# UNIDAD DE VIGILANCIA TECNOLÓGICA E INTELIGENCIA COMPETITIVA

# Microalgas

Diciembre de 2023

Ministerio de Agricultura, Ganadería y Pesca
Argentina

# Contenido

## Fluoxetine and Nutrients Removal from Aqueous Solutions by Phycoremediation

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Int J Environ Res Public Health. 2022 May 17;19(10):6081. doi: 10.3390/ijerph19106081.

ABSTRACT

The tertiary treatment using microalgae offers an attractive alternative to the removal of low but relevant concentrations of pharmaceuticals from domestic wastewaters. The removal of fluoxetine from aqueous solutions by living and non-living (lyophilized) Chlorella vulgaris was assessed. The determination of the pH at the point of zero charge, Fourier transmittance infrared analysis, and scanning electron microscopy were performed to characterize the microalgae biomass. Kinetic and equilibrium experiments were performed. The pseudo-second-order model described the kinetics of fluoxetine. The corresponding kinetic constants indicated that biosorption was faster onto non-living biomass than onto living biomass. The equilibrium results showed that the systems followed the Langmuir isotherm model. The maximum capacity of living microalgae (1.9 ± 0.1 mg·g-1) was slightly higher than the non-living microalgae (1.6 ± 0.2 mg·g-1). Living Chlorella vulgaris, free and immobilized in calcium-alginate, were also used to remove fluoxetine and nutrients (nitrogen and phosphorus) from treated municipal wastewater in a batch system. In both experiments, fluoxetine was completely removed within six days. The total phosphorus (TP) and total nitrogen (TN) removal efficiencies achieved for free and immobilized cells were, null and 65.0 ± 0.1%, and 86.2 ± 0.1% and 81.8 ± 3.1, respectively.

## Integrated strategies for robust growth of Chlorella vulgaris on undiluted dairy farm liquid digestate and pollutant removal

Autor: Shunni Zhu
Sci Total Environ. 2022 Dec 15;852:158518. doi: 10.1016/j.scitotenv.2022.158518. Epub 2022 Sep 5.

ABSTRACT

Undiluted dairy farm liquid digestate contains high levels of organic matters, chromaticity and total ammonia nitrogen (TAN), resulting in inhibition to microalgal growth. In this study, a novel cascade pretreatment with ozonation and ammonia stripping (O + S) was employed to remove these inhibitors, and was compared with single pretreatment approach. The optimum parameters for ozonation and ammonia stripping were obtained and the mechanisms of inhibition elimination were investigated. The results show that ozonation contributed to the degradation of non-fluorescent chromophoric organics through the direct molecular ozone attack, which mitigated the inhibition of chromaticity to microalgae, while ammonia stripping relieved the inhibition of high TAN to microalgae. After cascade pretreatment, TAN, total nitrogen (TN), COD and chromaticity were reduced by 80.2 %, 75.4 %, 20.6 % and 75.8 % respectively. When C. vulgaris was cultured on different pretreated digestate, it was found that cascade pretreatment was beneficial for retaining high PSII activity and synergistically improved microalgal growth. The highest biomass increment and productivity achieved 5.40 g L-1 and 900 mg L-1 d-1 respectively in the integration system of cascade pretreatment with microalgae cultivation (O + S + M). After O + S + M treatment, the removal efficiencies of TAN, TN, COD and total phosphorus (TP) were 100 %, 92.8 %, 46.7 % and 99.6 %, respectively. This work provided a promising strategy (O + S + M) for sustainable liquid digestate treatment, along with nutrient recovery and value-added biomass production.

## Microalgae-based wastewater treatment for developing economic and environmental sustainability: Current status and future prospects

Autor: Piroonporn Srimongkol
Front Bioeng Biotechnol. 2022 Sep 7;10:904046. doi: 10.3389/fbioe.2022.904046. eCollection 2022.

ABSTRACT

Over the last several decades, concerns about climate change and pollution due to human activity has gained widespread attention. Microalgae have been proposed as a suitable biological platform to reduce carbon dioxide, a major greenhouse gas, while also creating commercial sources of high-value compounds such as medicines, cosmetics, food, feed, and biofuel. Industrialization of microalgae culture and valorization is still limited by significant challenges in scaling up the production processes due to economic constraints and productivity capacities. Therefore, a boost in resource usage efficiency is required. This enhancement not only lowers manufacturing costs but also enhancing the long-term viability of microalgae-based products. Using wastewater as a nutrient source is a great way to reduce manufacturing costs. Furthermore, water scarcity is one of the most important global challenges. In recent decades, industrialization, globalization, and population growth have all impacted freshwater resources. Moreover, high amounts of organic and inorganic toxins in the water due to the disposal of waste into rivers can have severe impacts on human and animal health. Microalgae cultures are a sustainable solution to tertiary and quaternary treatments since they have the ability to digest complex contaminants. This review presents biorefineries based on microalgae from all angles, including the potential for environmental pollution remediation as well as applications for bioenergy and value-added biomolecule production. An overview of current information about microalgae-based technology and a discussion of the associated hazards and opportunities for the bioeconomy are highlighted.

## Cultivating photosynthetic microorganisms in cooling water waste and urban effluents as a strategy of water regeneration and valorization

Autor: Edwin Ortíz-Sánchez
Environ Technol. 2022 Oct 30:1-10. doi: 10.1080/09593330.2022.2140077. Online ahead of print.

ABSTRACT

Contaminants from cooling water waste (CWW) generated by industries represent an environmental hazard if discharged into aquatic bodies and soil without treatment. Most treatment strategies are energy-demanding and costly; hence, low-cost and sustainable treatment alternative technologies are needed. The present study proposed cyanobacteria culture as a low-cost biological method to treat cooling water waste (CWW) while simultaneously producing carbohydrates. For this purpose, CWW from a cooling tower was evaluated in different dilutions with domestic wastewater (DW) (DW25% -CWW75%, DW50% -CWW50%, DW25% -CWW75%, DW100%, and CWW100%) (v/v). The CWW provided a high content of inorganic carbon and low content of N and P, which resulted in a high C/N ratio promoting a fast carbohydrate accumulation but low biomass production. In contrast, cultures with higher DW concentrations achieved similar results in 14 days. The best results were obtained with DW25% -CWW75%, achieving up to 52 ± 18% carbohydrate content on day 8, with the highest biomass concentration of 1.7 ± 0.12 g L-1 on day 14. This culture removed >94% of TAN, N-NO3- and P-PO43-, and 84 ± 10.82% of COD. This strategy could be a promising approach to treating CWW and DW from the same industry and producing value-added products and bioenergy.

## Nutrient Removal and Membrane Performance of an Algae Membrane Photobioreactor in Urban Wastewater Regeneration

Autor: Verónica Díaz
Membranes (Basel). 2022 Oct 10;12(10):982. doi: 10.3390/membranes12100982.

ABSTRACT

The increase in industry and population, together with the need for wastewater reuse, makes it necessary to implement new technologies in the circular economy framework. The aim of this research was to evaluate the quality of the effluent of an algae membrane photobioreactor for the treatment of the effluent of an urban wastewater treatment plant, to characterise the ultrafiltration membranes, to study the effectiveness of a proposed cleaning protocol, and to analyse the performance of the photobioreactor. The photobioreactor operated under two days of hydraulic retention times feed with the effluent from the Los Vados wastewater treatment plant (WWTP) (Granada, Spain). The microalgae community in the photobioreactor grew according to the pseudo-second-order model. The effluent obtained could be reused for different uses of diverse quality with the removal of total nitrogen and phosphorus of 56.3% and 64.27%, respectively. The fouling of the polyvinylidene difluoride ultrafiltration membrane after 80 days of operation was slight, increasing the total membrane resistance by approximately 22%. Moreover, the higher temperature of the medium was, the lower intrinsic resistance of the membrane. A total of 100% recovery of the membrane was obtained in the two-phase cleaning protocol, with 42% and 58%, respectively.

## Comparison of Growth and Chemical Profile of Diatom Skeletonema grevillei in Bioreactor and Incubation-Shaking Cabinet in Two Growth Phases

Autor: Roberta Frleta
Mar Drugs. 2022 Nov 7;20(11):697. doi: 10.3390/md20110697.

ABSTRACT

Marine microalgae, diatoms, are considered a source of a wide range of high-value compounds, and numerous studies indicate their biotechnological potential in the food and feed industry, cosmetic industry, nanotechnology, pharmaceutical industry, biodiesel production, fertilizers, and wastewater treatment. The aim of this study was to compare the growth, chemical profiles, and antioxidant activity of the diatom Skeletonema grevillei cultivated in a bioreactor and an incubation-shaking cabinet at different growth phases (after 192 and 312 h). Growth was monitored by evaluating cell density with the Sedgewick Rafter chamber, and the collected biomass was extracted with 70% ethanol assisted by ultrasound. Extracts were evaporated to dryness and compounds were identified in derivatized form by gas chromatography and mass spectrometry (GC-MS) analysis, while antioxidant capacity was evaluated by DPPH and ORAC. Significantly faster growth was observed in the bioreactor than in the incubation-shaking cabinet. Oleamide, palmitelaidic acid, glycerol monostearate, myristic acid, cholesterol, eicosapentaenoic acid, 1-monopalmitin, and 24-methylene cholesterol were identified as the major compounds in both systems. Among them, oleamide was the dominant compound in both systems. It is also shown that prolonging the cultivation period had a direct effect on increasing the extract yield. The highest DPPH inhibition (11.4 ± 1%) and ORAC values (93.3 ± 8.4 mM TE) were obtained for the S. grevillei extract recovered from the bioreactor after 312 h. The obtained results contribute to the possibility of using S. grevillei for various biotechnological applications in the future.

## Evaluation of fatty acid profiles of Chlorella Vulgaris microalgae grown in dairy wastewater for producing biofuel

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J Environ Health Sci Eng. 2022 Jun 7;20(2):691-697. doi: 10.1007/s40201-022-00808-z. eCollection 2022 Dec.

ABSTRACT

Biodiesel is a biofuel made from plant oils and animal lipids. Utilization of lipid accumulation in algae biomass as biodiesel is a good alternative to fossil fuels. In this research Chlorella vulgaris microalga was applied after planting in BG11 culture medium in effluent and wastewater of dairy industry after preparation of 25, 50, and 75% dilutions. Algae in two concentrations with low (13 million cells/mL) and high density (26 million

cells/mL) were injected. According to the results obtained in the wastewater environment the highest amount of C16:0 fatty acid was observed in F2 25% treatment, and C18:0 fatty acid is related to F1 75% treatment. In the effluent environment, the highest amount of fatty acids C16:0 and C16:1n7 occur in P1 50% treatment, and C18:0 and C18:3n3 fatty acids are related to P1 50% treatment, respectively. The highest amount of saturated fatty acids (SFA) was reported at P2 75% treatment (56.25%) and monounsaturated fatty acids (MUFA) has accumulated in F175% (40.13%) treatment. Chlorella vulgaris microalgae can be considered as a rich source of lipid and fatty acid profiles in both wastewater and effluents, and it can be regarded as potential significance source for biodiesel production.

## Evaluation of Monoraphidium contortum for the tertiary treatment of dairy industry wastewater and biomass production with nitrogen supplementation

Autor: Nicole Choi
Bioprocess Biosyst Eng. 2023 Feb;46(2):265-271. doi: 10.1007/s00449-022-02831-8. Epub 2022 Dec 15.

ABSTRACT

The present study sought to evaluate the secondary wastewater from dairy industry as a culture medium for Monoraphidium contortum, in bench-scale tubular photobioreactor, aiming at tertiary wastewater treatment and microalgae biomass production. Since the used secondary wastewater contained residual phosphorus (P) but negligible residual nitrogen (N), we also evaluated the nitrogen supplementation, following Redfield ratio (N:P = 16:1) and the same N:P proportion of Bold Medium (N:P = 1.71:1). These cultures were compared to secondary wastewater without N and Bold Medium (control). Secondary wastewater without N addition provided lower values of maximum biomass concentration, indicating the importance of this supplementation. The nitrogen supplementation following Bold Medium represented the best protocol, since biomass productivity was higher than that in control culture, but with lower nitrogen addition (in comparison with the supplementation following Redfield proportion). The biomass of M. contortum showed to be an excellent candidate for oil production, which could be employed as feedstock for biodiesel, for example.

## Effect of biomass retention time on performance and fouling of a stirred membrane photobioreactor

Autor: Bao-Trong Dang
Sci Total Environ. 2022 Dec 21;864:161047. doi: 10.1016/j.scitotenv.2022.161047. Online ahead of print.

ABSTRACT

Co-culture of microalgae-activated sludge has the potential to purify wastewater while reduce energy demand from aeration. In this work, a mechanically stirred membrane photobioreactor (stirred-MPBR) was used to evaluate the impact of the biomass retention time (BRT) on the treatment performance and membrane fouling. Results showed that stirred-MPBR was affected by BRT during treating domestic wastewater at a flux of 16.5 L m-2 h-1. The highest productivity was attained at BRT 7d (102 mg L-1 d-1), followed by BRT 10d (86 mg L-1 d-1), BRT 5d (85 mg L-1 d-1), and BRT 3d (83 mg L-1 d-1). Statistical analysis results showed that BRT 7d had a higher COD removal rate than BRT 10d, however, there is no difference in total nitrogen removal rate. The highest TP removal occurred when the biomass operated at BRT as short as 3d. Reduced BRTs caused a change in the microalgae-activated sludge biomass fraction that encouraged nitrification activity while simultaneously contributing to a higher fouling rate. The bound protein concentrations dropped from 31.35 mg L-1 (BRT 10d) to 10.67 mg L-1 (BRT 3d), while soluble polysaccharides increased from 0.99 to 1.82 mg L-1, respectively. The concentrations of extracellular polymeric substance fractions were significantly altered, which decreased the mean floc size and contributed to the escalating fouling propensity. At the optimum BRT of 7d, the stirred-MPBR showed sufficient access to light and nutrients exchange for mutualistic interactions between the microalgae and activated sludge.

## Exploring the effects of organic loading rate and domestic wastewater treatment by algal-bacterial granules under natural daylight conditions

Autor: Francis Vincent
Water Environ Res. 2023 Jan;95(1):e10831. doi: 10.1002/wer.10831.

ABSTRACT

Algal-bacterial granules or phototrophic granules (PGs) comprising phototrophic microorganisms and bacteria are explored in wastewater treatment for achieving both environmental and economic sustainability. This study describes development of PGs and their use in biological treatment of synthetic and real domestic wastewater (sewage) under natural daylight conditions and low organic loading rate (OLR). Development of PGs was sequentially recorded in a photobioreactor operated in photo-sequencing batch reactor (photo-SBR) mode at a low OLR of 1 kgCOD.m-3 .day-1 and the developed PGs was evaluated for treating synthetic wastewater and real municipal wastewater with 0.14 kg COD m-3 .day-1 . PGs formed in the photo-sequential batch reactor (SBR) were compact and dense and exhibited excellent settling properties. The removal efficiencies were determined to be up to 95%, 93%, 97%, 72%, and 88% for turbidity, COD, TOC, NH4 + -N, and NO2 - -N/NO3 - -N, respectively. Additionally, a reduction in total viable bacterial counts and fecal coliform bacteria up to 1.7 × 103 and 7.8 × 102 cfu.mL-1 , respectively, during treatment of real municipal wastewater was achieved. This study demonstrated cultivation of algal-bacterial granules or PGs and their application for treating real municipal wastewater under natural daylight and tropical climate conditions. Further studies are needed on understanding interactions among phototrophic, autotrophic, and heterotrophic microorganisms of complex algal-bacterial consortium for emerging applications in bioremediation and wastewater treatment. PRACTITIONER POINTS: Phototrophic granules (PGs) were cultivated from algal consortium and activated sludge inoculum in photo sequencing batch reactors. Granular photobioreactor was operated at low OLR of 1 kgCOD.m3 .day-1 for developing well-settling algal-bacterial granules. PGs were stable and showed efficient biological treatment of synthetic wastewater and real sewage. Removals for turbidity, pathogens, and ammonium were at 95%, 3-log, and 72%, respectively, from real sewage.

## Advanced treatment of secondary effluent from wastewater treatment plant by a newly isolated microalga Desmodesmus sp. SNN1

Autor: Pengchong Wang
Front Microbiol. 2023 Jan 26;14:1111468. doi: 10.3389/fmicb.2023.1111468. eCollection 2023.

ABSTRACT

Secondary effluents contain considerable amounts of nitrogen and phosphorous, which if dumped untreated can cause eutrophication of the receiving water bodies. Microalgae can remove these nutrients and other pollutants from the wastewater effluents and play an effective role in the secondary effluent treatment. In this study, six microalgae strains (SNN1, SNN2, SNN3, SNN4, SNS1, and SNS2) were isolated and screened from the water and mud of Yingxue Lake of Shandong Jianzhu University, and their efficiencies for the removal of COD, NH4 +-N, TN, and TP in the secondary effluent were assessed. By comparing the growth performances and nutrient removal ability of algal strains in domestic sewage, we found that SNN1 (identified and named as Desmodesmus sp. SNN1) has the highest efficiency for biomass accumulation and sewage purification. Hence, the algal strain SNN1 was selected for further screening and optimization experiments. The strain showed higher biomass yield and better nutrient removal rate when the pH of secondary effluent was 9.0 and the initial inoculum concentration (optical density at 680 nm) of algal strain was 0.4. After 12 days of treatment, the concentrations of COD, NH4 +-N, TN, and TP in the secondary effluent were 31.79, 0.008, 8.631, and 0.069 mg/L, respectively. Therefore, SNN1 with the removal rates of 52.69% (COD), 99.99% (NH4 +-N), 89.09% (TN), and 94.64% (TP) displayed its high potential in nutrient removal. In addition, it also yielded 5.30 mg/L of chlorophyll a and 168.33 mg/L of lipids. These results demonstrated that this strain exhibited an effective treatment capacity for secondary effluent and microalgal oil production. This study is helpful to provide a strategy for the

resource utilization of secondary effluent and the conservation of freshwater resources required by microalgae culture.

## Bioremediation of coastal aquaculture effluents spiked with florfenicol using microalgae-based granular sludge - a promising solution for recirculating aquaculture systems

Autor: Ana S Oliveira
Water Res. 2023 Apr 15;233:119733. doi: 10.1016/j.watres.2023.119733. Epub 2023 Feb 12.

ABSTRACT

Aquaculture is a crucial industry in the agri-food sector, but it is linked to serious environmental problems. There is a need for efficient treatment systems that allow water recirculation to mitigate pollution and water scarcity. This work aimed to evaluate the self-granulation process of a microalgae-based consortium and its capacity to bioremediate coastal aquaculture streams that sporadically contain the antibiotic florfenicol (FF). A photo-sequencing batch reactor was inoculated with an autochthonous phototrophic microbial consortium and was fed with wastewater mimicking coastal aquaculture streams. A rapid granulation process occurred within ca. 21 days, accompanied by a substantially increase of extracellular polymeric substances in the biomass. The developed microalgae-based granules exhibited high and stable organic carbon removal (83-100%). Sporadically wastewater contained FF which was partially removed (ca. 5.5-11.4%) from the effluent. In periods of FF load, the ammonium removal slightly decreased (from 100 to ca. 70%), recovering 2 days after FF feeding ceased. A high-chemical quality effluent was obtained, complying with ammonium, nitrite, and nitrate concentrations for water recirculation within a coastal aquaculture farm, even during FF feeding periods. Members belonging to the Chloroidium genus were predominant in the reactor inoculum (ca. 99%) but were replaced from day-22 onwards by an unidentified microalga from the phylum Chlorophyta (>61%). A bacterial community proliferated in the granules after reactor inoculation, whose composition varied in response to feeding conditions. Bacteria from the Muricauda and Filomicrobium genera, Rhizobiaceae, Balneolaceae, and Parvularculaceae families, thrived upon FF feeding. This study demonstrates the robustness of microalgae-based granular systems for aquaculture effluent bioremediation, even during periods of FF loading, highlighting their potential as a feasible and compact solution in recirculation aquaculture systems.

## Production of a wide spectrum biopesticide from Monoraphidium sp. KMC4 grown in simulated dairy wastewater

Autor: Satya Sundar Mohanty
Bioresour Technol. 2023 Apr;374:128815. doi: 10.1016/j.biortech.2023.128815. Epub 2023 Mar 1.

ABSTRACT

The present work aims on developing an eco-friendly strategy that couples the remediation of dairy wastewater with crop protection strategy using microalgal biomass for sustainable agriculture. In the present study, the microalgal strain Monoraphidium sp. KMC4 was cultivated in dairy wastewater. It was observed that the microalgal strain is able to tolerate up to as high as 2000 mg/L of COD and utilize the organic carbon and other nutrient component of the wastewater for biomass production. The biomass extract demonstrates excellent antimicrobial activity against the two phytopathogens (Xanthomonas oryzae and Pantoea agglomerans). GC-MS analysis of the microalgae extract revealed phytochemicals such as chloroacetic acid and 2, 4- di tert butylphenol that are responsible for the inhibition of the microbial growth. These preliminary results indicates that integration of microalgal cultivation and nutrient recycling from wastewaters for the production of biopesticides is a promising prospect for the replacement of synthetic pesticides.

## Bioconversion of Cheese Whey and Food By-Products by Phaeodactylum tricornutum into Fucoxanthin and n-3 Lc-PUFA through a Biorefinery Approach

Autor: Giovanni Luca Russo
Mar Drugs. 2023 Mar 19;21(3):190. doi: 10.3390/md21030190.

ABSTRACT

This study investigates the potential of utilizing three food wastes: cheese whey (CW), beet molasses (BM), and corn steep liquor (CSL) as alternative nutrient sources for the cultivation of the diatom Phaeodactylum tricornutum, a promising source of polyunsaturated eicosapentaenoic acid (EPA) and the carotenoid fucoxanthin. The CW media tested did not significantly impact the growth rate of P. tricornutum; however, CW hydrolysate significantly enhances cell growth. BM in cultivation medium enhances biomass production and fucoxanthin yield. The optimization of the new food waste medium was conducted through the application of a response surface methodology (RSM) using hydrolyzed CW, BM, and CSL as factors. The results showed a significant positive impact of these factors ($p < 0.005$), with an optimized biomass yield of 2.35 g L-1 and a fucoxanthin yield of 3.64 mg L-1 using a medium composed of 33 mL L-1 of CW, 2.3 g L-1 of BM, and 2.24 g L-1 of CSL. The experimental results reported in this study showed that some food by-products from a biorefinery perspective could be utilized for the efficient production of fucoxanthin and other high-added-value products such as eicosapentaenoic acid (EPA).

## Eukaryotic Community Structure and Interspecific Interactions in a Stratified Acidic Pit Lake Water in Anhui Province

Autor: Xin Pan
Microorganisms. 2023 Apr 9;11(4):979. doi: 10.3390/microorganisms11040979.

ABSTRACT

The stratified acidic pit lake formed by the confluence of acid mine drainage has a unique ecological niche and is a model system for extreme microbial studies. Eukaryotes are a component of the AMD community, with the main members including microalgae, fungi, and a small number of protozoa. In this study, we analyzed the structural traits and interactions of eukaryotes (primarily fungi and microalgae) in acidic pit lakes subjected to environmental gradients. Based on the findings, microalgae and fungi were found to dominate different water layers. Specifically, Chlorophyta showed dominance in the well-lit aerobic surface layer, whereas Basidiomycota was more abundant in the dark anoxic lower layer. Co-occurrence network analysis showed that reciprocal relationships between fungi and microalgae were prevalent in extremely acidic environments. Highly connected taxa within this network were Chlamydomonadaceae, Sporidiobolaceae, Filobasidiaceae, and unclassified Eukaryotes. Redundancy analysis (RDA) and random forest models revealed that Chlorophyta and Basidiomycota responded strongly to environmental gradients. Further analysis indicated that eukaryotic community structure was mainly determined by nutrient and metal concentrations. This study investigates the potential symbiosis between fungi and microalgae in the acidic pit lake, providing valuable insights for future eukaryotic biodiversity studies on AMD remediation.

## Effect of co-culturing bacteria and microalgae and influence of inoculum ratio during the biological treatment of tannery wastewater

Autor: Velmurugan Nagabalaji
J Environ Manage. 2023 Sep 1;341:118008. doi: 10.1016/j.jenvman.2023.118008. Epub 2023 May 3.

ABSTRACT

This present investigation is carried out to study the effect of algal and bacterial inoculum concentrations on the removal of organic pollutants and nutrients from the tannery effluent by the combined symbiotic treatment process. The bacterial and microalgal consortia was developed in laboratory setup and mixed together to perform this study. The Influence of algae and bacteria inoculum concentrations on the removal of pollutants such as Chemical Oxygen Demand (COD) and Total Kjeldahl Nitrogen (TKN) were studied using statistical optimization through Response surface methodology. For the design of experimental set up and optimization, full factorial Central composite design was used. The profiles of pH, Dissolved Oxygen (DO) and nitrate were also monitored and studied. The inoculum concentrations of microalgae and bacteria showed significant effect on Co-culturing on COD, TKN and nitrate removals as major response. The linear effect of bacterial inoculum has positive dominant influence on COD and TKN removal efficiencies. Nitrate utilization by microalgae increases with the increase in microalgal inoculum concentration. The maximum removal efficiencies of COD and TKN with 89.9% and 80.9% were obtained at optimum bacterial and algal inoculum concentrations of 6.7 g/L and 8.0 g/L respectively. These outcomes of this study are immensely favorable for maximizing the COD and nitrogen (nutrients) removal capabilities of microalgae-bacterial consortia in tannery effluent.

## Electrochemical degradation of surfactants in domestic wastewater using a DiaClean® cell equipped with a boron-doped diamond electrode

Autor: Dayana G Cisneros-León
Front Chem. 2023 Apr 25;11:900670. doi: 10.3389/fchem.2023.900670. eCollection 2023.

ABSTRACT

Treating domestic wastewater has become more and more complicated due to the high content of different types of detergents. In this context, advanced electro-oxidation (AEO) has become a powerful tool for complex wastewater remediation. The electrochemical degradation of surfactants present in domestic wastewater was carried out using a DiaClean® cell in a recirculation system equipped with boron-doped diamond (BDD) as the anode and stainless steel as the cathode. The effect of recirculation flow (1.5, 4.0 and 7.0 L min-1) and the applied current density (j = 7, 14, 20, 30, 40, and 50 mA cm-2) was studied. The degradation was followed by the concentration of surfactants, chemical oxygen demand (COD), and turbidity. pH value, conductivity, temperature, sulfates, nitrates, phosphates, and chlorides were also evaluated. Toxicity assays were studied through evaluating Chlorella sp. performance at 0, 3, and 7 h of treatment. Finally, the mineralization was followed by total organic carbon (TOC) under optimal operating conditions. The results showed that applying j = 14 mA cm-2 and a flow rate of 1.5 L min-1 during 7 h of electrolysis were the best conditions for the efficient mineralization of wastewater, achieving the removal of 64.7% of surfactants, 48.7% of COD, 24.9% of turbidity, and 44.9% of mineralization analyzed by the removal of TOC. The toxicity assays showed that Chlorella microalgae were unable to grow in AEO-treated wastewater (cellular density: 0 × 104 cells ml-1 after 3- and 7-h treatments). Finally, the energy consumption was analyzed, and the operating cost of 1.40 USD m-3 was calculated. Therefore, this technology allows for the degradation of complex and stable molecules such as surfactants in real and complex wastewater, if toxicity is not taken into account.

## Livestock and poultry farm wastewater treatment and its valorization for generating value-added products: Recent updates and way forward

Autor: Sakshi Vaishnav
Bioresour Technol. 2023 Aug;382:129170. doi: 10.1016/j.biortech.2023.129170. Epub 2023 May 15.

ABSTRACT

Livestock and poultry wastewater poses a potent risk for environmental pollution accelerating disease load and premature deaths. It is characterized by high chemical oxygen demand, biological oxygen demand, suspended solids, heavy metals, pathogens, and antibiotics, among other contaminants. These contaminants have a negative impact on the quality of soil, groundwater, and air, and is a potential hazard to human health.

Depending on the specific characteristics of wastewater, such as the type and concentration of pollutants present; several physical, chemical and biological strategies have been developed for its treatment. This review aims at providing comprehensive overview of the profiling of livestock wastewater from the dairy, swine and poultry sub-sectors along with the biological, physico-chemical, AI-based and integrated treatment methodologies, and valorisation for the generation of value-added products such as bioplastics, biofertilizers, biohydrogen and microalgal-microbial fuel cells. Additionally, future perspectives for efficient and sustainable wastewater treatment are contemplated.

## Cultivation of blue green algae (Arthrospira platensis Gomont, 1892) in wastewater for biodiesel production

Autor: Jasim Mohammed Salman
Chemosphere. 2023 Sep;335:139107. doi: 10.1016/j.chemosphere.2023.139107. Epub 2023 Jun 2.

ABSTRACT

The production of biodiesel has become an important issue in the effort to reduce gas emissions due to the climate change crisis; therefore, algae have widely used to produce biodiesel for energy sustainability. The present study represented an effort to assess the ability of the alga Arthrospira platensis to produce fatty acids involved in biofuel (diesel) by cultivation in Zarrouk media enriched with different municipal wastewater concentrations. Wastewater was used in different concentrations (5, 15, 25, 35 and 100% [control]). Five fatty acids from the alga were determined and included in the present study. These were inoleic acid, palmitic acid, oleic acid, gamma-linolenic acid, and docosahexaenoic acid. Impact of different cultivation conditions were studied in terms of observed changes in growth rate, doubling time, total carbohydrate, total protein, chlorophyll a, carotenoids, phycocyanin, allophycocyanin, and phycobiliproteins. Results showed an increase in the values of growth rate, total protein content, chlorophyll a, and levels of carotenoids at all treatments except for carbohydrate content, which decreased with an increasing concentration of wastewater. The high value of doubling time (11.605 days) was recorded at treatment 5%. Fatty acids yields were increased at treatment 5% and 15%. The highest concentrations of fatty acids were 3.108 mg/g for oleic acid, gamma-linolenic acid (28.401 mg/g), docosahexaenoic acid (41.707 mg/g), palmitic acid (1.305 mg/g), and linoleic acid (0.296 mg/g). Moreover, the range of phycocyanin (0.017-0.084 mg/l), allophycocyanin (0.023-0.095 mg/l), and phycobiliproteins (0.041-0.180 mg/l) were obtained in treatment with 15-100%, respectively. Cultivation with municipal wastewater reduced the values of nitrate, phosphate, and electrical conductivity as well as increased dissolved oxygen. Maximum electrical conductivity was recorded in untreated wastewater with algae, while the highest level of dissolved oxygen was noted at 35% concentration. The use of the household wastewater is more environmentally friendly as an alternative of the traditional cultivation techniques used for long-term for biofuel production.

## Heterotrophic growth of Galdieria sulphuraria on residues from aquaculture and fish processing industries

Autor: Daniel Pleissner
Bioresour Technol. 2023 Sep;384:129281. doi: 10.1016/j.biortech.2023.129281. Epub 2023 Jun 8.

ABSTRACT

The study aimed at zero-waste utilization of fish processing streams for cultivation of microalgae Galdieria sulphuraria. Wastewater from a fish processing facility, slam (mix of used fish feed and faeces), and dried pellet (sediments after enzymatic hydrolysis of rainbow trout) were investigated as potential sources of carbon, nitrogen, and phosphate for cultivation of G. sulphuraria. The pellet extract was found to support the growth of G. sulphuraria when appropriate diluted, at concentrations below 40 % (v/v). It was revealed that wastewater does not impact the growth negatively, however free amino nitrogen and carbon sources need to be supplied from another source. Therefore, only proteolyzed pellet extract (20 %, v/v) was selected for upscaling and a biomass concentration of 80 g L-1 (growth rate was 0.72 day-1) was achieved in a non-sterile fed-batch culture. Even though

biomass was produced under non-sterile conditions no pathogens such as Salmonella sp. could be detected.

## Evaluation of the effect of the feeding regime on the removal of metals and pathogens in microalgae-bacterial systems

Autor: Sarah Lacerda Farias
Water Sci Technol. 2023 Jul;88(1):11-22. doi: 10.2166/wst.2023.194.

ABSTRACT

Microalgae-bacteria systems are used for the treatment of effluents, using a technology that has stood out with excellent results, as reported in the literature. However, investigating these systems in more depth can improve our understanding of the removal mechanisms for a wide range of existing and emerging pollutants and help improve the guidelines for design and operation, in order to improve the treatment efficiency as well as biomass productivity. This work studied the impact of the feeding regime on the removal of metals and pathogens from primary domestic wastewater in high rate algal ponds (HRAPs). For this, one reactor was fed continuously (HRAP1) while two reactors were fed in semi-continuous mode, during 12 h day-1(HRAP2) and 0.1 h day-1 (HRAP3). Although removal efficiencies of 82 ± 5% for Mn and 90% for E. coli were reached in the semi-continuously fed reactors, there was no significant difference between the conditions studied. On the other hand, for biomass productivity, the semi-continuous feeding regime was more advantageous with a growth of ≈ 22 mg L-1 day-1.

## Hybrid microalgae-activated sludge system for carbon-efficient wastewater treatment

Autor: Kasim Mohammed
Water Sci Technol. 2023 Aug;88(3):586-594. doi: 10.2166/wst.2023.246.

ABSTRACT

Engineered microalgae-bacteria systems can play a key role in the realisation of energy-efficient carbon-neutral wastewater treatment technologies. An attempt was made to develop a hybrid microalgae-activated sludge (HMAS) system coupling carbon capture with domestic wastewater treatment. Photobioreactors internally illuminated with red light-emitting diodes (LEDs), and inoculated with mixed microbial culture, resulted in substantial savings in operational cost. System performance was evaluated at about 600 µmol/m2 s LED irradiance while treating synthetic municipal wastewater in a chemostat for about 2 months, containing about 250 mg/L soluble chemical oxygen demand (SCOD), 90 mg/L NH3-N and 10 mg/L orthophosphate. Carbon dioxide was supplied into the HMAS at 25 mL/min, 25% v/v. SCOD was efficiently removed from the wastewater (up to 70%) and bacterial oxygen requirement of >2 mg/L was met through microalgal photosynthesis. The system demonstrated its potential in achieving carbon-efficient wastewater treatment.

## Emerging Applications of Chlorella sp. and Spirulina (Arthrospira) sp

Autor: Ana P Abreu
Bioengineering (Basel). 2023 Aug 11;10(8):955. doi: 10.3390/bioengineering10080955.

ABSTRACT

Chlorella sp. and Spirulina (Arthrospira) sp. account for over 90% of the global microalgal biomass production and represent one of the most promising aquiculture bioeconomy systems. These microorganisms have been widely recognized for their nutritional and therapeutic properties; therefore, a significant growth of their market is expected, especially in the nutraceutical, food, and beverage segments. However, recent advancements in biotechnology and environmental science have led to the emergence of new applications for these microorganisms. This paper aims to explore these innovative

applications, while shedding light on their roles in sustainable development, health, and industry. From this state-of-the art review, it was possible to give an in-depth outlook on the environmental sustainability of Chlorella sp. and Spirulina (Arthrospira) sp. For instance, there have been a variety of studies reported on the use of these two microorganisms for wastewater treatment and biofuel production, contributing to climate change mitigation efforts. Moreover, in the health sector, the richness of these microalgae in photosynthetic pigments and bioactive compounds, along with their oxygen-releasing capacity, are being harnessed in the development of new drugs, wound-healing dressings, photosensitizers for photodynamic therapy, tissue engineering, and anticancer treatments. Furthermore, in the industrial sector, Chlorella sp. and Spirulina (Arthrospira) sp. are being used in the production of biopolymers, fuel cells, and photovoltaic technologies. These innovative applications might bring different outlets for microalgae valorization, enhancing their potential, since the microalgae sector presents issues such as the high production costs. Thus, further research is highly needed to fully explore their benefits and potential applications in various sectors.

## A critical review on phycoremediation of pollutants from wastewater-a novel algae-based secondary treatment with the opportunities of production of value-added products

Autor: Swagata Laxmi Sengupta
Environ Sci Pollut Res Int. 2023 Nov;30(54):114844-114872. doi: 10.1007/s11356-023-30470-3. Epub 2023 Nov 3.

ABSTRACT

Though the biological treatment employing bacterial strains has wide application in effluent treatment plant, it has got several limitations. Researches hence while looking for alternative biological organisms that can be used for secondary treatment came up with the idea of using microalgae. Since then, a large number of microalgal/cyanobacterial strains have been identified that can efficiently remove pollutants from wastewater. Some researchers also found out that the algal biomass not only acts as a carbon sink by taking up carbon dioxide from the atmosphere and giving oxygen but also is a renewable source of several value-added products that can be extracted from it for the commercial use. In this work, the cleaning effect of different species of microalgae/cyanobacteria on wastewater from varied sources along with the value-added products obtained from the algal biomass as observed by researchers during the past few years are reviewed. While a number of review works in the field of phycoremediation technology was reported in literature, a comprehensive study on phycoremediation of wastewater from different industries and household individually is limited. In the present review work, the efficiency of diverse microalgal/cyanobacterial strains in treatment of wide range of industrial effluents along with municipal wastewater having multi-pollutants has been critically reviewed.

## Ecotoxicity and rapid degradation of quaternary ammonium compounds (QACs) subjected to combined vacuum UV and UV-C treatment

Autor: Lana Flanjak
Chemosphere. 2024 Jan;346:140584. doi: 10.1016/j.chemosphere.2023.140584. Epub 2023 Nov 2.

ABSTRACT

Quaternary ammonium compounds (QACs) are active ingredients in a palette of commercially available disinfectants, sanitizers, and biocides. QACs are widely used because of their broad-spectrum antimicrobial properties but the ubiquitous uses have resulted in frequent detection in aquatic and terrestrial matrices including domestic wastewater, surface waters, urban soils and sediments. An increased domestic QACs consumption has increased the environmental occurrence, and investigation of mitigation methods and effects on non-target organisms are in demand. In this study, we examined the potential ecotoxicity of six QACs and investigated the effect of combined vacuum UV (185 nm) and UV-C (254 nm) irradiation (VUV/UVC) on degradation and mitigation of

ecotoxicity of QACs. The study showed that combined VUV/UVC irradiation facilitated rapid degradation of benzalkonium chloride, benzethonium chloride, didecyldimethylammonium chloride, dodecyltrimethylammonium chloride, and hexadecyltrimethylammonium chloride. The estimated half-lives varied between 2 and 7 min, and degradation was affected by the initial QAC concentrations, the UV fluence, and the water matrix. The potential ecotoxicity of QACs and VUV/UVC treated QACs was examined using a battery of test organisms that included the luminescent bacterium Aliivibrio fischeri, the gram-negative and gram-positive bacteria Escherichiacoli and Enterococcus faecalis, the freshwater microalga Raphidocelis subcapitata, and the crustacean Daphia magna. The potential for trophic transfer of QACs was investigated in a simplified aquatic food web. Test organisms from different trophic levels were included to assess adverse effects of bioactive compounds in VUV/UVC treated samples including transformation products. The study showed that several QACs were highly toxic to aquatic test organisms with EC50 and/or EC20 values < 1 μM. VUV/UVC treatment of QACs resulted in substantial photolysis of the parent compounds and comprehensive mitigation of the ecotoxicity potential. VUV/UVC represent an attractive oxidation technology for abatement QACs in contaminated water because the process does not require addition of catalysts or precursors.

## Treatment of mixed wastewater by vertical rotating microalgae-bacteria symbiotic biofilm reactor

Autor: Mingran Yu
Bioresour Technol. 2023 Nov 19;393:130057. doi: 10.1016/j.biortech.2023.130057. Online ahead of print.

ABSTRACT

A novel vertical rotating microalgae-bacteria symbiotic biofilm reactor was built to treat the mixed wastewater containing municipal and soybean soaking wastewater. The reactor was operated in both sequential batch and semi-continuous modes. Under the sequential batch operation mode, the maximum removal rates for Chemical Oxygen Demand (COD), Total Nitrogen (TN), Total Phosphorus (TP), and Ammonia Nitrogen (NH4+-N) of the mixed wastewater were 95.6 %, 96.1 %, 97.6 %, and 100 %, respectively. During the semi-continuous operation, the water discharge indices decreased gradually and eventually stabilized. At stabilization, the removal rates of COD, TN, and NH4+-N achieved 98 %, 95 %, and 99.9 %, respectively. The maximum biomass productivity of the biofilm was 2.69 g·m-2·d-1. Additionally, the carbohydrate, protein and lipid comprised approximately 22 %, 51 % and 10 % of the dry weight of Chlorella. This study demonstrates the great potential of the microalgae-bacteria symbiotic biofilm system to treat food and domestic wastewater while harvesting microalgal biomass.

## Unlocking microalgal host-exploring dark-growing microalgae transformation for sustainable high-value phytochemical production

Autor: Surumpa Jareonsin
Front Bioeng Biotechnol. 2023 Nov 9;11:1296216. doi: 10.3389/fbioe.2023.1296216. eCollection 2023.

ABSTRACT

Microalgae have emerged as a promising, next-generation sustainable resource with versatile applications, particularly as expression platforms and green cell factories. They possess the ability to overcome the limitations of terrestrial plants, such non-arable land, water scarcity, time-intensive growth, and seasonal changes. However, the heterologous expression of interested genes in microalgae under heterotrophic cultivation (dark mode) remains a niche area within the field of engineering technologies. In this study, the green microalga, Chlorella sorokiniana AARL G015 was chosen as a potential candidate due to its remarkable capacity for rapid growth in complete darkness, its ability to utilize diverse carbon sources, and its potential for wastewater treatment in a circular bioeconomy model. The aims of this study were to advance microalgal genetic engineering via dark cultivation, thereby positioning the strain as promising dark-host for expressing heterologous genes to produce high-value phytochemicals and ingredients for food and feed. To facilitate comprehensive screening based on resistance, eleven common antibiotics were tested

under heterotrophic condition. As the most effective selectable markers for this strain, G418, hygromycin, and streptomycin exhibited growth inhibition rates of 98%, 93%, and 92%, respectively, ensuring robust long-term transgenic growth. Successful transformation was achieved through microalgal cell cocultivation with Agrobacterium under complete darkness verified through the expression of green fluorescence protein and β-glucuronidase. In summary, this study pioneers an alternative dark-host microalgal platform, using, Chlorella, under dark mode, presenting an easy protocol for heterologous gene transformation for microalgal host, devoid of the need for expensive equipment and light for industrial production. Furthermore, the developed genetic transformation methodology presents a sustainable way for production of high-value nutrients, dietary supplements, nutraceuticals, proteins and pharmaceuticals using heterotrophic microalgae as an innovative host system.

## Microalgae cultivation for treating agricultural effluent and producing value-added products

Autor: Arsalan Alavianghavanini
Sci Total Environ. 2023 Dec 15;912:169369. doi: 10.1016/j.scitotenv.2023.169369. Online ahead of print.

ABSTRACT

Wastewater generated within agricultural sectors such as dairies, piggeries, poultry farms, and cattle meat processing plants is expected to reach 600 million m3 yr-1 globally. Currently, the wastewater produced by these industries are primarily treated by aerobic and anaerobic methods. However, the treated effluent maintains a significant concentration of nutrients, particularly nitrogen and phosphorus. On the other hand, the valorisation of conventional microalgae biomass into bioproducts with high market value still requires expensive processing pathways such as dewatering and extraction. Consequently, cultivating microalgae using agricultural effluents shows the potential as a future technology for producing value-added products and treated water with low nutrient content. This review explores the feasibility of growing microalgae on agricultural effluents and their ability to remove nutrients, specifically nitrogen and phosphorus. In addition to evaluating the market size and value of products from wastewater-grown microalgae, we also analysed their biochemical characteristics including protein, carbohydrate, lipid, and pigment content. Furthermore, we assessed the costs of both upstream and downstream processing of biomass to gain a comprehensive understanding of the economic potential of the process. The findings from this study are expected to facilitate further techno-economic and feasibility assessments by providing insights into optimized processing pathways and ultimately leading to the reduction of costs.

## Organic sludge-energy recycling method

Inventor(s): ERICKSON LENNART G; WORNE HOWARD E +
Applicant(s): ERICKSON LENNART G; WORNE HOWARD E +

A method is described for converting substantially untreated organic sludge into useful substances. The sludge may include primary sludge, a mixture of primary and secondary sludges from municipal wastewater treatment facilities, slurries of agricultural manure, and other organic wastes. The sludge is mechanically comminuted to reduce the size of organic solids, the sludge is then further mechanically disintegrated and thereafter it is subjected to enzyme hydrolysis to produce a biologically stable colloidal slurry with improved biochemical potential reactivity. Typically, the hydrolysis step is followed by a further cell/particle disintegration step and a secondary hydrolysis step. If necessary, heavy metals are removed from the suspension in a chelating step which are recovered as a recyclable concentrate. The suspension can be used as a liquid fertilizer or it can be dewatered. If used as a liquid fertilizer the suspension can be inoculated with microalgae to enrich the fertilizer with nitrogen. Alternatively, the demineralized product may be incinerated or used as a feedstock for other industrial processing.

## Method for culturing high-density oil microalgae to treat yeast industrial wastewater

Inventor(s): FUZHEN LIAO; XIAO DIAO; QINGYU WU; GUANGCHENG LU; JIEYUN WEI; YUE LU; YUJUAN CHANG; SHUQIN CHEN; ZILIN ZHAO +
Applicant(s): GUANGXI XIANGGUI SUGAR INDUSTRY GROUP CO LTD; UNIV TSINGHUA

The invention discloses a method for culturing high-density oil microalgae to treat yeast industrial wastewater. The method comprises the following steps of: carrying out clean pre-treatment on wastewater obtained by producing yeast; then adding reducing sugar and nutritive salts to prepare a culture medium; sterilizing, inoculating and fermenting; and discontinuously feeding materials, and carrying out heterotrophism culture, so as to obtain energy microalgae with the cell density of 41.26-50.83g/L and the oil content of 40.86-45.26%. According to the method disclosed by the invention, a novel efficient and economical way which combines recycled utilization and energy-form production of industrial organic wastewater discharged in a yeast industrial production process is realized, so that the damages of the organic wastewater to the environment is reduced, and good economic benefits and social benefits are obtained.

## Method for treating high ammonia-nitrogen wastewater through nutrition conversion of mixotroph

Inventor(s): ZHOU WENGUANG; RUAN RONGSHENG; WANG JINGHAN; LI JUN +
Applicant(s): UNIV NANCHANG +

The invention discloses a method for treating high ammonia-nitrogen wastewater through nutrition conversion of mixotroph. The method for treating the high ammonia-nitrogen wastewater through nutrition conversion of the mixotroph comprises the following steps: 1, conducting transferring and culture on the mixotroph; 2, conducting high density culture in a culture medium rich in organic carbon or wastewater rich in organic carbon; 3, harvesting heterotrophic cells of the mixotroph; 4, transferring the heterotrophic cells into the high ammonia-nitrogen wastewater for autotrophic culture, absorbing high-concentration nitrogen and ammonia, and purifying the wastewater. According to the method, the method for changing the nutrition metabolism pathway of the mixotroph is introduced for treating the high ammonia-nitrogen wastewater, the treated wastewater can be recycled, the requirement of industrialized wastewater treatment conducted through microalgae is met, and the method is a new approach for conducting sewage

treatment through produced microalgae economically and efficiently. The harvested microalgae cells can be further treated and used for preparing biological energy source, animal feed and the like.

## Microalgae culturing method and application thereof

Inventor(s): CHENG PENGFEI; ZHENG GUOHUA; WANG JUNFENG; LIU TIANZHONG; WANG YAN +
Applicant(s): UNIV JIUJIANG +

The invention provides a microalgae culturing method and application thereof. The microalgae culturing method is to remove cobalt ions and nitrogen and phosphorus in wastewater during the culture of microalgae. The microalgae culturing method of the invention includes inoculating the microalgae in the adherent culturing device, feeding the CO<2> gas, irradiating and feeding the wastewater containing the culture solution, wherein the wastewater is from the industrial waste water, and is rich in a large amount of metal ions such as cobalt and nitrogen and phosphorus. The microalgae cultured in the present invention can be used as raw materials for gasoline, diesel and aviation fuels. The microalgae culture method provided by the invention not only can remove the cobalt ions and nitrogen and phosphorus in the wastewater, but also the oil yield of the microalgae is improved at a certain high cobalt concentration. The invention provides a feasible new technology for the removal of metal ions in wastewater and the industrialization of microalgae biofuels.

## Urban ecological environment self-healing system

Inventor(s): QIAN JIAN; ZHENG JINCAI; HUANG XIAODONG; LU ZHIYONG; CAI ZHIGANG; LU CHUAN +
Applicant(s): SHANGHAI ZAOFU ENERGY TECH CO LTD +

The invention discloses an urban ecological environment self-healing system. The urban ecological environment self-healing system comprises a domestic garbage magnetic thermal cracking module, an integrated sewage treatment module, an industrialized microalgae industry module, a soil remediation agent preparation module and a microalgae concentration module; the domestic garbage magnetic thermal cracking module carries out thermal cracking treatment on garbage for 24 hours by using a thermal cracking furnace; the garbage is reduced to 1/200-300 ashes to be discharged; the ashes are mixed withalgae water in the following to be used for soil remediation; flue gas is cooled to 45 degrees centigrade by using water heat exchanging equipment; the cooled flue gas enters flue gas treatment equipment; after being treated, the flue gas enters the industrialized microalgae industry module to be utilized; and heat generated by thermal cracking passes through a water heat exchanging system. The urban ecological environment self-healing system disclosed by the invention has the advantages of rapidness, no harm, no residue, high applicability, small floor area, reclamation, good microalgae concentration production market prospect, advanced equipment, energy cyclic utilization, good economic benefit and so on; and a problem that the domestic garbage operation and treatment cost is high because domestic garbage separation, recycling and utilization project is developed from the source is solved.

## Method for processing soy sauce wastewater through microalgae

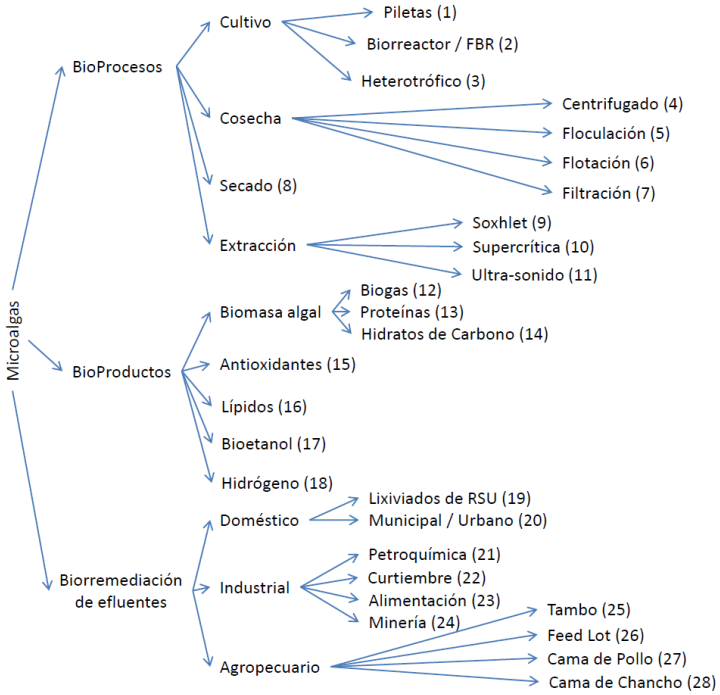
Inventor(s): ZHOU WENGUANG; SONG HANWU; LU QIAN; HAN PEI; LI JINGJING; LENG LIJIAN; LI JUN +
Applicant(s): UNIV NANCHANG +

A method for processing soy sauce wastewater through microalgae specifically includes the steps of obtaining salt-resistant and stain-resistant microalgae through screening, adding the microalgae to aculture medium for high-density culturing, inoculating harvested microalgae cells into the soy sauce wastewater, and conducting oscillation culturing under the illumination conditions. Since a largeamount of organic matter, nitrogen, phosphorus and other substances in the wastewater can be consumed in the microalgae growth and

metabolism process, the concentration of pollutants in the wastewateris reduced, and the aim of purifying the wastewater is realized. The method is simple in operation and small in device input, greatly reduces the wastewater processing cost, meets the microalgae industrial wastewater processing application requirements, and has the advantages of being high in efficiency, environmentally friendly, high in comprehensive utilization rate and the like. The microalgaeefficiently absorb the organic matter, nitrogen, phosphorus and other nutrient substances in the soy sauce wastewater and convert the organic matter, nitrogen, phosphorus and other nutrient substances into high-additional-value biomass, the harvested microalgae cells can be used for subsequent biological energy preparing, feed and bait applying and the like, economic benefits are improved, and resource recycling is sufficiently realized.

**Árbol de categorías**

Español

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