in environmental biotechnology patents requests, holder of international awards for best platform research presentations and gold medals.

ORGANIZATION PROFILE

The National Research and Development Institute for Industrial Ecology - ECOIND is a leading Romanian public research institute, renowned for its multidisciplinary expertise in environmental protection and innovation, committed to addressing complex environmental challenges and providing sustainable solutions. With a team of around 150 scientists, ECOIND is organized into four key departments specializing in pollution control, environmental impact assessment, technologies and biotechnologies, and environmental monitoring. The Institute's expertise covers a wide range of environmental issues, including air, water, soil and waste pollution control, ecotoxicological studies, biological remediation and consultancy services. In addition, ECOIND conducts specialized research in odour assessment, bioassays and biological conversion of organic waste. The institute has also a strong portfolio of more than 55 patents and patents requests and is the author of around 600 scientific articles published in national and international journals.