



**Unidad de Vigilancia  
Tecnológica**

e



**Inteligencia Competitiva**

**Microalgas**



**Mayo 2016**

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## Publicaciones

En esta sección del presente boletín se presentan las publicaciones de las ramas del árbol seleccionadas para esta edición.

Las ramas son:

**BioRemediación-Doméstico-Lixiviados/RSU**

**BioRemediación-Doméstico-Municipal/Urbano**

**BioRemediación-Industrial-Curtiembre**

**BioRemediación-Industrial-Alimentación**

**BioRemediación-Industrial-Minería**

**BioRemediación-Agropecuario-Tambo**

**BioRemediación-Agropecuario-Cama de Pollo**

**BioRemediación-Agropecuario-Cama de Chancho**

### **BioRemediación-Doméstico-Lixiviados/RSU**

## **Utilization of municipal solid and liquid wastes for bioenergy and bioproducts production**

**Fecha de Publicación:** Disponible online 5 Marzo 2016

**Fuente:** Bioresource Technology

**Autor(es):** Paul Chen, Qinglong Xie, Min Addy, Wenguang Zhou, Yuhuan Liu, Yunpu Wang, Yanling Cheng, Kun Li, Roger Ruan

**Enlace:**

[http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F\\_ob%3DGatewayURL%26\\_origin%3DIRSSSEARCH%26\\_method%3DcitationSearch%26\\_piikey%3DS0960852416302310%26\\_version%3D1%26md5%3Dffdb26bd2dba1165aeec87b6a9052147](http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0960852416302310%26_version%3D1%26md5%3Dffdb26bd2dba1165aeec87b6a9052147)

**Abstract**

Municipal wastes, be it solid or liquid, are rising due to the global population growth and rapid urbanization and industrialization. Conventional management practice involving recycling, combustion, and treatment/disposal is deemed unsustainable. Solutions must be sought to not only increase the capacity but also improve the sustainability of waste management. Research has demonstrated that the non-recyclable waste materials and bio-solids can be converted into useable heat, electricity, or fuel and chemical through a variety of processes, including gasification, pyrolysis, anaerobic digestion, and landfill gas in addition to combustion, and wastewater streams have the potential to support algae growth and provide other energy recovery options. The present review is intended to assess and analyze the current state of knowledge in the municipal

solid wastes and wastewater treatment and utilization technologies and recommend practical solution options and future research and development needs.

## **Dual role of microalgae: Phycoremediation of domestic wastewater and biomass production for sustainable biofuels production**

**Fecha de Publicación:** Octubre 2011

**Fuente:** Applied Energy, Volume 88, Issue 10

**Autor(es):** I. Rawat, R. Ranjith Kumar, T. Mutanda, F. Bux

**Enlace:**

[http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F\\_ob%3DGatewayURL%26\\_origin%3DIRSSSEARCH%26\\_method%3DcitationSearch%26\\_piikey%3DS0306261910004885%26\\_version%3D1%26md5%3D8e9ec5ebbc9ea4a45fade192077e4976](http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0306261910004885%26_version%3D1%26md5%3D8e9ec5ebbc9ea4a45fade192077e4976)

**Abstract**

Global threats of fuel shortages in the near future and climate change due to green-house gas emissions are posing serious challenges and hence and it is imperative to explore means for sustainable ways of averting the consequences. The dual application of microalgae for phycoremediation and biomass production for sustainable biofuels production is a feasible option. The use of high rate algal ponds (HRAPs) for nutrient removal has been in existence for some decades though the technology has not been fully harnessed for wastewater treatment. Therefore this paper discusses current knowledge regarding wastewater treatment using HRAPs and microalgal biomass production techniques using wastewater streams. The biomass harvesting methods and lipid extraction protocols are discussed in detail. Finally the paper discusses biodiesel production via transesterification of the lipids and other biofuels such as biomethane and bioethanol which are described using the biorefinery approach.

## **Seasonal variation of heavy metals in water, sediment and roach tissues in a landfill draining system pond (Etueffont, France)**

**Fecha de Publicación:** Agosto 2014

**Fuente:** Ecological Engineering, Volume 69

**Autor(es):** Zohra Ben Salem , Nicolas Capelli , Xavier Laffray , Grisey Elise , Habib Ayadi , Lotfi Aleya

**Enlace:**

[http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F\\_ob%3DGatewayURL%26\\_origin%3DIRSSSEARCH%26\\_method%3DcitationSearch%26\\_piikey%3DS0925857414001323%26\\_version%3D1%26md5%3Dfc4bca7076d1eb1540702744cab5665](http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0925857414001323%26_version%3D1%26md5%3Dfc4bca7076d1eb1540702744cab5665)

**Abstract**

Concentrations of cadmium, chromium, copper, iron, lead, manganese, nickel, strontium and zinc were determined in water, sediment and fish tissues (gills, liver, muscle and bones) of the common roach (*Rutilus rutilus*) in the Etueffont landfill draining system pond (Belfort, France), during summer and autumn in 2011. Metal concentrations in the water were higher in summer, whereas in sediment they were higher in autumn, except for lead. In fish tissues, the trend in the mean metal concentrations was: Zn>Fe>Sr>Mn>Cu>Cr>Cd≈Pb≈Ni for gills and muscle. Gills and liver showed greater accumulation than muscle and bones, while bones were subjected to concentrations of metals known to interact with calcium such as Mn, Sr and Zn. The tissues accumulated essential metals such as Fe, Zn, Cu, Mn and Sr, which are also found in high concentrations in both sediment and water. However, roach tissues are less suitable for Cd, Pb and Ni exposure, as high levels were measured in both sediment and water but not detected at all in fish tissues. Thus, a combination of physico-chemical and biological analysis is a good way to screen overall environmental circumstances. The roach may therefore be useful as a bioindicator for assessment of metal pollution, though this issue requires further study.

## **A critical review on anaerobic co-digestion achievements between 2010 and 2013**

**Fecha de Publicación:** Agosto 2014

**Fuente:** Renewable and Sustainable Energy Reviews, Volume 36

**Autor(es):** J. Mata-Alvarez , J. Dosta , M.S. Romero-Güiza , X. Fonoll , M. Peces , S. Astals

**Enlace:**

[http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F\\_ob%3DGatewayURL%26\\_origin%3DIRSSSEARCH%26\\_method%3DcitationSearch%26\\_piikey%3DS1364032114002664%26\\_version%3D1%26md5%3D8b8231b9fe78a461c8b65eee4b710c1d](http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS1364032114002664%26_version%3D1%26md5%3D8b8231b9fe78a461c8b65eee4b710c1d)

**Abstract**

Anaerobic digestion is a commercial reality for several kinds of waste. Nonetheless, anaerobic digestion of single substrates presents some drawbacks linked to substrate characteristics. Anaerobic co-digestion, the simultaneous digestion of two or more substrates, is a feasible option

to overcome the drawbacks of mono-digestion and to improve plant's economic feasibility. At present, since 50% of the publication has been published in the last two years, anaerobic co-digestion can be considered the most relevant topic within anaerobic digestion research. The aim of this paper is to present a review of the achievements and perspectives of anaerobic co-digestion within the period 2010–2013, which represents a continuation of the previous review made by the authors [3]. In the present review, the publications have been classified as for the main substrate, i.e., animal manures, sewage sludge and biowaste. Animal manures stand as the most reported substrate, agro-industrial waste and the organic fraction of the municipal solid waste being the most reported co-substrate. Special emphasis has been made to the effect of the co-digestion over digestate quality, since land application seems to be the best option for digestate recycling. Traditionally, anaerobic co-digestion between sewage sludge and the organic fraction of the municipal solid waste has been the most reported co-digestion mixture. However, between 2010 and 2013 the publications dealing with fats, oils and greases and algae as sludge co-substrate have increased. This is because both co-substrates can be obtained at the same wastewater treatment plant. In contrast, biowaste as a main substrate has not been as studied as manures or sewage sludge. Finally, three interdisciplinary sections have been written for addressing novelty aspects in anaerobic co-digestion, i.e., pre-treatments, microbial dynamics and modeling. However, much effort needs to be done in these later aspects to better understand and predict anaerobic co-digestion.

### **BioRemediación-Doméstico-Municipal/Urbano**

## **Emerging contaminant degradation and removal in algal wastewater treatment ponds: Identifying the research gaps**

**Fecha de Publicación:** 5 Agosto 2016

**Fuente:** Journal of Hazardous Materials, Volume 313

**Autor(es):** Zane N. Norvill, Andy Shilton, Benoit Guieysse

**Enlace:**

[http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F\\_ob%3DGatewayURL%26\\_origin%3DIRSSSEARCH%26\\_method%3DcitationSearch%26\\_piikey%3DS0304389416303089%26\\_verseion%3D1%26md5%3D3fe5194b82983acc8f36267ca7a788c9](http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0304389416303089%26_verseion%3D1%26md5%3D3fe5194b82983acc8f36267ca7a788c9)

**Abstract**

Whereas the fate of emerging contaminants (ECs) during 'conventional' and 'advanced' wastewater treatment (WWT) has been intensively studied, little research has been conducted on the algal WWT ponds commonly used in provincial areas. The long retention times and large surface areas exposed to light potentially allow more opportunities for EC removal to occur, but

experimental evidence is lacking to enable definite predictions about EC fate across different algal WWT systems. This study reviews the mechanisms of EC hydrolysis, sorption, biodegradation, and photodegradation, applying available knowledge to the case of algal WWT. From this basis the review identifies three main areas that need more research due to the unique environmental and ecological conditions occurring in algal WWT ponds: i) the effect of diurnally fluctuating pH and dissolved oxygen upon removal mechanisms; ii) the influence of algae and algal biomass on biodegradation and sorption under relevant conditions; and iii) the significance of EC photodegradation in the presence of dissolved and suspended materials. Because of the high concentration of dissolved organics typically found in algal WWT ponds, most EC photodegradation likely occurs via indirect mechanisms rather than direct photolysis in these systems.

## **Progress in the biological and chemical treatment technologies for emerging contaminant removal from wastewater: A critical review**

**Fecha de Publicación:** Disponible online 23 Abril 2016

**Fuente:** Journal of Hazardous Materials

**Autor(es):** Mohammad Boshir Ahmed, John L. Zhou, Huu Hao Ngo, Wenshan Guo, Nikolaos S. Thomaidis, Jiang Xu

**Enlace:**

[http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F\\_ob%3DGatewayURL%26\\_origin%3DIRSSSEARCH%26\\_method%3DcitationSearch%26\\_piikey%3DS0304389416303867%26\\_version%3D1%26md5%3D8af6aef4f7e74d1f0617f32e0de8a9f8](http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0304389416303867%26_version%3D1%26md5%3D8af6aef4f7e74d1f0617f32e0de8a9f8)

**Abstract**

This review focuses on the removal of emerging contaminants (ECs) by biological, chemical and hybrid technologies in effluents from wastewater treatment plants (WWTPs). Results showed that endocrine disruption chemicals (EDCs) were better removed by membrane bioreactor (MBR), activated sludge and aeration processes among different biological processes. Surfactants, EDCs and personal care products (PCPs) can be well removed by activated sludge process. Pesticides and pharmaceuticals showed good removal efficiencies by biological activated carbon. Microalgae treatment processes can remove almost all types of ECs to some extent. Other biological processes were found less effective in ECs removal from wastewater. Chemical oxidation processes such as ozonation/H<sub>2</sub>O<sub>2</sub>, UV photolysis/H<sub>2</sub>O<sub>2</sub> and photo-Fenton processes can successfully remove up to 100% of pesticides, beta blockers and pharmaceuticals, while EDCs can be better removed by ozonation and UV photocatalysis. Fenton process was found less effective in

the removal of any types of ECs. A hybrid system based on ozonation followed by biological activated carbon was found highly efficient in the removal of pesticides, beta blockers and pharmaceuticals. A hybrid ozonation-ultrasound system can remove up to 100% of many pharmaceuticals. Future research directions to enhance the removal of ECs have been elaborated.

## **Algal biofilm reactors for integrated wastewater treatment and biofuel production: A review**

**Fecha de Publicación:** 1 Marzo 2016

**Fuente:** Chemical Engineering Journal, Volume 287

**Autor(es):** Donghee Hoh, Stuart Watson, Eunsung Kan

**Enlace:**

[http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F\\_ob%3DGatewayURL%26\\_origin%3DIRSSSEARCH%26\\_method%3DcitationSearch%26\\_piikey%3DS138589471501606X%26\\_version%3D1%26md5%3D3ca5a5a7808a62b7a5d5619ed6486248](http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS138589471501606X%26_version%3D1%26md5%3D3ca5a5a7808a62b7a5d5619ed6486248)

**Abstract**

This review analyzes various algal biofilm reactors used for integrated wastewater treatment and biofuel production to overcome the current challenges for algal biofuel production. Various reactor configurations, support materials and operation strategies of algal biofilm reactors are discussed and compared with conventional suspended culture systems in terms of algal biomass productivity, nutrient removal, biomass harvest and biofuel production. The rotating biofilm reactor among various types of biofilm reactors was found to be a promising option to provide high biomass productivity and efficient utilization of nutrients in wastewater. Some materials such as stainless steel, nylon and natural fibers among various materials were found to be highly effective for supporting microalgal biofilm. To date mainly municipal wastewater has been integrated with algal bioreactors while only a few agricultural wastewater have been used for algal bioreactors due to inhibition of algal growth with high ammonium concentrations in animal manure and poor light delivery with high turbidity of animal manure. Overall, the algal biofilm reactors integrated with wastewater would have great potential for high productivity of algal biomass and efficient wastewater treatment if various conditions are optimized.

## **Nutrients and pharmaceuticals removal from wastewater by culture and harvesting of *Chlorella sorokiniana***

**Fecha de Publicación:** Junio 2015

**Fuente:** Bioresource Technology, Volume 185

**Autor(es):** C. Escapa, R.N. Coimbra, S. Paniagua, A.I. García, M. Otero

**Enlace:**

[http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F\\_ob%3DGatewayURL%26\\_origin%3DIRSSSEARCH%26\\_method%3DcitationSearch%26\\_piikey%3DS0960852415002953%26\\_version%3D1%26md5%3D81e6d902905c6575aaf1b68066fe4bc6](http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0960852415002953%26_version%3D1%26md5%3D81e6d902905c6575aaf1b68066fe4bc6)

**Abstract**

This work aimed to study both the removal of nutrients and pharmaceuticals, namely salicylic acid or paracetamol, from water by the culture of *Chlorella sorokiniana*. The removal of nutrients was nearly complete at the end of the batch culture; above 70% for nitrates and 89% for phosphates in the semicontinuous culture. The pharmaceuticals removal kinetics were 2.3 times greater for the salicylic acid than paracetamol, reaching volumetric efficiencies above 93% for salicylic acid in the semicontinuous culture. Finally, to separate the microalgae biomass from treated water, metal salts, synthetic polyelectrolytes and a biopolymer were tested as coagulants–flocclulants. The best flocculation results were achieved with  $AlCl_3$  (95.23% with  $200\text{mgg}^{-1}$ , 1min incubation time). However, given that resulting flocs had different characteristics, flocculants must be chosen on the basis of the subsequent use of the biomass.

**Graphical abstract**



# The journey traversed in the remediation of hexavalent chromium and the road ahead toward greener alternatives—A perspective

**Fecha de Publicación:** 15 Junio 2016

**Fuente:** Coordination Chemistry Reviews, Volume 317

**Autor(es):** S. Kalidhasan, A. Santhana Krishna Kumar, Vidya Rajesh, N. Rajesh

## **Enlace:**

[http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F\\_ob%3DGatewayURL%26\\_origin%3DIRSSSEARCH%26\\_method%3DcitationSearch%26\\_piikey%3DS0010854515300874%26\\_version%3D1%26md5%3D6b8a53a7b7b2e54469a236de032350b1](http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0010854515300874%26_version%3D1%26md5%3D6b8a53a7b7b2e54469a236de032350b1)

## **Abstract**

The discharge of heavy metals from industrial wastewater beyond the permissible limit causes serious pollution to the environment. In this regard, chromium that is discharged from electroplating, tannery and dye industrial effluents poses a major health hazard in view of the carcinogenic and genotoxic nature of hexavalent chromium. It is imperative to devise effective remediation strategies to detoxify chromium keeping in view the USEPA regulatory limit. This review deals with the environmental occurrence, remediation methods and future perspectives in the sequestration of hexavalent chromium [Cr(VI)] from wastewater. Remediation methods such as solvent extraction, adsorption using polymeric resins, clays, biopolymers, biomass, activated carbon and graphene oxide are discussed with respect to their removal efficiency, regenerability, adsorption capacities and other characteristics. Considerable emphasis is laid on the utility of chelating adsorbents and ionic liquid impregnated adsorbents for the remediation of chromium from tannery and electroplating wastewater. The review examines published data in last few years concerning the removal of toxic Cr(VI) with a critical evaluation on the merits and demerits of each of the processes and the road ahead towards formulating more effective strategies.

## **Graphical abstract**



## Biological treatment of 2,4,6-trinitrotoluene (TNT) red water by immobilized anaerobic-aerobic microbial filters

**Fecha de Publicación:** 1 Enero 2015

**Fuente:** Chemical Engineering Journal, Volume 259

**Autor(es):** Mohe Zhang , Guo-hua Liu , Kai Song , Zhongyou Wang , Quanlin Zhao , Shijie Li , Zhengfang Ye

**Enlace:**

[http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F\\_ob%3DGatewayURL%26\\_origin%3DIRSSSEARCH%26\\_method%3DcitationSearch%26\\_piikey%3DS138589471401095X%26\\_version%3D1%26md5%3D13ce05887ec8e80c02bc7a109f56be93](http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS138589471401095X%26_version%3D1%26md5%3D13ce05887ec8e80c02bc7a109f56be93)

**Abstract**

An immobilized microbial process containing anaerobic filters and biological aerated filters (I-AF-BAF) system was used to treat 2,4,6-trinitrotoluene (TNT) red water. The results showed that the system could effectively degrade the organic pollutants in TNT red water, especially 2,4-dinitrotoluene-5-sulfonate (2,4-DNT-5-SO<sub>3</sub><sup>-</sup>), most of which was degraded by the microorganisms in the system. The results of high performance liquid chromatographic (HPLC) and liquid chromatography-mass spectrum (LC-MS) indicated that 2-amino-4-mononitrotoluene(MNT)-5-SO<sub>3</sub><sup>-</sup> and 3-amino-2-MNT-5-SO<sub>3</sub><sup>-</sup> might be the main anaerobic degradation metabolites. As the extra carbon source and electron donor, ethanol played a major role in the biodegradation of TNT red water. In addition, environment scanning electron microscope (ESEM) analysis revealed that many globular microorganisms were successfully immobilized on the surface of the carriers. Further analysis by polymerase chain reaction-denaturing gradient gel electrophoresis (PCR-DGGE) demonstrated that some special bacteria for the degradation of the pollutants in TNT red water might be generated during the acclimatization with TNT red water for 110days, and they were identified as *Hydrogenophaga* sp., *Exiguobacterium* sp., *Azospirillum* zaeae, *Rhizobium* sp., and iron-reducing bacterium by comparing the gene sequences from Genbank. This study may be useful for the treatment of actual TNT red water loaded with high concentrations of salinity and toxic organic components.

## Biosorption of Cu<sup>2+</sup> and Ni<sup>2+</sup> by *Arthrospira platensis* with different biochemical compositions

**Fecha de Publicación:** 1 Enero 2015

**Fuente:** Chemical Engineering Journal, Volume 259

**Autor(es):** Giorgos Markou, Dimitris Mitrogiannis, Abuzer Çelekli, Hüseyin Bozkurt, Dimitris Georgakakis, Constantinos V. Chrysikopoulos

**Enlace:**

[http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F\\_ob%3DGatewayURL%26\\_origin%3DIRSSSEARCH%26\\_method%3DcitationSearch%26\\_piikey%3DS1385894714010912%26\\_version%3D1%26md5%3D73bd4f0c238eef4569eb686c337f2135](http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS1385894714010912%26_version%3D1%26md5%3D73bd4f0c238eef4569eb686c337f2135)

**Abstract**

This study is focused on copper and nickel biosorption onto *Arthrospira platensis* biomass of different biochemical compositions. Four types of *A. platensis* were employed, namely: (1) typical dry biomass (TDB), (2) carbohydrate-enriched dry biomass (CDB), (3) typical living biomass (TLB), and (4) carbohydrate-enriched living biomass (CLB). The CDB was produced using a cultivation mode where phosphorus was the limiting nutrient. The biosorption of both metals investigated was shown to be very fast. Most of the metal sorption capacity of the biomass was filled within 15–30min, and equilibrium was achieved within 30–60min. The cultivation conditions (nutrient repletion or depletion) did not affect the pattern of copper and nickel biosorption kinetics. The capacity for copper ions biosorption was significantly positively affected by the accumulation of carbohydrates in the dry biomass, but was negatively affected by the accumulation of carbohydrates in the living biomass. For nickel ions, the alteration of biomass had a little but positive effect on the dry biomass, and a greater negative effect (about 30% lower biosorption capacity) on the living biomass. Living biomass exhibited a higher biosorption capacity than dry biomass, for both metals. The biosorption of copper and nickel onto *A. platensis* biomass occurred mainly due to the mechanisms of ion exchange and complexation, and less to physical adsorption.

## **Comparative efficiency of algal biofilters in the removal of chromium and copper from wastewater**

**Fecha de Publicación:** Mayo 2009

**Fuente:** Ecological Engineering, Volume 35, Issue 5

**Autor(es):** Maria Lourdes J.A.J. Jacinto, Carlos Primo C. David, Teresita R. Perez, Benjamin R. De Jesus

**Enlace:**

[http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F\\_ob%3DGatewayURL%26\\_ori](http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_ori)

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### **Abstract**

The performance of a macroalgae (*Sargassum* sp.), a laboratory-cultivated microalgae (*Chlorococcum* sp.) and a commercially available granulated activated carbon (GAC) for the removal of copper (Cu) and chromium (Cr) from aqueous solutions was evaluated using batch experiments. Kinetic and isotherm experiments were done at the optimal pH of  $4.5 \pm 0.1$  for Cu (II) and  $2.0 \pm 0.1$  for Cr (total). The equilibrium isotherms were determined and the results were analyzed using the Langmuir and Freundlich models. The best Cu removal performance was observed on *Sargassum* at a maximum removal of 87.3% obtained for an initial concentration of  $20 \text{ mg L}^{-1}$  Cu. The maximum uptake capacities for Cu (II) were 71.4, 19.3 and  $11.4 \text{ mg g}^{-1}$  of *Sargassum*, *Chlorococcum* and GAC, respectively. The biosorbents were also able to remove appreciable amounts of Cr, again with *Sargassum* showing maximum uptake capacity over the other materials. Kinetic studies also reveal that the removal rate is faster for both metals in *Sargassum*. Tests with an actual wastewater confirm the maximum uptake capacity of Cu by *Sargassum*. In all experiments the *Sargassum* biofilter outperformed GAC, which makes it a promising low-cost alternative to conventional filtration materials for wastewater treatment.

### **BioRemediación-Industrial-Alimentación**

## **Self-sustainable *Chlorella pyrenoidosa* strain NCIM 2738 based photobioreactor for removal of Direct Red-31 dye along with other industrial pollutants to improve the water-quality**

**Fecha de Publicación:** 5 Abril 2016

**Fuente:** Journal of Hazardous Materials, Volume 306

**Autor(es):** Surbhi Sinha, Rachana Singh, Akhilesh K. Chaurasia, Subhasha Nigam

### **Enlace:**

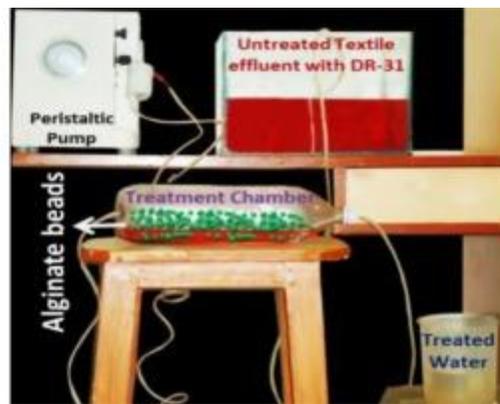
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### **Abstract**

The genotoxic and carcinogenic effects of diazo dyes from industrial effluents pose a serious environmental threat by contaminating aquatic ecosystem and consequently impact human health. The potential of a diazo dye resistant, self-sustainable photosynthetic green alga *Chlorella pyrenoidosa* NCIM 2738 provides a viable green technology for an efficient biodegradation of diazo dye Direct Red-31 (DR-31) and overall improvement of water quality. Herein, we for the first

time report the degradation of DR-31 using *C. pyrenoidosa*. Batch experiments were performed to optimize the effect of initial pH, contact time and toxicity-range of DR-31 in order to achieve the optimal conditions for maximum decolourization in continuous cyclic photobioreactor. In batch culture, *C. pyrenoidosa* exhibited 96% decolourization with 40mgL<sup>-1</sup> dye at pH3. The equilibrium was attained within 30min and the maximum uptake of 30.53mgg<sup>-1</sup> algal biomass was observed during this period. This was found to be fitted well with Langmuir and Freundlich adsorption isotherm. The FT-IR spectra showed a change from NN to NH suggesting the possible involvement of the azoreductase enzyme. The application of *C. pyrenoidosa* not only degraded the DR-31 but also improved the quality of water by reducing COD (82.73%), BOD (56.44%), sulphate (54.54%), phosphate (19.88%), and TDS (84.18%) which was further enhanced in continuous cyclic bioreactor treatment. The results clearly showed that *C. pyrenoidosa* provides an efficient, self-sustainable green technology for decolourization of DR-31 and improved the water quality.

### Graphical abstract



## Bio-oil production and removal of organic load by microalga *Scenedesmus* sp. using culture medium contaminated with different sugars, cheese whey and whey permeate

**Fecha de Publicación:** 15 Mayo 2016

**Fuente:** Journal of Environmental Management, Volume 173

**Autor(es):** Wesley da Silva Borges, Breno Severiano Alves Araújo, Lucas Gomes Moura, Ubirajara Coutinho Filho, Miriam Maria de Resende, Vicelma Luiz Cardoso

**Enlace:**

[http://rss.sciencedirect.com/action/redirectFile?&zzone=main&currentActivity=feed&usageType=otward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F\\_ob%3DGatewayURL%26\\_ origin%3DIRSSSEARCH%26\\_method%3DcitationSearch%26\\_piikey%3DS0301479715303698%26\\_ vers ion%3D1%26md5%3D2ab99da09b1df743c466780d24761474](http://rss.sciencedirect.com/action/redirectFile?&zzone=main&currentActivity=feed&usageType=o utward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_ origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0301479715303698%26_ vers ion%3D1%26md5%3D2ab99da09b1df743c466780d24761474)

## **Abstract**

The objective of this study was to evaluate the bio-oil production and the organic load removal using the microalga *Scenedesmus* sp. The cultivation was carried out in reactors with a total volume of 3 L and 0.7 vvm aeration, with illumination in photoperiods of 12 h light/12 h dark for 12 days. The following sugar concentrations were tested: 2.5, 5.0 and 10 g/L of glucose, lactose, fructose and galactose with 10% inoculum volume. After experiments were performed with cheese whey in natura and cheese whey permeate with different lactose concentrations (1.5, 2.5, 3.5 and 5.0 g/L). In these experiments the inoculum concentrations were 10, 15, 20 and 30% (v/v). The results showed that this microalga was effective for the production of lipids when it was cultivated in medium with cheese whey in natura with 2.5 g/L of lactose and 20% inoculum (v/v). Using cheese whey in natura at the concentration of 3.5 g/L of lactose and 30% (v/v) of inoculum obtained 77.9% of TOC removal and 38.447 mg of TOC removed/mg oil produced. It was also observed that when there is increased production of bio-oil, there is less removal of organic matter. The addition of glucose, fructose or galactose in the medium did not enhance the production of bio-oil by *Scenedesmus* sp. when compared to lactose, but increased the organic matter removal.

## **Cultivation of *Spirulina maxima* in medium supplemented with sugarcane vinasse**

**Fecha de Publicación:** Marzo 2016

**Fuente:** Bioresource Technology, Volume 204

**Autor(es):** Raquel Rezende dos Santos, Ofélia de Queiroz Fernandes Araújo, José Luiz de Medeiros, Ricardo Moreira Chaloub

**Enlace:**

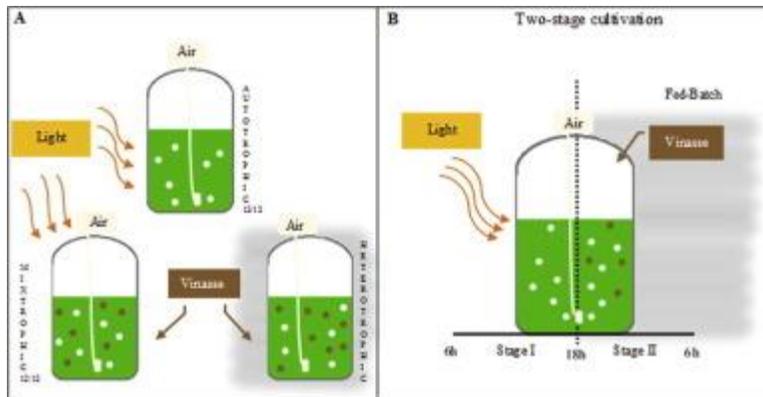
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## **Abstract**

The feasibility of sugarcane vinasse as supplement in growth medium of *Spirulina maxima* was investigated. The cell was cultivated under autotrophic (no vinasse,  $70\mu\text{mol photons m}^{-2} \text{ s}^{-1}$ ), heterotrophic (no light, culture medium supplemented with vinasse at 0.1% v/v and 1.0% v/v) and mixotrophic conditions ( $70\mu\text{mol photons m}^{-2} \text{ s}^{-1}$ , vinasse at 0.1% v/v and 1.0% v/v). These preliminary results suggested a cyclic two-stage cultivation – CTSC, with autotrophic condition

during light phase of the photoperiod (12h,  $70\text{--}200\mu\text{mol photons m}^{-2}\text{ s}^{-1}$ ) and heterotrophic condition during dark phase (12h, 3.0% v/v vinasse). The adopted CTSC strategy consisted in three cycles with 75% withdrawal of suspension and reposition of medium containing 3.0% v/v vinasse, separated by autotrophic rest periods of few days between cycles. Results show an increase of biomass concentration between  $0.495\text{g L}^{-1}$  and  $0.609\text{g L}^{-1}$  at the 7th day of each cycle and high protein content (between 74.3% and 77.3% w/w).

## Graphical abstract



## Mitigating ammonia nitrogen deficiency in dairy wastewaters for algae cultivation

**Fecha de Publicación:** Febrero 2016

**Fuente:** Bioresource Technology, Volume 201

**Autor(es):** Qian Lu, Wenguang Zhou, Min Min, Xiaochen Ma, Yiwei Ma, Paul Chen, Hongli Zheng, Yen T.T. Doan, Hui Liu, Chi Chen, Pedro E. Urriola, Gerald C. Shurson, Roger Ruan

### **Enlace:**

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### **Abstract**

This study demonstrated that the limiting factor to algae growth on dairy wastewater was the ammonia nitrogen deficiency. Dairy wastewaters were mixed with a slaughterhouse wastewater that has much higher ammonia nitrogen content. The results showed the mixing wastewaters improved the nutrient profiles and biomass yield at low cost. Algae grown on mixed wastewaters

contained high protein (55.98–66.91%) and oil content (19.10–20.81%) and can be exploited to produce animal feed and biofuel. Furthermore, algae grown on mixed wastewater significantly reduced nutrient contents remained in the wastewater after treatment. By mitigating limiting factor to algae growth on dairy wastewaters, the key issue of low biomass yield of algae grown on dairy wastewaters was resolved and the wastewater nutrient removal efficiency was significantly improved by this study.

### **BioRemediación-Industrial-Minería**

## **Continuous removal of zinc from wastewater and mine dump leachate by a microalgal biofilm PSBR**

**Fecha de Publicación:** 30 Octubre 2015

**Fuente:** Journal of Hazardous Materials, Volume 297

**Autor(es):** Tong Li, Gengyi Lin, Björn Podola, Michael Melkonian

**Enlace:**

[http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F\\_ob%3DGatewayURL%26\\_origin%3DIRSSSEARCH%26\\_method%3DcitationSearch%26\\_pikey%3DS0304389415003787%26\\_version%3D1%26md5%3D4e0ab27b7dc204f7d474ff7c0cfa5439](http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_pikey%3DS0304389415003787%26_version%3D1%26md5%3D4e0ab27b7dc204f7d474ff7c0cfa5439)

**Abstract**

Bio-removal of heavy metals from wastewater by microalgae has been investigated for decades. However, technical and economical limitations of cultivation systems for microalgae still impair progress toward application. Recently, a novel type of bioreactor for (immobilized) biofilm cultivation, the Porous Substrate Bioreactor (PSBR), has been shown to optimize biomass feedstock production and harvest, offering novel possibilities for application in the treatment of wastewater. We used two types of laboratory-scale Twin-Layer PSBRs to remove zinc (2–3mgZnL<sup>-1</sup>) from synthetic wastewater and real mine dump leachate in a continuous and batch process. The selection and use of a biofilm of a Zn-resistant strain of the green alga *Stichococcus bacillaris* (EC50 of 28.9mgZnL<sup>-1</sup> based on Pulse-amplitude modulated (PAM) chlorophyll fluorescence analysis) led to a high zinc absorption capacity of 15–19mgZng<sup>-1</sup> algal dry matter. The removal capacity for zinc correlated positively with biomass production and was thus, light dependent. Bio-removal properties observed here combined with biomass productivities of PSBR systems compare favorably with other algal-based bio-sorption technologies.

## **Immobilization of heavy metal contaminated mine wastes using *Canavalia ensiformis* extract**

**Fecha de Publicación:** Enero 2016

**Fuente:** CATENA, Volume 136

**Autor(es):** In-Hyun Nam, Seung-Bum Roh, Min-Jeong Park, Chul-Min Chon, Jae-Gon Kim, Sueng-Won Jeong, Hocheol Song, Min-Ho Yoon

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**Abstract**

This study examined the ability of crude extracts of *Canavalia ensiformis* to catalyze the precipitation of calcium carbonate (CaCO<sub>3</sub>) in columns packed with heavy metal contaminated mine waste collected from an abandoned mine site, and examined the effect of CaCO<sub>3</sub> precipitates on the leaching of heavy metals out of such waste. X-ray diffraction and scanning electron microscopy were employed to confirm CaCO<sub>3</sub> precipitation and to characterize the morphology of the resulting material. Urease in the *C. ensiformis* crude extracts catalyzed the hydrolysis of urea, leading to the formation of CaCO<sub>3</sub> precipitates that formed bridges between the particles in the mine waste. In column experiments, the amounts of the heavy metals As, Mn, Zn, Pb, Cr, and Cu in leachates from the mine waste were reduced by 31.7%, 65.7%, 52.3%, 53.8%, 55.2%, and 49.0%, respectively, when the waste was treated with *C. ensiformis* crude extract. This reduction can be attributed to immobilization of heavy metals within the mine waste as a result of CaCO<sub>3</sub> precipitation. Comparison of the microbial communities in mine waste columns that were untreated or incubated for 2 weeks with *C. ensiformis* crude extract and purified urease, using PCR-DGGE of 16S rDNA, showed that a greater diversity of microorganisms was present in the columns treated with *C. ensiformis* crude extract and purified urease. These findings suggest that crude extracts of *C. ensiformis* may be used to stabilize and immobilize heavy metals in contaminated mine waste to prevent further dispersion to the surrounding environment.

## **Microalgae – A promising tool for heavy metal remediation**

**Fecha de Publicación:** Marzo 2015

**Fuente:** Ecotoxicology and Environmental Safety, Volume 113

**Autor(es):** K. Suresh Kumar, Hans-Uwe Dahms, Eun-Ji Won, Jae-Seong Lee, Kyung-Hoon Shin

**Enlace:**

[http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F\\_ob%3DGatewayURL%26\\_origin%3DIRSSSEARCH%26\\_method%3DcitationSearch%26\\_piikey%3DS0147651314005740%26\\_version%3D1%26md5%3Db9687283a7adbecb8040c99c65285bfa](http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0147651314005740%26_version%3D1%26md5%3Db9687283a7adbecb8040c99c65285bfa)

**Abstract**

Biotechnology of microalgae has gained popularity due to the growing need for novel environmental technologies and the development of innovative mass-production. Inexpensive growth requirements (solar light and CO<sub>2</sub>), and, the advantage of being utilized simultaneously for multiple technologies (e.g. carbon mitigation, biofuel production, and bioremediation) make microalgae suitable candidates for several ecofriendly technologies. Microalgae have developed an extensive spectrum of mechanisms (extracellular and intracellular) to cope with heavy metal toxicity. Their wide-spread occurrence along with their ability to grow and concentrate heavy metals, ascertains their suitability in practical applications of waste-water bioremediation. Heavy metal uptake by microalgae is affirmed to be superior to the prevalent physicochemical processes employed in the removal of toxic heavy metals. In order to evaluate their potential and to fill in the loopholes, it is essential to carry out a critical assessment of the existing microalgal technologies, and realize the need for development of commercially viable technologies involving strategic multidisciplinary approaches. This review summarizes several areas of heavy metal remediation from a microalgal perspective and provides an overview of various practical avenues of this technology. It particularly details heavy metals and microalgae which have been extensively studied, and provides a schematic representation of the mechanisms of heavy metal remediation in microalgae.

## **Modelling of optimum conditions for bioaccumulation of As(III) and As(V) by response surface methodology (RSM)**

**Fecha de Publicación:** Disponible online 3 Julio 2015

**Fuente:** Journal of Environmental Chemical Engineering

**Autor(es):** M.S. Podder , C.B. Majumder

**Enlace:**

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**Abstract**

The significant factors affecting the simultaneous growth and bioaccumulation of arsenic (As(III) or As(V)) ions by metal adapted living cells of bacteria, *Bacillus arsenicus* MTCC 4380 was explored

under various pH. The optimum pH was found to be 7.0 for both As(III) and As(V) resistant *Bacillus arsenicus* MTCC 4380. The combined effects of initial peptone and arsenic (As(III) or As(V)) ion concentrations on the specific growth rate and arsenic bioaccumulation efficiency of bacteria were analysed by Response Surface Methodology (RSM). A 22 full factorial central composite design was effectively used for the experimental design and analyses of the results. Two numerical correlations fitted to a second order quadratic equation were obtained to estimate the responses of specific growth rate and arsenic (As(III) or As(V)) bioaccumulation yields. The optimum combination predicted via RSM proved that *Bacillus arsenicus* MTCC 4380 was capable to bioaccumulate As(III) and As(V) up to 79.4% and 85.03%, respectively, in the growth medium containing 1000 mg/L arsenic (either As(III) or As(V)) and 9 g/L peptone. The present study provides a new insight into the influence of As(III) and As(V) ions on *Bacillus arsenicus* MTCC 4380, exclusively relating to its toxicity, bioaccumulation and bioremediation potential.

### **BioRemediación-Agropecuario-Tambo**

## **Cultivation of filamentous cyanobacteria (blue-green algae) in agro-industrial wastes and wastewaters: A review**

**Fecha de Publicación:** Octubre 2011

**Fuente:** Applied Energy, Volume 88, Issue 10

**Autor(es):** Giorgos Markou, Dimitris Georgakakis

**Enlace:**

[http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F\\_ob%3DGatewayURL%26\\_origin%3DIRSSSEARCH%26\\_method%3DcitationSearch%26\\_piikey%3DS0306261910005623%26\\_version%3D1%26md5%3De7680d24363a974e0a8e28fa5c331348](http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0306261910005623%26_version%3D1%26md5%3De7680d24363a974e0a8e28fa5c331348)

**Abstract**

Recently research interest has focused on the production of biofuel from microalgae. Microalgae are photosynthetic microorganisms that grow utilizing solar energy, nevertheless, the quantities of fertilizers that should be used for their production are enormous. One alternative to the use of synthetic fertilizers is to employ wastes and wastewaters (W&W), especially from the agro-industrial sector which are rich in inorganic pollutants such as nitrogen and phosphorus, which can be recovered. Simultaneously with the cultivation of microalgae using wastes and wastewaters for biomass production, treatment of the wastes and wastewaters occur through removal of the pollutants. Filamentous cyanobacteria appear to be suitable candidates for cultivation in wastes and wastewaters because they produce biomass in satisfactory quantity and can be harvested relatively easily due to their size and structure. In addition their biomass composition can be manipulated by several environmental and operational factors in order to produce biomass with concrete characteristics. Herein we review the factors that affect the biomass composition of cyanobacteria and present several studies that discuss the culture of

filamentous cyanobacteria in agro-industrial wastes and wastewaters, with special emphasis on Spirulina.

## Mixotrophic cultivation of *Chlorella vulgaris* using industrial dairy waste as organic carbon source

**Fecha de Publicación:** Agosto 2012

**Fuente:** Bioresource Technology, Volume 118

**Autor(es):** Ana P. Abreu, Bruno Fernandes, António A. Vicente, José Teixeira, Giuliano Dragone

**Enlace:**

[http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F\\_ob%3DGatewayURL%26\\_origin%3DIRSSSEARCH%26\\_method%3DcitationSearch%26\\_piikey%3DS0960852412007997%26\\_version%3D1%26md5%3D232e20aedcabf6744057dd4c60fd98cf](http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0960852412007997%26_version%3D1%26md5%3D232e20aedcabf6744057dd4c60fd98cf)

**Abstract**

Growth parameters and biochemical composition of the green microalga *Chlorella vulgaris* cultivated under different mixotrophic conditions were determined and compared to those obtained from a photoautotrophic control culture. Mixotrophic microalgae showed higher specific growth rate, final biomass concentration and productivities of lipids, starch and proteins than microalgae cultivated under photoautotrophic conditions. Moreover, supplementation of the inorganic culture medium with hydrolyzed cheese whey powder solution led to a significant improvement in microalgal biomass production and carbohydrate utilization when compared with the culture enriched with a mixture of pure glucose and galactose, due to the presence of growth promoting nutrients in cheese whey. Mixotrophic cultivation of *C. vulgaris* using the main dairy industry by-product could be considered a feasible alternative to reduce the costs of microalgal biomass production, since it does not require the addition of expensive carbohydrates to the culture medium.

### Highlights

► Cheese whey was used as carbon source for *Chlorella vulgaris* growth. ► Mixotrophic microalgae grew faster than photoautotrophic cells. ► Maximum starch productivity was achieved under mixotrophic conditions. ► Highest pigment content (0.74%) was obtained in the photoautotrophic culture.

## Wastewater treatment in microbial fuel cells – an overview

**Fecha de Publicación:** 20 Mayo 2016

**Fuente:** Journal of Cleaner Production, Volume 122

**Autor(es):** Veera Gnanaswar Gude

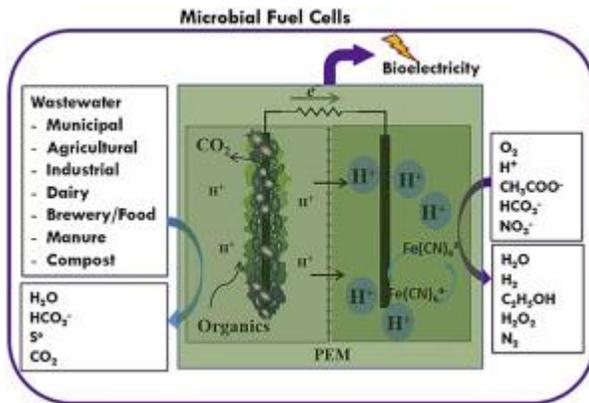
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**Abstract**

Environmental issues associated with water sanitation are not confined to developing countries alone but are the most basic human and environmental necessities all over the world. Wastewater sources are major causes for environmental pollution in surface and ground water bodies. Current wastewater treatment technologies are not sustainable to meet the ever growing water sanitation needs due to rapid industrialization and population growth, simply because they are energy- and cost-intensive leaving latitude for development of technologies that are energy-conservative or energy-yielding. For the present and future context, microbial fuel cells technology may present a sustainable and an environmentally friendly route to meet the water sanitation needs. Microbial fuel cell based wastewater systems employ bioelectrochemical catalytic activity of microbes to produce electricity from the oxidation of organic, and in some cases inorganic, substrates present in urban sewage, agricultural, dairy, food and industrial wastewaters. This article presents the potential for energy generation and comprehensive wastewater treatment in microbial fuel cells. The article provides an overview of recent literature with two specific aims. First, it provides an overview of current energy needs for wastewater treatment and potential energy recovery options followed by a comprehensive review of the principles of wastewater treatment, substrate utilization (organic removal), recent process developments, nutrient and metal removal capacities in microbial fuel cells. Several issues related to process performance, organic removal capacities and potential environmental impacts were discussed in detail. From the economic and life cycle assessment point of view, although recent developments in power production are encouraging, important discoveries in electrode materials, innovative and integrated process configurations along with experience in pilot scale studies are urgently required to determine the real potential of the microbial fuel cell technology to provide sustainable and energy-positive wastewater treatment.

### Graphical abstract



## Bioenergy production from algae using dairy manure as a nutrient source: Life cycle energy and greenhouse gas emission analysis

**Fecha de Publicación:** 15 Septiembre 2015

**Fuente:** Applied Energy, Volume 154

**Autor(es):** Raja Chowdhury, Fausto Freire

**Enlace:**

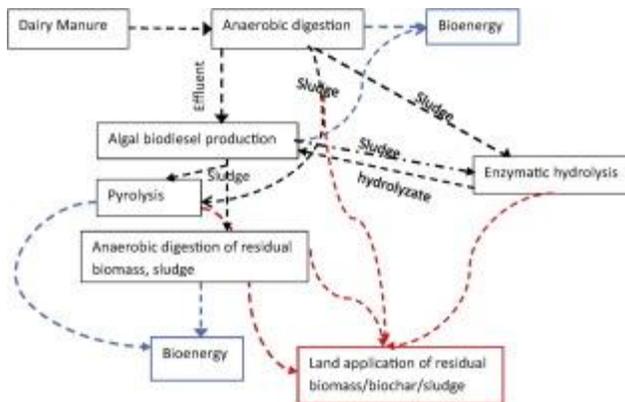
[http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F\\_ob%3DGatewayURL%26\\_origin%3DIRSSSEARCH%26\\_method%3DcitationSearch%26\\_piikey%3DS0306261915006558%26\\_version%3D1%26md5%3D77633b96a594defc472116cf0439001f](http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0306261915006558%26_version%3D1%26md5%3D77633b96a594defc472116cf0439001f)

**Abstract**

This study estimated the potential of algal bioenergy production using nitrogen and phosphorus present in the dairy manure (produced in the US). State wise dairy manure production and energy mixes were used to estimate algal bioenergy production and associated life cycle nonrenewable primary energy demand and greenhouse gas emissions for the four scenarios. These scenarios were constructed using various combination of following processes (i) anaerobic digestion, (ii) algal biodiesel production using effluent from (i), (iii) pyrolysis, and (iv) enzymatic hydrolysis. Bioenergy production, nonrenewable primary energy demand and greenhouse gas emissions of each state were aggregated to estimate the total bioenergy production, nonrenewable primary energy requirement and greenhouse gas emissions for the US. Two different cases were simulated for each scenario, one without taking into account the nutrient values (N, P) of applied sludge generated from the bioenergy production (Case B) while in the other one, nutrient values of sludge were considered (Case A). For incorporation of nutrient values of sludge, system expansion approach was used. It was estimated that by using dairy manure, 0.56 billion GJ/yr bioenergy could be produced. Minimum “nonrenewable primary energy requirement (NRPER)” (GJ/GJ) [Total primary nonrenewable energy requirement/bioenergy produced] and GHG emissions (kg CO<sub>2</sub>

eq./GJ bioenergy produced) for the four scenarios (1–4) for case B were as follows (1) 0.37, 27 (2) 0.51, –30; (3) 0.55, 47 and (4) 0.70, 15 respectively. In case A, NRPER did not change as compared to case B. GHG emissions increased in case A scenarios as compared to case B scenarios. The increase in GHG emission was mostly due to incorporation of reference scenario (raw dairy manure was applied on the ground) and N<sub>2</sub>O emission from the sludge amended soil.

## Graphical abstract



## BioRemediación-Agropecuario-Cama de Pollo

### Fed-batch cultivation of *Arthrospira* and *Chlorella* in ammonia-rich wastewater: Optimization of nutrient removal and biomass production

**Fecha de Publicación:** Octubre 2015

**Fuente:** Bioresource Technology, Volume 193

**Autor(es):** Giorgos Markou

**Enlace:**

[http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F\\_ob%3DGatewayURL%26\\_origin%3DIRSSSEARCH%26\\_method%3DcitationSearch%26\\_piikey%3DS0960852415008627%26\\_version%3D1%26md5%3D75035781a953338f5cf12858ce21f16f](http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0960852415008627%26_version%3D1%26md5%3D75035781a953338f5cf12858ce21f16f)

**Abstract**

In the present work the cyanobacterium *Arthrospira platensis* and the microalga *Chlorella vulgaris* were fed-batch cultivated in ammonia-rich wastewater derived from the anaerobic digestion of poultry litter. Aim of the study was to maximize the biomass production along with the nutrient

removal aiming to wastewater treatment. Ammonia and phosphorus removals were very high (>95%) for all cultures investigated. Both microorganisms were able to remove volatile fatty acids to an extent of >90%, indicating that they were capable of mixotrophic growth. Chemical oxygen demand and proteins were also removed in various degrees. In contrast, in all cultures carbohydrate concentration was increased. The biochemical composition of the microorganisms varied greatly and was influenced by the indicate that the nutrient availability. *A. platensis* accumulated carbohydrates (~40%), while *C. vulgaris* accumulated lipids (~50%), rendering them interesting for biofuel production.

## Microalgal system for treatment of effluent from poultry litter anaerobic digestion

**Fecha de Publicación:** Diciembre 2011

**Fuente:** Bioresource Technology, Volume 102, Issue 23

**Autor(es):** Manjinder Singh, David L. Reynolds, Keshav C. Das

**Enlace:**

[http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F\\_ob%3DGatewayURL%26\\_origin%3DIRSSSEARCH%26\\_method%3DcitationSearch%26\\_piikey%3DS096085241101323X%26\\_version%3D1%26md5%3D4a1e5f6f79e0f1b4abd377b07d8b989a](http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS096085241101323X%26_version%3D1%26md5%3D4a1e5f6f79e0f1b4abd377b07d8b989a)

**Abstract**

The potential of mixotrophic microalgae to utilize poultry litter anaerobic digester (AD) effluent (PLDE) as nutritional growth medium was evaluated. Three algal strains viz. *Chlorella minutissima*, *Chlorella sorokiniana* and *Scenedesmus bijuga* and their consortium showed significant biomass productivity in 6% (v/v) concentration of PLDE in deionized water. Multiple booster dosage of PLDE supported better growth relative to a single dose PLDE. The maximum biomass productivity of 76mgL<sup>-1</sup> d<sup>-1</sup> was recorded. The biomass was rich in protein (39% w/w) and carbohydrates (22%) while lipids (<10%) were low, making it most suitable as an animal feed supplement. The mixotrophic algae showed sustainable growth against variations in PLDE composition in different AD batches, thus proving to be a suitable candidate for large scale wastewater treatment with concomitant production of renewable biomass feedstock for animal feed and bioenergy applications.

### Highlights

► Poultry litter anaerobic digestion effluent (PLDE) diluted into water at 6% (v/v) supported significant algae growth. ► Multiple dosage of PLDE recoded better algae growth relative to single dose. ► Algae biomass productivity of 76mgL<sup>-1</sup> d<sup>-1</sup> was recorded under booster dosage

conditions. ► Average biochemical composition of dry biomass (w/w) was; protein 39%, carbohydrates 22% and lipids 10%. ► Algae removed 60% of total nitrogen and 80% of total phosphorus present in PLDE.

## **Agricultural nutrient surpluses as potential input sources to grow third generation biomass (microalgae): A review**

**Fecha de Publicación:** Mayo 2012

**Fuente:** Algal Research, Volume 1, Issue 1

**Autor(es):** Owen Fenton, Daire Ó hUallacháin

**Enlace:**

[http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F\\_ob%3DGatewayURL%26\\_origin%3DIRSSSEARCH%26\\_method%3DcitationSearch%26\\_piikey%3DS2211926412000094%26\\_version%3D1%26md5%3D6e83303a1a613aa16998f38b8cb63faa](http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS2211926412000094%26_version%3D1%26md5%3D6e83303a1a613aa16998f38b8cb63faa)

**Abstract**

Biofuel consumption is increasing and in order to meet EU targets, alternatives to first and second generation biofuels are being examined. The use of micro-algal biomass in the production of biofuel is an area of research which has received attention in recent years. Traditionally, microalgae are commercially grown using synthetic fertilisers, the price of which is linked with rising oil prices. An alternative to the use of inorganic fertiliser is to use surplus agricultural manures in their raw state, bi-products of anaerobic digestion, or runoff and artificial drainage waters, all of which have variable nutrient contents within and across source types. Many studies have shown that manures containing a high nutrient content e.g. pig and poultry manures, or bi-products from anaerobic digestion, are potentially viable sources of nutrients to grow algae. Feasibility issues prevail such as variable nutrient contents amongst and across source types, transparency issues and early and sustained nutrient losses during the storage phase. Agitation and efficient nutrient testing before use are important. In Ireland, pig and poultry manures, dairy dirty water, artificial drainage or runoff waters where coupled with agitation during storage to prevent P precipitation and a CO<sub>2</sub> source, all have potential to be used in the future.

## **Applying raw poultry litter leachate for the cultivation of *Arthrospira platensis* and *Chlorella vulgaris***

**Fecha de Publicación:** Enero 2016

**Fuente:** Algal Research, Volume 13

**Autor(es):** Giorgos Markou, Dimitris Iconomou, Koenraad Muylaert

**Enlace:**

[http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F\\_ob%3DGatewayURL%26\\_origin%3DIRSSSEARCH%26\\_method%3DcitationSearch%26\\_piikey%3DS2211926415301089%26\\_version%3D1%26md5%3Dd1e2fa4fb1696ac00d13c8f647acee69](http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS2211926415301089%26_version%3D1%26md5%3Dd1e2fa4fb1696ac00d13c8f647acee69)

**Abstract**

In the present paper, the use of raw poultry litter (PL) as a nutrient source for the cultivation of *Arthrospira platensis* and *Chlorella vulgaris* was investigated. PL was added to acid solution (62.5mM H<sub>2</sub>SO<sub>4</sub>) for the extraction of nutrients contained in PL. After settling, the supernatant, called PL leachate (PLL) was diluted 25×, 20×, 15×, and 10× and used as a medium for the cultivation of *A. platensis* and *C. vulgaris*. *A. platensis* could not survive in 15× and 10× diluted leachate and while in 20× and 25× dilutions the biomass production was only half of that in a control medium (Zarrouk). The biomass composition had a high carbohydrate content (37–44%), which suggests that *A. platensis* was stressed due to nutrient limitation. *C. vulgaris* grew well in PLL-based media and the biomass production was higher than in the control medium (BG-11). Biomass composition of *C. vulgaris* in PLL-based media had lower protein content and higher carbohydrate and lipid content than in the control medium. The overall process for producing microalgal biomass from PL that we propose includes: (i) acid extraction of nutrients through the generation of PL leachate (PLL), (ii) indoor PL composting and recovery of stripped ammonia and CO<sub>2</sub>, and (iii) use of recovered ammonia and CO<sub>2</sub> along with the PLL for the cultivation of microalgae and cyanobacteria for the production of biomass.

### **BioRemediación-Agropecuario-Cama de Chancho**

## **Evaluating integrated strategies for robust treatment of high saline piggery wastewater**

**Fecha de Publicación:** 1 Febrero 2016

**Fuente:** Water Research, Volume 89

**Autor(es):** Hyun-Chul Kim, Wook Jin Choi, A Na Chae, Joonhong Park, Hyung Joo Kim, Kyung Guen Song

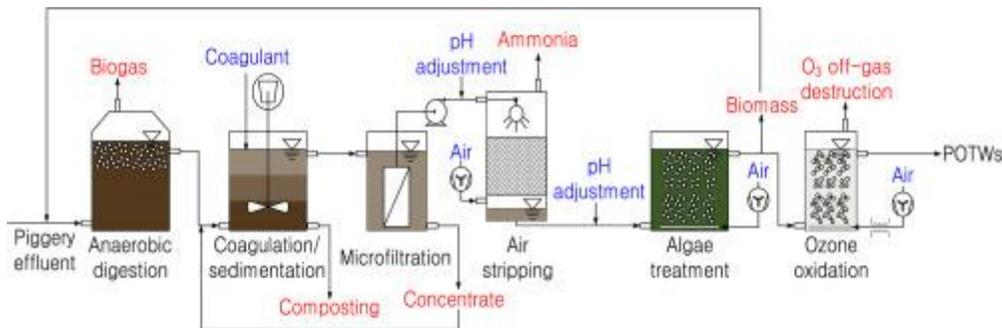
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## **Abstract**

In this study, we integrated physicochemical and biological strategies for the robust treatment of piggery effluent in which high levels of organic constituents, inorganic nutrients, color, and salts remained. Piggery effluent that was stabilized in an anaerobic digester was sequentially coagulated, micro-filtered, and air-stripped prior to biological treatment with mixotrophic algal species that showed tolerance to high salinity (up to 4.8% as Cl<sup>-</sup>). The algae treatment was conducted with continuous O<sub>2</sub> supplementation instead of using the combination of high lighting and CO<sub>2</sub> injection. The microalga *Scenedesmus quadricauda* employed as a bio-agent was capable of assimilating both nitrogen (222 mg N g cell<sup>-1</sup> d<sup>-1</sup>) and phosphorus (9.3 mg P g cell<sup>-1</sup> d<sup>-1</sup>) and utilizing dissolved organics (2053 mg COD g cell<sup>-1</sup> d<sup>-1</sup>) as a carbon source in a single treatment process under the heterotrophic growth conditions. The heterotrophic growth of *S. quadricauda* proceeded rapidly by directly incorporating organic substrate in the oxidative assimilation process, which coincided with the high productivity of algal biomass, accounting for 2.4 g cell L<sup>-1</sup> d<sup>-1</sup>. The algae-treated wastewater was subsequently ozonated to comply with discharge permits that limit color in the effluent, which also resulted in improved biodegradability of residual organics. The integrated treatment scheme proposed in this study also achieved 89% removal of COD, 88% removal of TN, and 60% removal of TP. The advantage of using the hybrid configuration suggests that this would be a promising strategy in full-scale treatment facilities for piggery effluent.

## **Graphical abstract**



## **Cultivation of *Chlorella* sp. GD using piggery wastewater for biomass and lipid production**

**Fecha de Publicación:** Octubre 2015

**Fuente:** Bioresource Technology, Volume 194

**Autor(es):** Chiu-Mei Kuo, Tsai-Yu Chen, Tsung-Hsien Lin, Chien-Ya Kao, Jinn-Tsyy Lai, Jo-Shu Chang, Chih-Sheng Lin

**Enlace:**

[http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F\\_ob%3DGatewayURL%26\\_origin%3DIRSSSEARCH%26\\_method%3DcitationSearch%26\\_pikey%3DS0960852415009797%26\\_version%3D1%26md5%3De4e81b902611d0c2ffac50d0a2b5632b](http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_pikey%3DS0960852415009797%26_version%3D1%26md5%3De4e81b902611d0c2ffac50d0a2b5632b)

**Abstract**

The development of a culture system for *Chlorella* sp. GD to efficiently produce biomass and oil for biodiesel production was investigated. *Chlorella* sp. GD was cultivated with 0%, 25%, 50%, 75% and 100% piggery wastewater (diluted by medium) at  $300\mu\text{molm}^{-2}\text{s}^{-1}$ , a 2% CO<sub>2</sub> aeration rate of 0.2vvm and  $26\pm 1^\circ\text{C}$ ; after a 10-day culture in batch cultures, the maximum specific growth rate and biomass productivity of the microalga obtained in 100% piggery wastewater were  $0.839\text{d}^{-1}$  and  $0.681\text{gL}^{-1}\text{d}^{-1}$ , respectively. The highest lipid content and lipid productivity were 29.3% and  $0.155\text{gL}^{-1}\text{d}^{-1}$  at 25% wastewater, respectively. In semi-continuous cultures, the biomass and lipid productivities with 25–75% wastewater ratios were greater than 0.852 and  $0.128\text{gL}^{-1}\text{d}^{-1}$ , respectively. These results show that *Chlorella* sp. GD grows efficiently in piggery wastewater, and that a stable growth performance was achieved for long-term microalgal cultivation in a semi-continuous culture.

Graphical abstract



**Growth optimisation of microalga mutant at high CO<sub>2</sub> concentration to purify undiluted anaerobic digestion effluent of swine manure**

**Fecha de Publicación:** Febrero 2015

**Fuente:** Bioresource Technology, Volume 177

**Autor(es):** Jun Cheng, Jiao Xu, Yun Huang, Yuyou Li, Junhu Zhou, Kefa Cen

**Enlace:**

[http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F\\_ob%3DGatewayURL%26\\_origin%3DIRSSSEARCH%26\\_method%3DcitationSearch%26\\_piikey%3DS0960852414017131%26\\_version%3D1%26md5%3Dbe371f15141b21c29ba2eae4df188158](http://rss.sciencedirect.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%3F_ob%3DGatewayURL%26_origin%3DIRSSSEARCH%26_method%3DcitationSearch%26_piikey%3DS0960852414017131%26_version%3D1%26md5%3Dbe371f15141b21c29ba2eae4df188158)

**Abstract**

Growth rate of the microalga *Chlorella* PY-ZU1 mutated by nuclear irradiation was optimised for use in the purification of undiluted anaerobic digestion effluent of swine manure (UADESM) with 3745mgL<sup>-1</sup> chemical oxygen demand (COD) and 1135mgL<sup>-1</sup> total nitrogen content. The problem of accessible carbon in UADESM was solved by continuous introduction of 15% (v/v) CO<sub>2</sub>. Adding phosphorus to UADESM and aeration of UADESM before inoculation both markedly reduced the lag phase of microalgal growth. In addition, the biomass yield and average growth rate of *Chlorella* PY-ZU1 increased significantly to 4.81gL<sup>-1</sup> and 601.2mgL<sup>-1</sup> d<sup>-1</sup>, respectively, while the removal efficiencies of total phosphorus, COD and ammonia nitrogen increased to 95%, 79% and 73%, respectively. Thus, the findings indicate that *Chlorella* PY-ZU1 can be used for effective purification of UADESM, while the biomass can be safely used as animal feed supplement.

## **A simplified process of swine slurry treatment by primary filtration and *Haematococcus pluvialis* culture to produce low cost astaxanthin**

**Fecha de Publicación:** Mayo 2016

**Fuente:** Ecological Engineering, Volume 90

**Autor(es):** Claudio Ledda, Jessica Tamiazzo, Maurizio Borin, Fabrizio Adani

**Enlace:**

<http://syndic8.scopus.com/action/redirectFile?&zone=main&currentActivity=feed&usageType=outward&url=http%3A%2F%2Fwww.scopus.com%2Finward%2Frecord.url%3Fid%3D2-s2.0-84960540480%26rel%3DR4.0.0%26partnerID%3D35%26md5%3D0fbea93b1c962a08ab24628d81516511>

**Abstract**

A simplified process for treating swine slurry through primary filtration and subsequent depuration of the filtrate with the astaxanthin-rich microalga *Haematococcus pluvialis* is proposed. The first step comprises a low-cost filtration system capable of reducing 66% of ammonia, 7% of phosphorus and 19% of chemical oxygen demand, and increasing the concentration of nitrate,

being this useful for subsequent growth of the algae. The second step comprises the discontinuous cultivation of *H. pluvialis* in diluted filtered slurry. The optimal dilution was researched by testing undiluted and 2, 4 and 8-fold diluted filtrate. This step led to a drastic reduction in macro and micronutrients concentration (up to 99% for NO<sub>3</sub>-N and NH<sub>4</sub>-N, 98% for TP and 26% for chemical oxygen demand). After *H. pluvialis* growth the accumulation of astaxanthin took place for 14d in nutrient-deprived conditions: an astaxanthin accumulation of 1.27% on a dry weight basis was measured. These results indicate the possibility to couple low-cost filtration and microalgae production to recover nutrients from swine wastewaters and to add value by producing valuable astaxanthin for the feed market or for an on-farm utilization as feed additive.

## Patentes

En esta sección del presente boletín se presentan las publicaciones de patentes de las ramas del árbol seleccionadas para esta edición.

En ésta oportunidad, dentro de los últimos 10 años, solamente se publicó una única patente perteneciente a la rama **BioRemediación-Industrial-Alimentación**

### **Method for culturing microalgae on large scale by bean product wastewater** **CN104357327A**

Fecha de Publicación: 18 Feb 2015

Aplicación: CN201410373329A (31 Jul 2014)

Aplicante: PKU HKUST SHENZHEN HONGKONG ENVIRONMENTAL PROT ENGINEERING CO LTD

Abstract:

The invention discloses a method for culturing microalgae on a large scale by bean product wastewater. The method comprises the following steps: (1) performing amplified culture on microalga seeds; (2) preparing a bean product wastewater microalga culture medium; (3) inoculating the microalga seeds into the bean product wastewater microalga culture medium, and culturing the microalgae on a large scale; (4) performing heterotrophic culture for synthesizing and accumulating a large amount of grease in microalga cells; (5) separating and recovering the microalgae, and extracting microalga grease. According to the method, the energy microalgae are cultured by the bean product wastewater, so that a large amount of water resources and nutritional salt can be saved, the microalga culture cost can be greatly reduced, COD (chemical oxygen demand), TN (total nitrogen) and TP (total phosphorus) in the wastewater can be effectively removed, and the regeneration and emission-reduction dual-effect mode of the energy microalgae can be performed. Therefore, the method has relatively good industrialized application prospects.

Dirección: <http://www.patentinspiration.com/redirect?url=/patent/CN104357327A>

## Eventos y Cursos

### Congresos

10<sup>th</sup> ISEB Conference 2016.  
June 01-03 Barcelona, Spain.  
<http://www.iseb2016.com/es/>

The 6th International Conference on Algal Biomass, Biofuels and Bioproducts.  
June 26 - 29. Paradise Point, San Diego. EEUU.  
<http://www.algalbbb.com/>

Euro Global Summit and Expo on Biomass.  
August 08-09. Birmingham, UK.  
<http://biomass.global-summit.com/europe/>

2<sup>nd</sup> International Congress and Expo on Biofuels & Bioenergy.  
August 29-31. Sao Paulo, Brazil.  
<http://biofuels-bioenergy.conferenceseries.com/call-for-abstracts.php>

Algae Biomass Summit.  
October 23 - 26. Phoenix, Arizona. EEUU.  
<http://www.algaebiomasssummit.org/?page=Agenda>

The 9<sup>th</sup> Asia-Pacific Conference on Algal Biotechnology. Algae for food, feed, fuel and beyond.  
November 15-18. Bankhok, Thailand.  
<http://www.apcab2016.com/overview.asp>

ALGAEUROPE  
December 06 - 08 2016, UK.  
<http://algaecongress.com/>

## Workshop/ Talleres y cursos

June 15 to June 29, 2016: Freshwater Algae Identification Intensive Summer Workshop.

This workshop will embark on a study of the largest, most diverse, and arguably the most important group of plants on earth: the algae. NY, USA.

[http://www.fordham.edu/info/25156/freshwater\\_algae\\_identification\\_intensive\\_summer\\_workshop](http://www.fordham.edu/info/25156/freshwater_algae_identification_intensive_summer_workshop)

Aug 22-26: Summer ATP3 Workshop, UTEX - Microalgal Culture Management & Strain Selection.

This workshop will provide an introduction to the major classifications of microalgae, including their diversity, nutrition, ecology, and biochemical content. Topics are designed for advanced students, instructors and trainees who are interested in obtaining a broad survey of the microalgae and the field of applied phycology.

Workshop are hosted at AzCATI, a nationally-recognized algae testbed facility, where participants can explore every aspect of growing microalgae at the production scale. The summer workshop will take place at the UTEX Culture Collection of Algae located at the University of Texas at Austin.

<http://utex.org/blogs/training-workshops>

<http://www.psaalgae.org/workshops-and-courses/>

National Center for Marine Algae and Microbiota

Biología y Taxonomía de Diatomeas Continentales. UBA.

Maidana Nora Irene, [nim@bg.fcen.uba.ar](mailto:nim@bg.fcen.uba.ar); [postgrado.bbe@bg.fcen.uba.ar](mailto:postgrado.bbe@bg.fcen.uba.ar).

<http://www.dbbe.fcen.uba.ar/objetos/biologia-y-taxonomia-de-diatomeas-continentales-P174.html>

Taller de identificación de Diatomeas Continentales, UBA.

Este curso teórico y práctico brinda actualización de los conocimientos sobre la biología, taxonomía y ecología de las diatomeas (Bacillariophyceae), con énfasis en los géneros que habitan las aguas continentales. Se estudian las Bacillariophyceae actuales y fósiles, tanto en los aspectos de su biodiversidad como en los limnológicos y micropaleontológicos, así como sus aplicaciones en diversos campos de la ciencia y la industria.

Carga horaria: 60 hs.

Duración: quincenal.

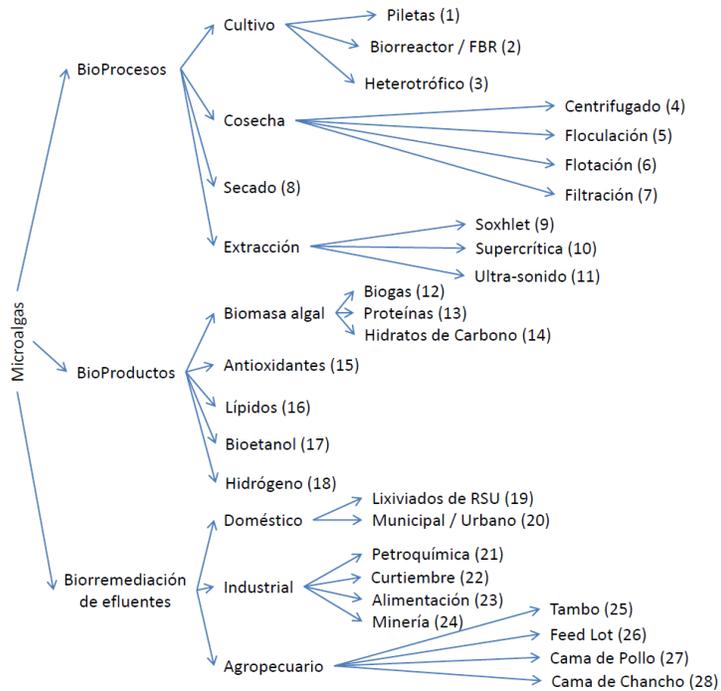
Frecuencia de dictado: anual.

Maidana Nora Irene, [nim@bg.fcen.uba.ar](mailto:nim@bg.fcen.uba.ar); [postgrado.bbe@bg.fcen.uba.ar](mailto:postgrado.bbe@bg.fcen.uba.ar).

<http://www.dbbe.fcen.uba.ar/objetos/taller-de-identificacion-de-diatomeas-continentales-P193.html>.

# Árbol de categorías

## Español



## Inglés

