European Sustainable Phosphorus Platform

Regulatory questions around nutrient recycling and materials valorisation from algae grown in wastewater or waste

Monday 22nd March 2021,

09h00 - 13h00 (Paris time, CET)

Overview of waste-related (wastewater) algae production, nutrient recycling routes, current states of development and potential markets.

Vítor Verdelho Vieira

General Manager - European Algae Biomass Association
Council Member of the Executive Committee of
ISAP - International Society for Applied Phycology
Member for the Board - A4F Algae for Future, SA

a4f algae for future

EABA EUROPEAN ALGAE BIOMASS ASSOCIATION

Overview of waste-related algae production, nutrient recycling routes, current states of development and potential markets.

Brief presentation about EABA the European Algae Biomass Association

Overview of waste-related / wastewater algae production

- nutrient recycling routes

- current states of development and potential markets

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Brief presentation about EABA the European Algae Biomass Association

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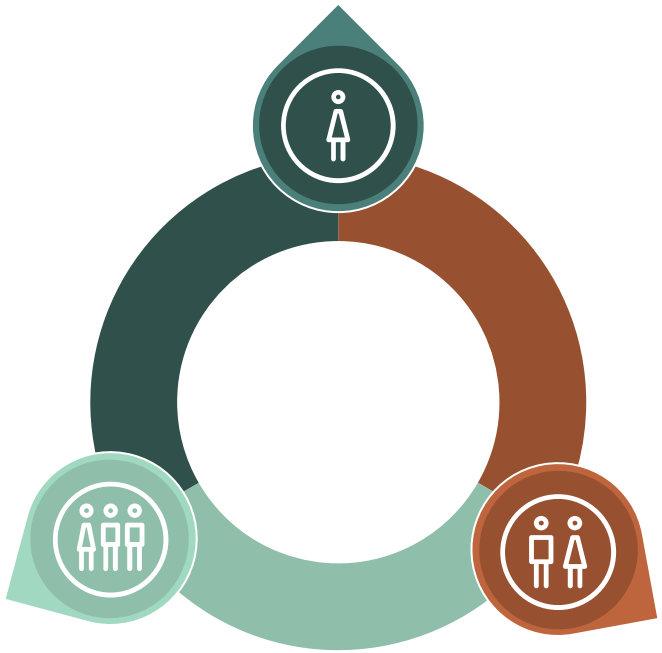
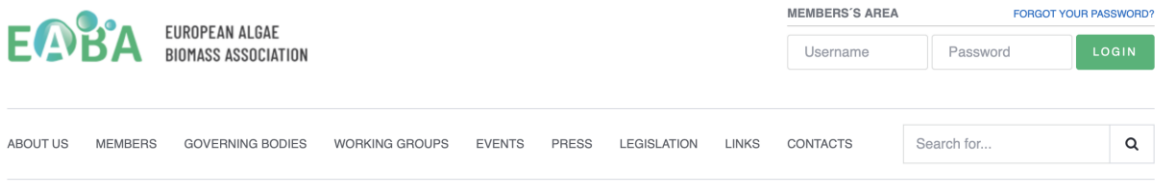
European Algae Biomass Association

Objective
Promote mutual interchange and cooperation in the field of algae biomass production and use, including biofuels uses and all other utilizations

Established in Florence in June 2009

Target
Its main target is to act as a catalyst for fostering synergies among scientists, industrialists and decision makers in order to promote the development of research, technology and industry





Website: https://www.eaba-association.org/en

Aim
It aims at creating, developing and maintaining solidarity and links between its Members and at defending their interests at European and international level

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Hi, I'm Algae

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CEA - Commission for Atomic Energy and Alternative Energies

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TNO

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Norwegian Institute for Water Research (NIVA)

Stichting CaribAlgae

IBVF - Institute of Plant Biochemistry and Photosynthesis - University of Sevilla & CSIC

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Benefits of becoming a member

01 Influence the future of the sector with **specific positions** and contributions

02 Opportunities to participate on **EABA committees** and EABA policy initiatives

03 Access **unique network** to disseminate, scientific, industrial and commercial news

04 **Visibility** through the EABA of relevant news and advances by your organization

05 Access to EABA's **members-only reports, presentations, publications**

06 Inputs and participation in the development of well **technical standards**

07 **Networking with members** to develop joint projects, proposals,...

08 Opportunity to participate in **on-going EABA educational** activities

09 Obtaining to regular updates on developments via member alerts and newsletter

10 **Reduced fees for EABA activities** and events, and those promoted by affiliated partners

Europe has a long tradition in algae knowledge development and innovation with European companies in the forefront of practical applications of algae for novel foods and feeds, biofuels and chemicals, specialty bioproducts and environmental services.

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European Algae Biomass Association

Webinars & Conferences 2021

• INFO & REGISTRATION: WWW.ALGAEWORKSHOPS.ORG | WWW.EABA-ASSOCIATION.ORG | WWW.WHAT-ARE-ALGAE.COM

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TECHNICAL WEBINARS

Maxi webinar:
all about EABA workshops
2019 and webinars 2020
APRIL 7

Production technologies
for algae, including
harvesting
MAY 7

The use of algae biomass
in cosmetic products
JUNE 1

Novel proteins and
applications from
algae biomass
JUNE 17

Algae for aquafeeds
JULY 22

Biorefineries for
algae biomass
SEPTEMBER 23

High value products
from microalgae
OCTOBER 14

FLASH WEBINARS

Algae for cooking –
Cooking algae not
a mystery anymore
APRIL 15

Open calls for
EC Programmes
including Green Deal
MAY 25

Toxic algae blooms:
from environment problem
to biotech potential
JULY 8

CONFERENCES

Young Algaeneers
Symposium 2021
MAY 10, 11, 12

Seaweed Valorization
in Europe Conference:
learning from Asia
JULY 1, 2

European Chlorella
Conference 2021
SEPTEMBER 14, 15

Algae Europe 2021
DECEMBER 7, 8, 9

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TECHNICAL WEBINAR

Maxiwebinar: all about EABA workshops 2019 and webinars 2020 APRIL 7, 2021 · ONLINE

18 Days | 1 Hours | 29 Minutes | 8 Seconds

Register Now

a unique event

https://algaeworkshops.org

Why?

This webinar aims to follow-up the 2019 Workshops and Technical webinars in 2020. The webinar will provide a **global overview** and **details** about the **algae biomass sector** either about **specific algae** as *Haematococcus*, *Nannochloropsis*, *Arthrospira* (spirulina), and **products from algae** as phycocyanin, fucoxanthin and biostimulants or algae antivirals. The Maxi Webinar will bring a global vision about the algae biomass sector.

The European Algae Biomass Association (EABA) aims to promote a strong link between **science, technology and business** in the algae biomass sector. Both microalgae and seaweed will be presented.
It is very relevant to bring together the main stakeholders for knowledge exchange and collaboration and to learn from others.
We provide specific content with a unique opportunity for training and learning in a networking environment.

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Overview of waste-related (wastewater) algae production

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Key Players

- Overview of wastewater algae production

2 EXAMPLES

algae from wastewater

- Aqualia (ponds in Spain)
- Clearas (PBRs in USA)

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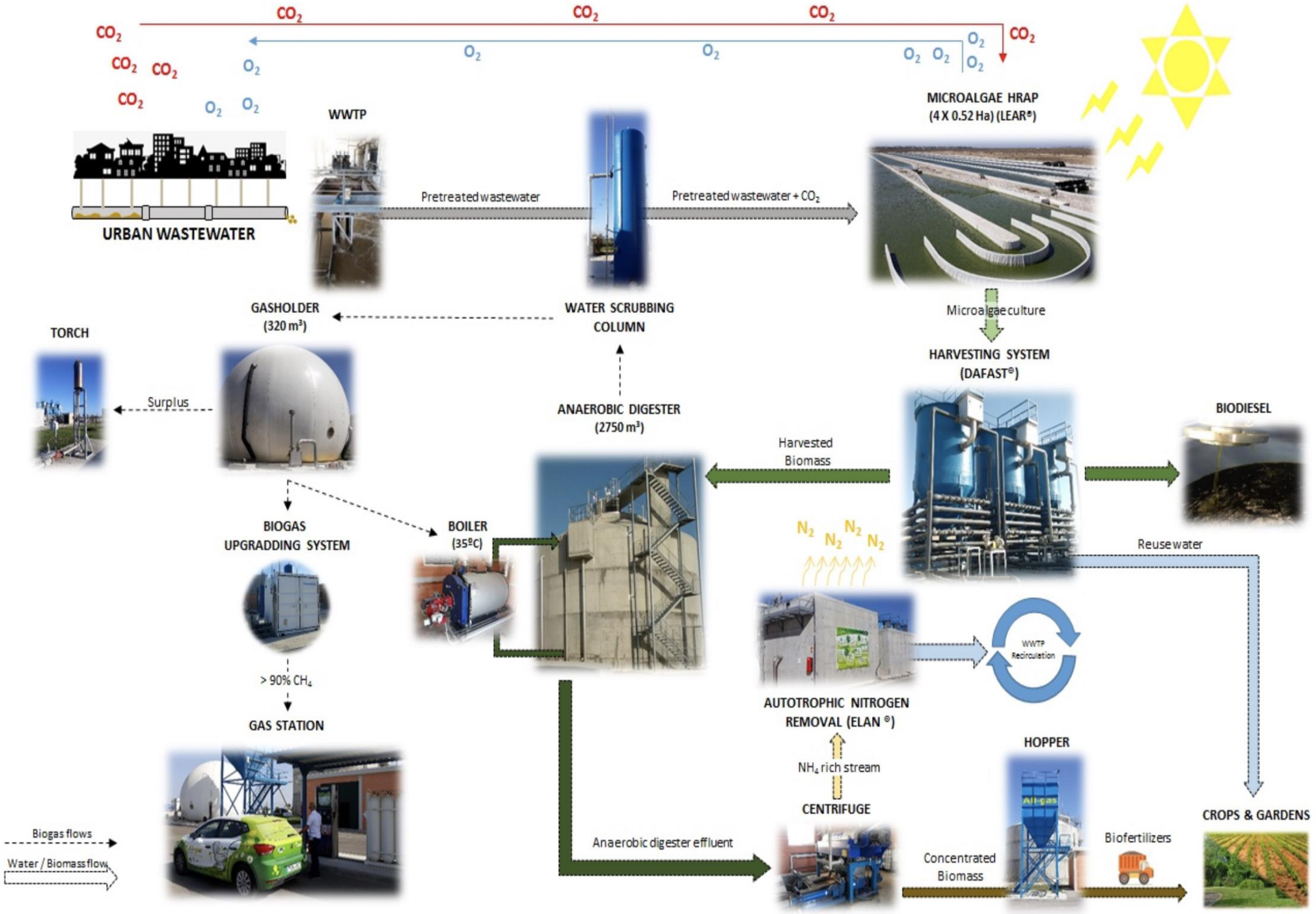

aqualia

Arcos de la Frontera y Chiclana de la Frontera (Cádiz)

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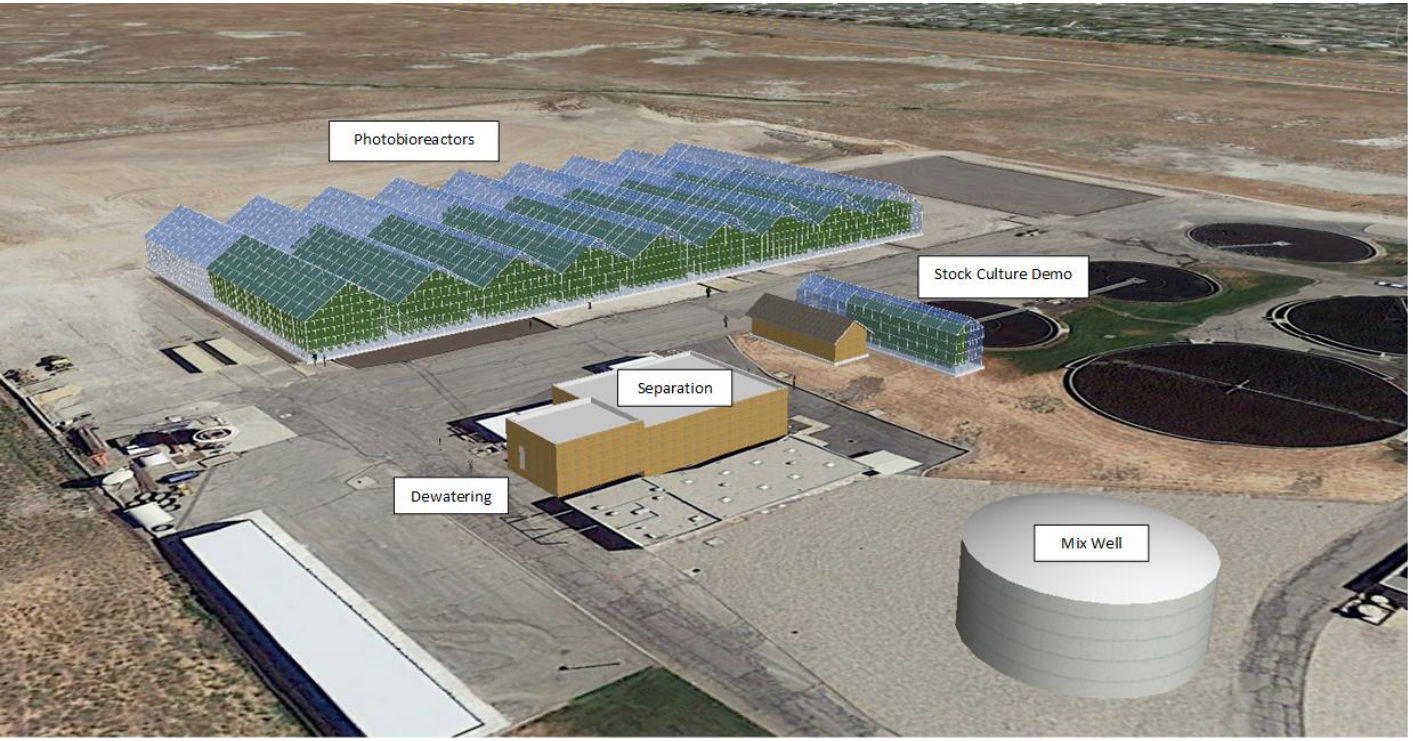
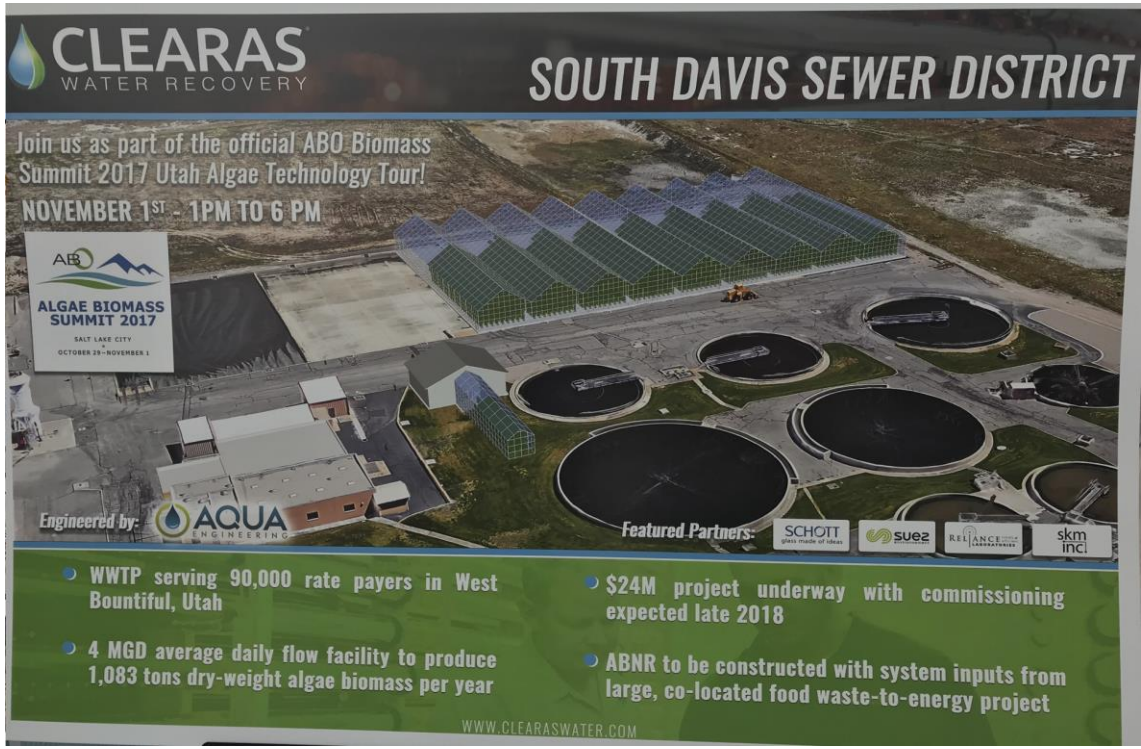
South Davis Sewer District, USA (2018)

Largest indoor PBR in the world, volume 1.600 m^3

www.clearaswater.com





Waste water cleaning with tubular glass PBR* reduced
10x more phosphate and 3x more nitrate than conventional systems.

*) Demonstration PBR in Spokane, Washington in 2014 with 531 glass tubes, 381 glass bends, and 675 couplings from SCHOTT

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Key Players

- nutrient recycling routes

2 EXAMPLES

wastewater algae reviews

- Nutrient recovery from wastewater streams
- Microalgae and wastewater treatment
- Microalgae brewery wastewater treatment

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Renewable and Sustainable Energy Reviews
Volume 19, March 2013, Pages 360-369

Nutrient recovery from wastewater streams by microalgae: Status and prospects

Ting Cai [1], Stephen Y. Park [1], Yebo Li

There is a wide range of evidences about the use of microalgae for inorganic nutrient recovery from wastewater with different cultivation systems.

https://doi.org/10.1016/j.rser.2012.11.030

Abstract

Disposal of wastewater often results in high nutrient loading into aquatic environments, which may lead to favorable conditions for undesirable phytoplankton blooms. Microalgae are efficient in removing nitrogen, phosphorus, and toxic metals from wastewater under controlled environments. If key nutrients in the wastewater stream can be used to grow microalgae for biofuel production, the nutrients can be removed, thus significantly reducing the risk of harmful phytoplankton overgrowth. This review paper summarizes the major nutrient components of different wastewater streams, the mechanisms of algal nutrient uptake, nutrient removal performance of various species of microalgae when cultured in wastewater, and current microalgae production systems. Finally, new algae cultivation technologies applicable for biofuel production and nutrient recovery in polluted water bodies are discussed.

Contents

5. Conclusions

Although the ability of microalgae to assimilate excess nut ents from the environment has been thoroughly studied, due the complex characteristics of wastewater, the tests of growi algae in wastewater are mostly at laboratory scale. Pilot-sca algae cultivation continues to face many issues including co tamination, inconsistent wastewater components, and unstab biomass production. The major challenge associated with cultu ing algae in nutrient-rich, natural water bodies comes from t design of the cultivation system. Further research is needed identify algae species and optimize operating parameters for lip production that can be used to prevent eutrophication of wat bodies.

* Corresponding author. Tel.: +1 330 263 3855.
E-mail address: li.851@osu.edu (Y. Li).
[1] Both authors contributed equally to this work.

http://dx.doi.org/10.1016/j.rser.2012.11.030

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REVIEW

Microalgae and wastewater treatment

N. Abdel-Raouf [a], A.A. Al-Homaidan [b,*], I.B.M. Ibraheem [b,c]

[a] *Botany and Microbiology Department, Faculty of Science, Medical Studies and Sciences Sections, King Saud University, Riyadh, Saudi Arabia*
[b] *Botany and Microbiology Department, Faculty of Science, P.O. Box 2455, King Saud University, Riyadh, Saudi Arabia*
[c] *Botany Department, Faculty of Science, Beni-Suef University, Beni-Suef 62511, Egypt*

Received 18 March 2012; revised 21 April 2012; accepted 21 April 2012
Available online 3 May 2012

KEYWORDS

Microalgae;
Wastewater treatment

Abstract Organic and inorganic substances which were released into the environment as a result of domestic, agricultural and industrial water activities lead to organic and inorganic pollution. The normal primary and secondary treatment processes of these wastewaters have been introduced in a growing number of places, in order to eliminate the easily settled materials and to oxidize the organic material present in wastewater. The final result is a clear, apparently clean effluent which is discharged into natural water bodies. This secondary effluent is, however, loaded with inorganic nitrogen and phosphorus and causes eutrophication and more long-term problems because of refractory organics and heavy metals that are discharged. Microalgae culture offers an interesting step for wastewater treatments, because they provide a tertiary biotreatment coupled with the production of potentially valuable biomass, which can be used for several purposes. Microalgae cultures offer an elegant solution to tertiary and quandary treatments due to the ability of microalgae to use inorganic nitrogen and phosphorus for their growth. And also, for their capacity to remove heavy metals, as well as some toxic organic compounds, therefore, it does not lead to secondary pollution. In the current review we will highlight on the role of micro-algae in the treatment of wastewater.

* Corresponding author.
E-mail addresses: neveingalal@yahoo.com (N. Abdel-Raouf), homaidan@msn.com (A.A. Al-Homaidan), ibraheemborie@hotmail.com (I.B.M. Ibraheem).

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http://dx.doi.org/10.1016/j.sjbs.2012.04.005

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Microalgae culture offers an elegant solution for wastewater tertiary treatment due to the ability to removal of inorganic nitrogen and phosphorus and lead to the production of valuable biomass.

Contents

14. Conclusion

* Algae can be used in wastewater treatment for a range of purposes, including;
  1. reduction of BOD,
  2. removal of N and/or P,
  3. inhibition of coliforms,
  4. removal of heavy metals

* The high concentration of N and P in most wastewaters also means these wastewaters may possibly be used as cheap nutrient sources for algal biomass production. This algal biomass could be used for:
  1. methane production,
  2. composting,
  3. production of liquid fuels ((pseudo-vegetable fuels),
  4. as animal feed or in aquaculture and
  5. production of fine chemicals.

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International Journal of
Environmental Research and Public Health

MDPI

Review

Microalgae Brewery Wastewater Treatment: Potentials, Benefits and the Challenges

David Kwame Amenorfenyo [1,2], Xianghu Huang [1,2,*], Yulei Zhang [1,2], Qitao Zeng [1,2], Ning Zhang [1,2], Jiajia Ren [1,2] and Qiang Huang [3]

1 Department of Aquaculture, Fishery College, Guangdong Ocean University, Zhanjiang 524088, China; davidamenorfenyo@yahoo.com (D.K.A.); yuleizhang88@163.com (Y.Z.); zeng364@163.com (Q.Z.); zning496@163.com (N.Z.); rjj12138@163.com (J.R.)
2 Guangdong Engineering Technology Research Center for Algae Breeding and Application, Zhanjiang 524088, China
3 SDIC Guangdong Bio-Energy Co., Ltd., Zhanjiang 524025, China; huangqiang@sdiczn.com
* Correspondence: hxh166@126.com

Received: 1 April 2019; Accepted: 24 May 2019; Published: 30 May 2019

Abstract: Concerns about environmental safety have led to strict regulations on the discharge of final brewery effluents into water bodies. Brewery wastewater contains huge amounts of organic compounds that can cause environmental pollution. The microalgae wastewater treatment method is an emerging environmentally friendly biotechnological process. Microalgae grow well in nutrient-rich wastewater by absorbing organic nutrients and converting them into useful biomass. The harvested biomass can be used as animal feed, biofertilizer, and an alternative energy source for biodiesel production. This review discusses conventional and current brewery wastewater treatment methods, and the application and potential of microalgae in brewery wastewater treatment. The study also discusses the benefits as well as challenges associated with microalgae brewery and other industrial wastewater treatments.

Keywords: brewery industry; wastewater; microalgae; environmental protection

7. Conclusions

As the brewery industry continues to expand, the amount of wastewater it produces will continue to increase and thus its negative impact on the environment. In order to safeguard the environment, biological methods such as aerobic and anaerobic treatments are mostly used due to their capability to remove high organic loads and COD. However, these methods are associated with high capital and operating costs. Moreover, these methods are only applied as pre-treatment options and the water may require further treatment.

In this review, MBR, activated carbon and MFC methods have shown some promising results that have great potential for brewery wastewater treatment. However, high energy consumption and maintenance cost may be an inhibitory factor. Membrane filtration is being used for industrial brewery effluent and other industrial wastewater treatment. The technology is also being applied in drinking water and wastewater reuse. This technology has undergone speedy improvement in terms of quality and costs in recent times and could be used as a polishing step after microalgae treatment. Activated carbon-based treatment methods are less expensive, efficient in organic pollutant removal and can be a suitable treatment option for the brewery industry but, it may be faced with environmental and health concerns due to the use of carbon/coal for the treatment of effluent on a large scale.

This study has shown some promising outcome from microalgae treatment methods. Microalgae treatment has high potential in brewery wastewater treatment. The technology is reliable, eco-friendly, and cost effective. Moreover, it is effective in removing ammonia and phosphorus from brewery effluents. Microalgae wastewater treatment has numerous benefits that have been outlined in this article. However, this technology requires the integration of other treatment methods in order to improve upon the final effluent for the protection of the environment. Currently, there are not many works about these integration options. This requires urgent investigation of other treatment methods with microalgae-based treatment methods, especially regarding color and odor removal from brewery effluent for its possible reuse. Further scientific research should be focused on finding more microalgae strains that are robust enough to adapt to stress and other growth inhibitors to effectively treat brewery and other industrial wastewaters for total protection of the environment.

Microalgae brewery wastewater treatment is effective in removing amoia and phosphorus but requires the integration of other treatment methods in order to improve the final effluent.

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Key Players

• current states of development and potential markets

EXAMPLES

EU SABANA Project

slides kindly provided by Prof. Gabriel Acien

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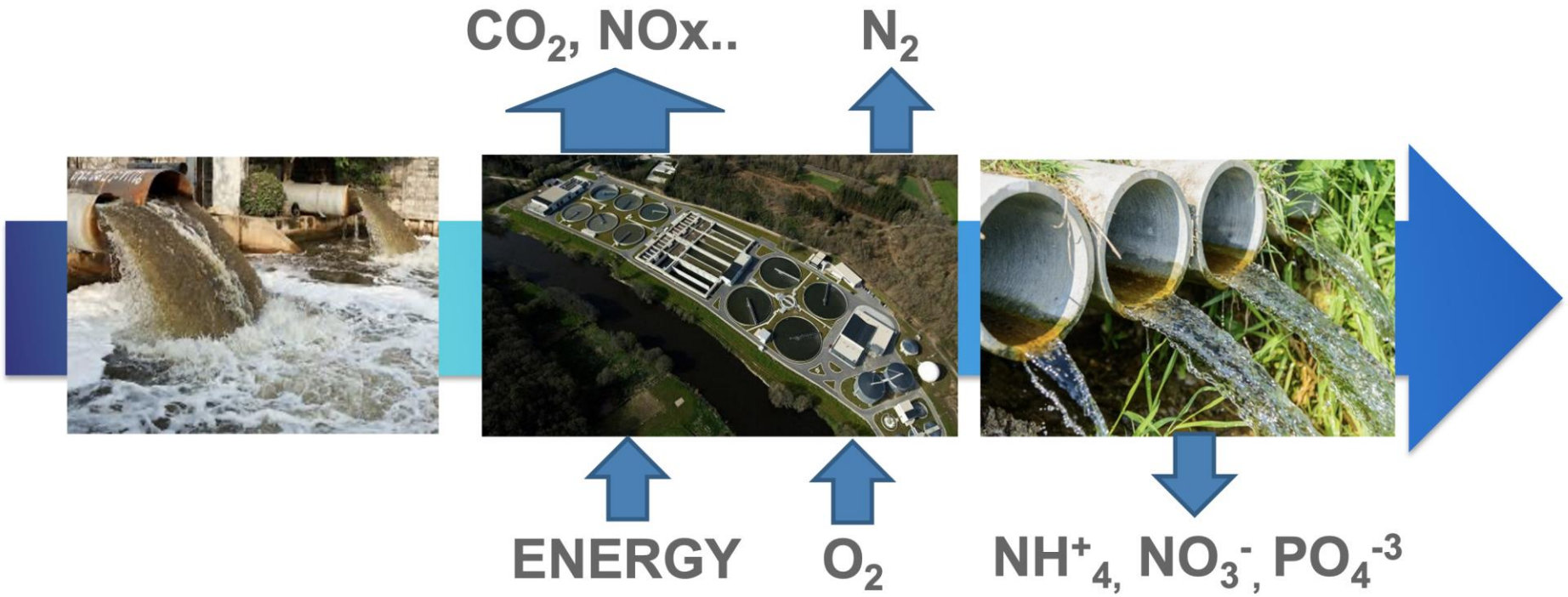
This project is funded by the European Union

Wastewater treatment

Conventional technology is not sustainable

Conventional processes uses huge amounts of energy and resources to dissipate to the environment C, N and P contained into wastewater

www.eu-sabana.eu



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Wastewater treatment

New technologies are necessary

New technologies are requested to allow:

- To reduce the energy consumption of conventional systems
- To recover the nutrients contained into wastewater
- To minimize the emissions of CO_2 and other GHG
- To accomplish the more restrictive regulations in N-P release
- To be installed in small cities at low cost thus allowing to treat 100% of WW
- Robust and don't requiring expert supervision

www.eu-sabana.eu

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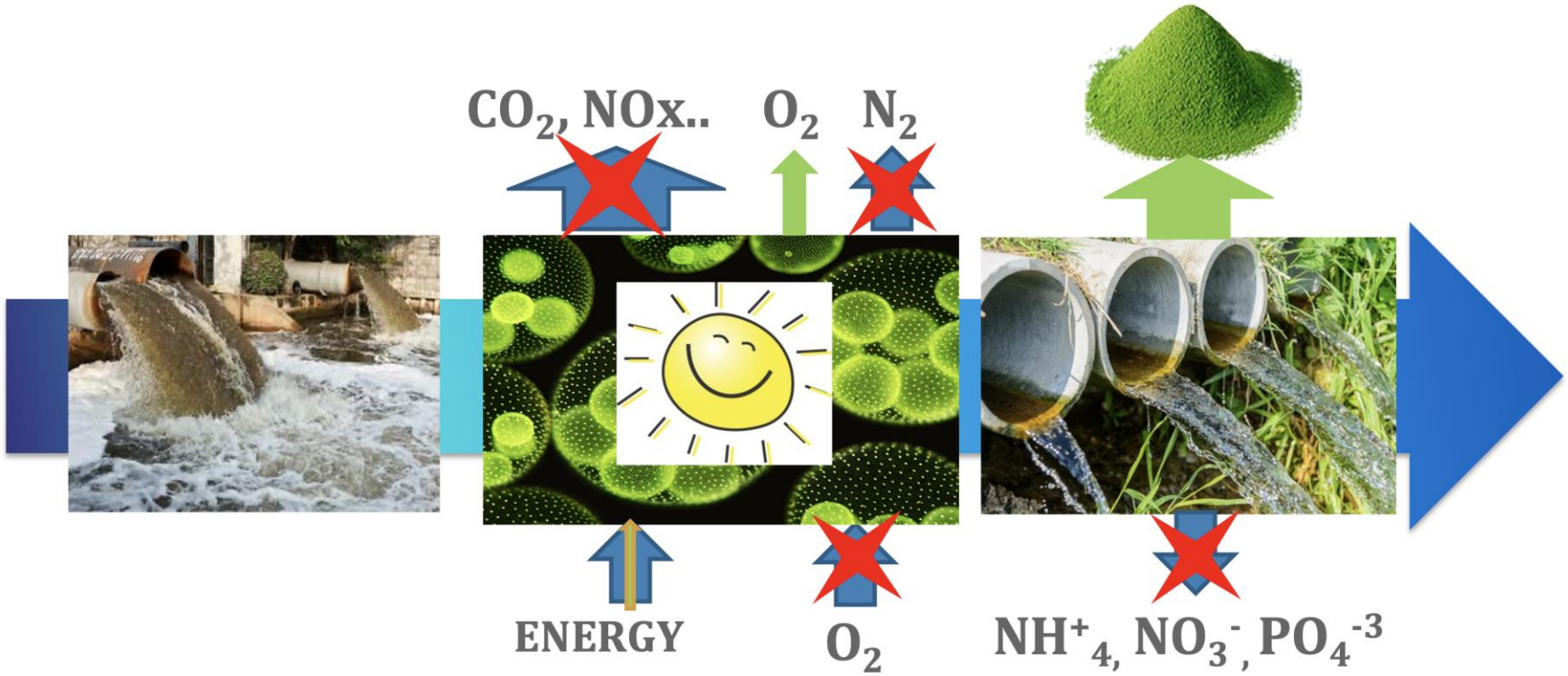
Contribution of microalgae

Using microalgae wastewater treatment is transformed into a productive process instead consuming resources



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Microalgae based treatment allows to recover nutrients on wastewater contained at the same time that saving GHG emissions and avoiding eutrophication problems

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Thank you for your attention!

Vítor Verdelho
GENERAL MANAGER

vitor.verdelho@eaba-association.org
+351 932 006 001

EUROPEAN ALGAE BIOMASS ASSOCIATION
10 YEARS

EABA – European Algae Biomass Association
Viale Belfiore, 10 – 50144 Florence, Italy

Established in Florence on june 2009, EABA is the European association representing both research and industry in the field of algal technologies.

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