Wastewater

1- Membrane Technologies in Wastewater Treatment: A Review

By:
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Abstract

In the face of water shortages, the world seeks to explore all available options in reducing the over exploitation of limited freshwater resources. One of the surest available water resources is wastewater. As the population grows, industrial, agricultural, and domestic activities increase accordingly in order to cater for the voluminous needs of man. These activities produce large volumes of wastewater from which water can be reclaimed to serve many purposes. Over the years, conventional wastewater treatment processes have succeeded to some extent in treating effluents for discharge purposes. However, improvements in wastewater treatment processes are necessary in order to make treated wastewater re-usable for industrial, agricultural, and domestic purposes. Membrane technology has emerged as a favorite choice for reclaiming water from different wastewater streams for re-use. This review looks at the trending membrane technologies in wastewater treatment, their advantages and disadvantages. It also discusses membrane fouling, membrane cleaning, and membrane modules. Finally, recommendations for future research pertaining to the application of membrane technology in wastewater treatment are made.

Keywords
Author Keywords
membrane technologywastewaterpotable waterfouling
Keywords Plus

Wastewater

VOLATILE ORGANIC-COMPOUNDSCONCENTRATION POLARIZATIONDRAW SOLUTESPERVAPORATION SEPARATIONOSMOSIS MEMBRANESAQUEOUS-SOLUTIONSHYBRID SYSTEMAIR-GAPDISTILLATIONDESALINATION

Wastewater

2- Integrating micro-algae into wastewater treatment: A review

By:
Mohsenpour, SF (Mohsenpour, Seyedeh Fatemeh) [1] ; Hennige, S (Hennige, Sebastian) [2] ; Willoughby, N (Willoughby, Nicholas) [1] ; Adeloye, A (Adeloye, Adebayo) [3] ; Gutierrez, T (Gutierrez, Tony) [4]
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Abstract

Improving the ecological status of water sources is a growing focus for many developed and developing nations, in particular with reducing nitrogen and phosphorus in wastewater effluent. In recent years, mixotrophic microalgae have received increased interest in implementing them as part of wastewater treatment. This is based on their ability to utilise organic and inorganic carbon, as well as inorganic nitrogen (N) and phosphorous (P) in wastewater for their growth, with the desired results of a reduction in the concentration of these substances in the water. The aim of this review is to provide a critical account of micro-algae as an important step in wastewater treatment for enhancing the reduction of N, P and the chemical oxygen demand (COD) in wastewater, whilst utilising a fraction of the energy demand of conventional biological treatment systems. Here, we begin with an overview of the various steps in the treatment process, followed by a review of the cellular and metabolic mechanisms that micro-algae use to reduce N, P and COD of wastewater with identification of when the process may potentially be most effective. We also describe the various abiotic and biotic factors influencingmicro-algae wastewater treatment, together with a review of bioreactor configuration and design. Furthermore, a detailed overview is provided of the current state-of-the-art in the use of micro-algae in wastewater treatment. (C) 2020 The Authors. Published by Elsevier B.V.

Keywords
Author Keywords
Micro-algaeWastewater treatmentPollutionOrganic wasteSewageBioremediationPhotobioreactors
Keywords Plus

Wastewater

ORGANIC-CARBON SUPPLEMENTATIONALGAL-BACTERIAL CONSORTIUMGREENHOUSE-GAS EMISSIONSNITROUS-OXIDE EMISSIONSHIGH-RATE PONDSNUTRIENT REMOVALCHLORELLA-VULGARISBIODIESEL PRODUCTIONBIOMASS PRODUCTIONTREATMENT-PLANT

Wastewater

3- Recent advances in polysaccharide-based adsorbents for wastewater treatment

By:
Qi, XL (Qi, Xiaoliang) [1] ; Tong, XQ (Tong, Xianqin) [2] , [3] ; Pan, WH (Pan, Wenhao) [2] , [3] ; Zeng, QK (Zeng, Qiankun) [2] ; You, SY (You, Shengye) [2] , [3] ; Shen, JL (Shen, Jianliang) [1] , [2] , [4]
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Abstract

The existence of toxic water contaminants (heavy metals, dyes, phenols, oils, pharmaceuticals and nutrients) restricts the sustainable supply of clean water globally. Among various economic and accessible wastewater disposal technologies, adsorption is the most extensively practiced approach due to its economic, feasible and sustainable characteristics. In recent years, polysaccharides have been extensively employed for constructing adsorption materials due to their intrinsic properties including high adsorptive ability, low cost, renewability, biodegradability, biocompatibility and ease of modification. Here, a systematic review of polysaccharide-based adsorbents for wastewater treatment is given. This review is aimed at providing: (1) general design principles for polysaccharide-based adsorbents, (2) some critical factors that may affect the adsorption and (3) future directions for the development of polysaccharide-based wastewater adsorbents. Overall, this review provides guidelines on the rational fabrication and application of polysaccharide-based adsorbents, which will be beneficial to novice/expert researchers in the field of wastewater remediation. Furthermore, the authors expect that this review provokes interdisciplinary discussions that would bring a revolution to the application of polysaccharide-based wastewater adsorbents.

Keywords
Author Keywords
PolysaccharidesAdsorptionWastewater treatmentAdsorbentsPollutants
Keywords Plus

Wastewater

HIGHLY EFFICIENT REMOVALADSORPTION CAPACITYMETHYLENE-BLUECOMPOSITE HYDROGELCELLULOSE HYDROGELCRYSTAL VIOLETHEAVY-METALSTOXIC DYESCHITOSANNANOCOMPOSITE

Wastewater

4- Critical review of advanced oxidation processes in organic wastewater treatment

By:
Ma, DS (Ma, Dengsheng) [1] , [2] ; Yi, H (Yi, Huan) [1] , [2] ; Lai, C (Lai, Cui) [1] , [2] ; Liu, XG (Liu, Xigui) [1] , [2] ; Huo, XQ (Huo, Xiuqin) [1] , [2] ; An, ZW (An, Ziwen) [1] , [2] ; Li, L (Li, Ling) [1] , [2] ; Fu, YK (Fu, Yukui) [1] , [2] ; Li, BS (Li, Bisheng) [1] , [2] ; Zhang, MM (Zhang, Mingming) [1] , [2] ;

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Abstract

With the development of industrial society, organic wastewater produced by industrial manufacturing has caused many environmental problems. The vast majority of organic pollutants in water bodies are persistent in the environment, posing a threat to human and animal health. Therefore, efficient treatment methods for highly concentrated organic wastewater are urgently needed. Advanced oxidation processes (AOPs) are widely noticed in the area of treating organic wastewater. Compared with other chemical methods, AOPs have the characteristics of high oxidation efficiency and no secondary pollution. In this paper, the mechanisms, advantages, and limitations of AOPs are comprehensively reviewed. Besides, the basic principles of combining different AOPs to enhance the treatment efficiency are described. Furthermore, the applications of AOPs in various wastewater treatments, such as oily wastewater, dyeing wastewater, pharmaceutical wastewater, and landfill leachate, are also presented. Finally, we conclude that the main direction in the future of AOPs are the modification of catalysts and the optimization of operating parameters, with the challenges focusing on industrial applications. (C) 2021 Published by Elsevier Ltd.

Keywords
Author Keywords
AOPsCombination of AOPsPrinciplesCharacteristicsOrganic wastewater treatment
Keywords Plus

Wastewater

WET AIR OXIDATIONLANDFILL LEACHATE TREATMENTFENTON-LIKE PROCESSIN-SITU GENERATIONPHOTO-FENTONAZO-DYEELECTROCHEMICAL OXIDATIONCATALYTIC OZONATIONELECTRO-FENTONAQUEOUS-SOLUTION

Wastewater

5- Application of coagulation/flocculation in oily wastewater treatment: A review

By:
Zhao, CL (Zhao, Chuanliang) [1] , [2] ; Zhou, JY (Zhou, Junyuan) [1] ; Yan, Y (Yan, Yi) [1] ; Yang, LW (Yang, Liwei) [1] ; Xing, GH (Xing, Guohua) [1] ; Li, HY (Li, Huanyu) [1] ; Wu, P (Wu, Pei) [1] ; Wang, MY (Wang, Mingyuan) [1] ; Zheng, HL (Zheng, Huaili) [3]

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Abstract

Volumes of oily wastewater are inevitably generated by every walk of life. The removal of oil particles from oil-contaminated wastewater which is characterized as huge amounts, intricate composition, and great threats to human health and the ecological environment is a research hotspot in water treatment fields. Due to high treatment costs and undesirable treatment efficiencies, oily wastewater treatment remains a topical and urgent issue. At present, coagulation/flocculation as an indispensable oily wastewater treatment technology receives much attention because it is very well established, economical, practical and relatively efficient. The influencing factors of oil wastewater treatment by coagulation/flocculation have also been summarized in-depth, like dosage, pH, etc. In consideration of its complex composition and treatment difficulty, this paper will also compare the treatment effects of different coagulants/flocculants used alone and combined effects in oily wastewater treatment: inorganic coagulants, organic synthetic polymeric flocculants, natural flocculants and modified polymeric flocculants. Additionally, in this review, the mechanisms of removing oily substance by coagulation/flocculation are emphasized. Given strict emission standards and the refractory nature of oily wastewater, the combination process with coagulation/flocculation, such as electrocoagulation, coagulation-membrane filtration hybrid process, and coagulation/flocculation-flotation can present better application potential and are discussed in this review. To provide a proper choice in practical application, the operating cost of coagulation and several conventional technologies are also compared. Finally, the existing challenges in the treatment of oily wastewater by coagulation are analyzed, and the feasible research direction is proposed.

Wastewater

Keywords
Author Keywords
Coagulants/flocculantsCoagulation mechanismDemulsificationCost estimationCombined technology

Wastewater

6- First confirmed detection of SARS-CoV-2 in untreated wastewater in Australia: A proof of concept for the wastewater surveillance of COVID-19 in the community

By:
Ahmed, W (Ahmed, Warish) [1] ; Angel, N (Angel, Nicola) [2] ; Edson, J (Edson, Janette) [2] ; Bibby, K (Bibby, Kyle) [3] ; Bivins, A (Bivins, Aaron) [3] ; O'Brien, JW (O'Brien, Jake W.) [4] ; Choi, PM (Choi, Phil M.) [4] ; Kitajima, M (Kitajima, Masaaki) [5] ; Simpson, SL (Simpson, Stuart L.) [6] ; Li, JY (Li, Jiaying) [4] ;
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Abstract

Infection with SARS-CoV-2, the etiologic agent of the ongoing COVID-19 pandemic, is accompanied by the shedding of the virus in stool. Therefore, the quantification of SARS-CoV-2 in wastewater affords the ability to monitor the prevalence of infections among the population via wastewater-based epidemiology (WBE). In the current work, SARS-CoV-2 RNA was concentrated from wastewater in a catchment in Australia and viral RNA copies were enumerated using reverse transcriptase quantitative polymerase chain reaction (RT-qPCR) resulting in two positive detections within a six day period from the same wastewater treatment plant (WWTP). The estimated viral RNA copy numbers observed in the wastewater were then used to estimate the number of infected individuals in the catchment via Monte Carlo simulation. Given the uncertainty and variation in the input parameters, the model estimated a median range of 171 to 1,090 infected persons in the catchment, which is in reasonable agreement with clinical observations. This work highlights the viability of WBE for monitoring infectious diseases, such as COVID-19, in communities. The work also draws attention to the need for further methodological and molecular assay validation for enveloped viruses in wastewater.

Keywords
Author Keywords
SARS-CoV-2COVID-19WBEWastewaterHuman health risksEnveloped viruses
Keywords Plus
HEPATITIS-A VIRUSSEWAGERISKFILTER

Wastewater

7- Removal of heavy metal ions from wastewater: a comprehensive and critical review

By:
Qasem, NAA (Qasem, Naef A. A.) [1] , [2] ; Mohammed, RH (Mohammed, Ramy H.) [3] ; Lawal, DU (Lawal, Dahiru U.) [2]
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Abstract

Removal of heavy metal ions from wastewater is of prime importance for a clean environment and human health. Different reported methods were devoted to heavy metal ions removal from various wastewater sources. These methods could be classified into adsorption-, membrane-, chemical-, electric-, and photocatalytic-based treatments. This paper comprehensively and critically reviews and discusses these methods in terms of used agents/adsorbents, removal efficiency, operating conditions, and the pros and cons of each method. Besides, the key findings of the previous studies reported in the literature are summarized. Generally, it is noticed that most of the recent studies have focused on adsorption techniques. The major obstacles of the adsorption methods are the ability to remove different ion types concurrently, high retention time, and cycling stability of adsorbents. Even though the chemical and membrane methods are practical, the large-volume sludge formation and post-treatment requirements are vital issues that need to be solved for chemical techniques. Fouling and scaling inhibition could lead to further improvement in membrane separation. However, pre-treatment and periodic cleaning of membranes incur additional costs. Electrical-based methods were also reported to be efficient; however, industrial-scale separation is needed in addition to tackling the issue of largevolume sludge formation. Electric- and photocatalytic-based methods are still less mature. More attention should be drawn to using real wastewaters rather than synthetic ones when investigating heavy metals removal. Future research studies should focus on ecofriendly, cost-effective, and sustainable materials and methods.

Keywords

Keywords Plus

Wastewater

HIGHLY EFFICIENT ADSORPTIONSURFACE FUNCTIONAL-GROUPSAQUEOUS-SOLUTIONCARBON NANOTUBESCOAGULATION-FLOCCULATIONELECTRODIALYSIS PROCESSORGANIC FRAMEWORKSACTIVATED CARBONCOPPER IONSCU II

Wastewater

8- Measurement of SARS-CoV-2 RNA in wastewater tracks community infection dynamics

By:
Peccia, J (Peccia, Jordan) [1] ; Zulli, A (Zulli, Alessandro) [1] ; Brackney, DE (Brackney, Doug E.) [2] ; Grubaugh, ND (Grubaugh, Nathan D.) [3] ; Kaplan, EH (Kaplan, Edward H.) [1] , [4] , [5] ; Casanovas-Massana, A (Casanovas-Massana, Arnau) [3] ; Ko, AI (Ko, Albert I.) [3] ; Malik, AA (Malik, Amyn A.) [6] , [7] ; Wang, D (Wang, Dennis) [6] ; Wang, MK (Wang, Mike) [6] ;
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Abstract
Testing sewage for the novel coronavirus reveals epidemiological trends.
We measured severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) RNA concentrations in primary sewage sludge in the New Haven, Connecticut, USA, metropolitan area during the Coronavirus Disease 2019 (COVID-19) outbreak in Spring 2020. SARS-CoV-2 RNA was detected throughout the more than 10-week study and, when adjusted for time lags, tracked the rise and fall of cases seen in SARS-CoV-2 clinical test results and local COVID-19 hospital admissions. Relative to these indicators, SARS-CoV-2 RNA concentrations in sludge were 0-2 d ahead of SARS-CoV-2 positive test results by date of specimen collection, 0-2 d ahead of the percentage of positive tests by date of specimen collection, 1-4 d ahead of local hospital admissions and 6-8 d ahead of SARS-CoV-2 positive test results by reporting date. Our data show the utility of viral RNA monitoring in municipal wastewater for SARS-CoV-2 infection surveillance at a population-wide level. In communities facing a delay between specimen collection and the reporting of test results, immediate wastewater results can provide considerable advance notice of infection dynamics.

Wastewater

9- Adsorption of emerging contaminants from water and wastewater by modified biochar: A review

By:
Cheng, N (Cheng, Ning) [1] ; Wang, B (Wang, Bing) [1] , [2] , [3] ; Wu, P (Wu, Pan) [1] , [2] , [3] ; Lee, XQ (Lee, Xinqing) [4] ; Xing, Y (Xing, Ying) [5] ; Chen, M (Chen, Miao) [1] , [2] , [3] ; Gao, B (Gao, Bin) [6]
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Abstract

Emerging contaminants (ECs), a group of relatively low-concentration but high-toxicity pollutants in the environment, have attracted widespread attention in recent years. These trace pollutants can be enriched in organisms and finally transferred to human bodies, posing a potential hazard to public health. Biochar, a low-cost and high-efficiency adsorbent, has been used to treat ECs in water. However, due to certain limitations of pristine biochar, such as poor adsorption capacity, narrow adsorption range, and other shortcomings, it is necessary to modify biochar to improve its applications in water treatment for ECs. Currently, there are a lot of reports on the removal of ECs from water by modified biochar. These studies explored different modification methods to functionalize biochar with various physicochemical properties, which resulted in distinct adsorption effects, behaviors and mechanisms of modified biochar on different ECs. There is a need to systematically review and digest the knowledge on the adsorption of ECs on modified biochar. In this review, recent biochar modification methods used in ECs removal are firstly summarized, and the adsorption performance and mechanisms of modified biochar on typical ECs are then systematically reviewed. Finally, the main research directions and trends, as well as recommendations and suggestions for future development are pointed out.

Keywords
Author Keywords
Modified biocharEmerging contaminantsAdsorption mechanismsModificatio

10- Converting nitrogen and phosphorus wastewater into bioenergy using microalgae-bacteria consortia: A critical review

By:
Zhang, CF (Zhang, Chaofan) [1] ; Li, SN (Li, Shengnan) [1] ; Ho, SH (Ho, Shih-Hsin) [1]
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Abstract

Conventional wastewater treatment using activated sludge cannot efficiently eliminate nitrogen and phosphorus, thus engendering the risk of water eutrophication and ecosystem disruption. Fortunately, a new wastewater treatment process applying microalgae-bacteria consortia has attracted considerable interests due to its excellent performance of nutrients removal. Moreover, some bacteria facilitate the harvest of microalgal biomass through bio-flocculation. Additionally, while stimulating the functional bacteria, the improved biomass and enriched components also brighten bioenergy production from the perspective of practical applications. Thus, this review first summarizes the current development of nutrients removal and mutualistic interaction using microalgaebacteria consortia. Then, advancements in bio-flocculation are completely described and the corresponding mechanisms are thoroughly revealed. Eventually, the recent advances of bioenergy production (i.e., biodiesel, biohydrogen, bioethanol, and bioelectricity) using microalgae-bacteria consortia are comprehensively discussed. Together, this review will provide the ongoing challenges and future developmental directions for better converting nitrogen and phosphorus wastewater into bioenergy using microalgae-bacteria consortia.

Keywords
Author Keywords
Advanced wastewater treatmentCell-to-cell communicationMicroalgae-bacteria interactionsMicroalgae biorefineryNutrients recovery
Keywords Plus

Wastewater

QUORUM SENSING MOLECULESBIOHYDROGEN PRODUCTIONCHLORELLA-VULGARISBIODIESEL PRODUCTIONBIOMASS PRODUCTIONACTIVATED-SLUDGEREMOVALFLOCCULATIONCULTIVATIONRECOVERY

Wastewater

11- Removal of pharmaceutical and personal care products (PPCPs) from wastewater using microalgae: A review

By:
Hena, S (Hena, Sufia) [1] ; Gutierrez, L (Gutierrez, Leonardo) [2] ; Croue, JP (Croue, Jean-Philippe) [3]
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Abstract

Pharmaceuticals and personal care products (PPCPs) are a group of emerging micro-pollutants causing detrimental effects on living organisms even at low doses. Previous investigations have confirmed the presence of PPCPs in the environment at hazardous levels, mainly due to the inefficiency of conventional wastewater treatment plants (CWWTPs). Their stable structure induces longer persistence in the environment. Microalgae are currently used to bioremediate numerous pollutants of different characteristics and properties released from the domestic, industrial, agricultural, and farm sectors. CO2 mitigation during culture and the use of biomass as feedstock for biodiesel or biofuel production are, briefly, other benefits of microalgae-mediated treatment over CWWTPs. This review provides a comprehensive summary of recent literature, an overview of approaches and treatment systems, and breakthrough in the field of algal-mediated removal of PPCPs in wastewater treatment processes. The mechanisms involved in phycoremediation, along with their experimental approaches, have been discussed in detail. Factors influencing the removal of PPCPs from aqueous media are comprehensively described and assessed. A comparative study on microalgal strains is analyzed for a more efficient implementation of future processes. The role of microalgae to mitigate the most severe environmental impacts of PPCPs and the generation of antibiotic-resistant bacteria is discussed. Also, a detailed assessment of recent research on potential toxic effects of PPCPs on microalgae was conducted. The current review highlights microalgae as a promising and sustainable approach to efficiently bio-transform or bio-adsorb PPCPs.

Keywords
Author Keywords

PPCPsMicroalgaeHybrid systemWastewaterEcological risk

Keywords Plus

ENDOCRINE DISRUPTING COMPOUNDSEMERGING ORGANIC CONTAMINANTS2 ANTIBIOTIC CONTAMINANTSFLOW CONSTRUCTED WETLANDALGA CHLORELLA-VULGARISFRESH-WATERMEMBRANE PHOTOBIOREACTORTREATMENT PLANTSAQUATIC ENVIRONMENTACTIVATED-SLUDGE

Wastewater

12- A review on conventional and novel materials towards heavy metal adsorption in wastewater treatment application

By:
Chai, WS (Chai, Wai Siong) [1] , [2] ; Cheun, JY (Cheun, Jie Ying) [2] ; Kumar, PS (Kumar, P. Senthil) [3] ; Mubashir, M (Mubashir, Muhammad) [4] ; Majeed, Z (Majeed, Zahid) [5] ; Banat, F (Banat, Fawzi) [6] ; Ho, SH (Ho, Shih-Hsin) [1] ; Show, PL (Show, Pau Loke) [2]
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Abstract

Wastewater treatment remains a critical issue globally till date despite various technological advancements and breakthroughs. Heavy metal in wastewater poses a great threat to human health if untreated properly, which makes its removal of utmost importance. Among various wastewater treatment techniques, adsorption is the most common technique to remove heavy metal in wastewater due to its flexible design, operation, and cost-effectiveness. Activated carbon being the most conventional adsorbent to remove heavy metal ion in wastewater owing to its microporous structure and ease of surface functionalization. However, the activated carbon separation from wastewater solution has been difficult and its high cost have prohibited its wide usage. Recently, the emergence of different novel materials has also showed their competitiveness in heavy metal ion removal. These promising novel materials exhibit several excellent attributes, for example large surface area, great mechanical strength, and high chemical inertness. This paper presents a brief review on the use, theory and future perspectives of conventional, as well as novel materials towards heavy metal adsorption in wastewater treatment application.

Keywords
Author Keywords
Wastewater treatmentHeavy metal removalAdsorptionConventional materialsNovel materials
Keywords Plus

Wastewater

AQUEOUS-SOLUTIONACTIVATED CARBONORGANIC FRAMEWORKSREMOVALBIOSORPTIONIONSPERFORMANCEGRAPHENECHROMIUM(VI)ADSORBENTS

13- SARS-CoV-2 RNA in wastewater anticipated COVID-19 occurrence in a low prevalence area

By:
Randazzo, W (Randazzo, Walter) [1] , [2] ; Truchado, P (Truchado, Pilar) [3] ; Cuevas-Ferrando, E (Cuevas-Ferrando, Enric) [2] ; Simon, P (Simon, Pedro) [4] ; Allende, A (Allende, Ana) [3] ; Sanchez, G (Sanchez, Gloria) [2]
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Abstract

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has caused more than 200,000 reported COVID-19 cases in Spain resulting in more than 20,800 deaths as of April 21, 2020. Faecal shedding of SARS-CoV-2 RNA from COVID-19 patients has extensively been reported. Therefore, we investigated the occurrence of SARS-CoV-2 RNA in six wastewater treatments plants (WWTPs) serving the major municipalities within the Region of Murcia (Spain), the area with the lowest COVID-19 prevalence within Iberian Peninsula. Firstly, an aluminum hydroxide adsorption-precipitation concentration method was validated using a porcine coronavirus (Porcine Epidemic Diarrhea Virus, PEDV) and mengovirus (MgV). The procedure resulted in average recoveries of 10 +/- 3.5% and 10 +/- 2.1% in influent water (n = 2) and 3.3 +/- 1.6% and 6.2 +/- 1.0% in effluent water (n = 2) samples for PEDV and MgV, respectively. Then, the method was used to monitor the occurrence of SARS-CoV-2 from March 12 to April 14, 2020 in influent, secondary and tertiary effluent water samples. By using the real-time RT-PCR (RT-qPCR) Diagnostic Panel validated by US CDC that targets three regions of the virus nucleocapsid (N) gene, we estimated quantification of SARS-CoV-2 RNA titers in untreated wastewater samples of 5.4 +/- 0.2 log(10) genomic copies/L on average. Two secondary water samples resulted positive (2 out of 18) and all tertiary water samples tested as negative (0 out 12). This environmental surveillance data were compared to declared COVID-19 cases at municipality level, revealing that members of the community were shedding SARS-CoV-2 RNA in their stool even before the first cases were reported by local or national authorities in many of the cities where wastewaters have been sampled. The detection of SARS-CoV-2 in wastewater in early stages of the spread of COVID-19 highlights the relevance of this strategy as an early indicator of the infection within a specific population. At this point, this environmental surveillance could be implemented

by municipalities right away as a tool, designed to help authorities to coordinate the exit strategy to gradually lift its coronavirus lockdown.

Keywords
Author Keywords
Environmental surveillanceInfluent waterReclaimed waterConcentration protocolRNA virusCoronavirus
Keywords Plus
ACUTE RESPIRATORY SYNDROMEHEPATITIS-A VIRUSCORONAVIRUSPCRQUANTIFICATIONINACTIVATIONOUTBREAKSEWAGE

Wastewater

14- The performance of electrode ultrafiltration membrane bioreactor in treating cosmetics wastewater and its anti-fouling properties

By:
Zhang, LH (Zhang, Lanhe) [1] ; Wang, L (Wang, Lu) [1] ; Zhang, YN (Zhang, Yuning) [1] ; Wang, D (Wang, Da) [1] ; Guo, JB (Guo, Jingbo) [2] ; Zhang, MS (Zhang, Mingshuang) [1] ; Li, YR (Li, Yiran) [1]

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Abstract

The membrane fouling problem of the membrane bioreactor (MBR) for wastewater treatment reduces the membrane flux and the pollutants removal efficiencies, which is the major obstacle limiting its application and should be properly solved. The combination of membrane and electricity can effectively slow down the mem-brane fouling rate due to electric repulsion between the pollutants and the membrane. In this study, the per-formance and the membrane fouling features of an electrode ultrafiltration membrane bioreactor (EMBR) fed with cosmetics wastewater were compared with a conventional ultrafiltration membrane bioreactor (UMBR). The results showed the COD removal efficiency increased by 4.43% and the transmembrane pressure (TMP) reduced by 50% in the EMBR as compared with the UMBR. The specific surface areas of electrode ultrafiltration membrane and conventional ultrafiltration membrane declined by 56.9% and 78.8% after 90 days of operation, respectively. The Protein (PN), polysaccharide (PS) and humic acids (HA) in the cake layer of EMBR were only 61.27%, 78.37% and 34.85% of that of UMBR, which contributed to its loose and porous structure and thus decreased the growth rate of TMP and extended the operation cycle. Extended Derja-guin-Landau-Verwey-Overbeek (XDLVO) theory calculation proved that the energy barrier between the elec-trode ultrafiltration membrane and the pollutants was 50% higher than that between the conventional ultrafiltration membrane and the pollutants. Therefore, the strong anti-fouling property of the electrode ultra-filtration membrane could reduce the chemicals dosage and manpower consumption for membrane cleaning and could be preferred for the treatment of cosmetics or alike wastewater containing high concentrations of sur-factants and fatty acids.

Wastewater

Keywords
Author Keywords
Membrane bioreactorMembrane foulingElectrode ultrafiltration membraneWastewater treatmentExtracellular polymeric substances
Keywords Plus
LINEAR ALKYLBENZENE SULFONATECOAGULATIONOPERATIONMICROFILTRATIONMITIGATIONREMOVALFLUXFLOWMBR

15- Recent developments in physical, biological, chemical, and hybrid treatment techniques for removing emerging contaminants from wastewater

By:
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Abstract

Emerging contaminants (ECs) in wastewater have recently attracted the attention of researchers as they pose significant risks to human health and wildlife. This paper presents the state-of-art technologies used to remove ECs from wastewater through a comprehensive review. It also highlights the challenges faced by existing EC removal technologies in wastewater treatment plants and provides future research directions. Many treatment technologies like biological, chemical, and physical approaches have been advanced for removing various ECs. However, currently, no individual technology can effectively remove ECs, whereas hybrid systems have often been found to be more efficient. A hybrid technique of ozonation accompanied by activated carbon was found significantly effective in removing some ECs, particularly pharmaceuticals and pesticides. Despite the lack of extensive research, nanotechnology may be a promising approach as nanomaterial incorporated technologies have shown potential in removing different contaminants from wastewater. Nevertheless, most existing technologies are highly energy and resource-intensive as well as costly to maintain and operate. Besides, most proposed advanced treatment technologies are yet to be evaluated for large-scale practicality. Complemented with techno-economic feasibility studies of the treatment techniques, comprehensive research and development are therefore necessary to achieve a full and effective removal of ECs by wastewater treatment plants.

Wastewater

Keywords
Author Keywords
Wastewater treatment techniquesPollutantsEffluentsActivated sludgeNanotechnology
Keywords Plus
ENDOCRINE-DISRUPTING CHEMICALSPERSONAL CARE PRODUCTSMEMBRANE BIOREACTOR-MICROFILTRATIONPHARMACEUTICALLY ACTIVE COMPOUNDSADVANCED OXIDATION PROCESSESTANDEM MASS-SPECTROMETRYMICROBIAL FUEL-CELLSPHOTOCATALYTIC DEGRADATIONRISK-ASSESSMENTFRESH-WATER

16- Study and evaluation of the characteristics of saline wastewater (brine) produced by desalination and industrial plants

By:
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Abstract

Desalination and industrial plants all around the world generate large amounts of saline wastewater (brine). The discharge of brine from facilities poses a severe environmental threat, while at the same time, the opportunity to recover resources is being lost as discharged brine is rich in valuable metals that could be recovered as salts/minerals. To this aim, this study presents and analyzes for the first time the characteristics of different brine effluents (from industries such as desalination, oil and gas production, petrochemical, aquaculture, pharmaceutical, textile) to prevent environmental pollution and to recover valuable resources (i.e., salts, minerals, metals, chemicals) enabling the concept of waste-to-resource (circular water economy model). The results revealed that the common salinity values in brine effluents range from 0.5 to 150 g/L, while the only exception is the produced water from the oil and gas industry (up to 400 g/L). Brine effluents from all sectors contain sodium, chloride, calcium, and potassium ions in high concentrations, while the production of common salts such as NaCl, CaCl2, and MgCl2 from brine can be economically profitable. Besides common ions, precious metals such as lithium, rubidium, and cesium are present in low concentrations (<25 mg/L); however, their extraction from brine effluents can be significantly profitable due to their very high sale price. The treatment and valorization of brine can be implemented by the hybridization of membrane-based, chemical, biological, and thermal-based technologies/processes in minimal and zero liquid discharge (MLD/ZLD) systems.

Wastewater

Keywords
Author Keywords
BrineDesalination brineIndustrial brineSaline wastewaterZero liquid discharge (ZLD)Minimal liquid discharge (MLD)
Keywords Plus: MEMBRANE BIOREACTORMANAGEMENTFLOWBACKIMPACTOIL

Wastewater

17- Per- and polyfluoroalkyl substances in water and wastewater: A critical review of their global occurrence and distribution

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Abstract

Per- and polyfluoroalkyl substances (PFAS) are a family of fluorinated organic compounds of anthropogenic origin. Due to their unique chemical properties, widespread production, environmental distribution, long-term persistence, bioaccumulative potential, and associated risks for human health, PFAS have been classified as persistent organic pollutants of significant concern. Scientific evidence from the last several decades suggests that their widespread occurrence in the environment correlates with adverse effects on human health and ecology. The presence of PFAS in the aquatic environment demonstrates a close link between the anthroposphere and the hydrological cycle, and concentrations of PFAS in surface and groundwater range in value along the ng L-1-mu g L-1 scale. Here, we critically reviewed the research published in the last decade on the global occurrence and distribution of PFAS in the aquatic environment. Ours is the first paper to critically evaluate the occurrence of PFAS at the continental scale and the evolving global regulatory responses to manage and mitigate the adverse human health risks posed by PFAS. The review reports that PFAS are widespread despite being phased out-they have been detected in different continents irrespective of the level of industrial development. Their occurrence far from the potential sources suggests that long-range atmospheric transport is an important pathway of PFAS distribution. Recently, several studies have investigated the health impacts of PFAS exposure-they have been detected in biota, drinking water, food, air, and human serum. In response to the emerging information about PFAS toxicity, several countries have provided administrative guidelines for PFAS in water, including Canada, the United Kingdom, Sweden, Norway, Germany, and Australia. In the US, additional regulatory measures are under consideration. Further, many PFAS have now been listed

as persistent organic pollutants. This comprehensive review provides crucial baseline information on the global occurrence, distribution, and regulatory framework of PFAS.

Keywords
Author Keywords
Perfluoroalkyl substancesPolyfluoroalkyl substancesPFASEnvironmental pollutionPFOSPFOA
Keywords Plus
PERFLUORINATED ALKYL SUBSTANCESPERFLUOROOCTANOIC ACID PFOAPERFLUOROALKYL SUBSTANCESDRINKING-WATERAQUATIC ENVIRONMENTSURFACE-WATERGREAT-LAKESSPATIAL-DISTRIBUTIONCARBOXYLIC-ACIDSPRODUCTION PLANT

18- Electrochemical advanced oxidation processes for wastewater treatment: Advances in formation and detection of reactive species and mechanisms

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Abstract

Over the past three decades, the knowledge of the mechanisms of electrochemical advanced oxidation processes (EAOPs) has progressively evolved with the advances in analytical and spectrometric techniques. A comprehensive understanding of the types and mechanisms of production of reactive species in EAOPs is a prerequisite to the understanding of their reactivities and elucidation of intermediate products generated during the oxidation process and degradation pathways. The type, nature, and quantity of reactive species generated in electrochemical treatment processes are controlled by many factors, including the type of the treatment technique, electrode/electrocatalyst materials, water/wastewater composition, water pH conditions, and operating parameters. Depending on the technique and operating parameters, single or multiple oxidants can be produced alone or combined electrochemical processes. However, the potency and reactivity of each oxidant are quite similar regardless of the technique, except in the case of heterogeneous and homogeneous hydroxyl radicals. This minireview presents the current state of mechanisms and models of reactive species generated in different EAOPs, highlighting different methods for their identification and reactivity.

Keywords
Author Keywords
Electrochemical oxidationReactive speciesMechanismDegradation kineticsMineralization
Keywords Plus

Wastewater

STOICHIOMETRIC TITANIUM-OXIDEHETEROGENEOUS ELECTRO-FENTONDOPED DIAMOND ELECTRODEACTIVATED PERSULFATEORGANIC POLLUTANTSCERAMIC ELECTRODEDEGRADATIONANODEEFFICIENCYPHOTOELECTROCATALYSIS

Wastewater

19- Biodegradable polymers and their nano-composites for the removal of endocrine-disrupting chemicals (EDCs) from wastewater: A review

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Abstract

Endocrine-disrupting chemicals (EDCs) target the endocrine system by interfering with the natural hormones in the body leading to adverse effects on human and animal health. These chemicals have been identified as major polluting agents in wastewater effluents. Pharmaceuticals, personal care products, industrial compounds, pesticides, dyes, and heavy metals are examples of substances that could be considered endocrine active chemicals. In humans, these chemicals could cause obesity, cancer, Alzheimer's disease, autism, reproductive abnormalities, and thyroid problems. While in wildlife, dysfunctional gene expression could lead to the feminization of some aquatic organisms, metabolic diseases, cardiovascular risk, and problems in the reproductive system as well as its levels of hatchability and vitellogenin. EDCs could be effectively removed from wastewater using advanced technologies such as reverse osmosis, membrane treatment, ozonation, advanced oxidation, filtration, and biodegradation. However, adsorption has been proposed as a more promising and sustainable method for water treatment than any other reported technique. Increased attention has been paid to biodegradable polymers and their nano-composites as promising adsorbents for the removal of EDCs from wastewater. These polymers could be either natural, synthetic, or a combination of both. This review presents a summary of the most relevant cases where natural and synthetic biodegradable polymers have been used for the successful removal of EDCs from wastewater. It demonstrates the effectiveness of these polymers as favorable adsorbents for novel wastewater treatment technologies. Hitherto, very limited work has

been published on the use of both natural and synthetic biodegradable polymers to remove EDCs from wastewater, as most of the studies focused on the utilization of only one type, either natural or synthetic. Therefore, this review could pave the way for future exploration of biodegradable polymers as promising and sustainable adsorbents for the removal of various types of pollutants from wastewater.

Keywords
Author Keywords
Wastewater treatmentEndocrine-disrupting chemicalsBiodegradable polymersAdsorption process
Keywords Plus
HEAVY-METAL IONSORGANIC FRAMEWORKS MOFSCELLULOSE-BASED WASTESLOW-COST ADSORBENTSAQUEOUS-SOLUTIONBISPHENOL-AMETHYLENE-BLUEEFFICIENT REMOVALHIGHLY EFFICIENTHYDROGEL NANOCOMPOSITES

Wastewater

20- Microalgae as a solution of third world energy crisis for biofuels production from wastewater toward carbon neutrality: An updated review

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Abstract

The boost of the greenhouse gases (GHGs, largely carbon dioxide - CO2) emissions owing to anthropogenic activity is one of the biggest global threats. Bio-CO2 emission reduction has received more and more attention as an environmentally sustainable approach. Microalgae are very popular in this regard because of excellent speed of growth, low costs of production, and resistance to extreme environments. Besides, most microalgae can undergo photosynthesis, where the CO2 and solar energy can be converted into sugar, and subsequently become biomass, providing a renewable and promising biofuel strategy with a few outstanding benefits. This review focuses on presenting CO2 sequestration by microalgae towards wastewater treatment and biodiesel production. First, the CO2 fixation mechanism by microalgae viz., sequestration and assimilation of CO2 in green microalgae as well as cyanobacteria were introduced. Besides, factors affecting CO2 sequestration in microalgae, containing microalgae species and cultivation conditions, such as light condition, photobioreactor, configuration, pH, CO2 concentration, temperature, and medium composition, were then comprehensively discussed. Special attention was given to the production of biodiesel as third-generation biofuel from various wastewater (CO2 biofixation), including processing steps of biodiesel production by microalgae, biodiesel production from wastewater, and improved methods. Furthermore, current life cycle assessment (LCA) and techno-economic analysis (TEA) used in biodiesel production were discussed. Finally, the research challenges and specific prospects were considered. Taken together, this review provides useful and updated information to facilitate the development of microalgal "green chemistry" and "environmental sustainability".

Wastewater

Keywords
Author Keywords
MicroalgaeCarbon concentrating mechanism (CCM)Carbon neutral biodieselWastewater bioremediationLife cycle assessment (LCA)CO2 capture and sequestration (CCS)
Keywords Plus
LIFE-CYCLE ASSESSMENTSCENEDESMUS-OBLIQUUSBIODIESEL PRODUCTIONBIOMASS PRODUCTIONCO2 SEQUESTRATIONCONCENTRATING MECHANISMBOTRYOCOCCUS-BRAUNIILIPID-ACCUMULATIONDIOXIDE FIXATIONGROWTH

Wastewater

21- Occurrence and fate of antibiotics, antibiotic resistant genes (ARGs) and antibiotic resistant bacteria (ARB) in municipal wastewater treatment plant: An overview

By:
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Abstract

The occurrence and fate of antibiotics and antibiotic resistant genes (ARGs) and antibiotic resistant bacteria (ARB) in Municipal Wastewater Treatment Plants (WWTPs) worldwide were reviewed. The prevalence of antibiotics in WWTPs among different periods (1999-2009 and 2010-2019) and geographical areas (Europe, America, Asia and Africa) was summarized, analyzed and evaluated. The classes of macrolides (clarithromycin, erythromycin/erythromycin-H2O, azithromycin, roxithromycin), sulfonamides (sulfamethoxazole), trimethoprim, quinolones (ofloxacin, ciprofloxacin, norfloxacin) and tetracyclines (tetracycline) were the antibiotics most frequently detected, while bla (bla(CTXM), bla(TEM)), sul (sul1, sul2), tet (tetO, tetQ, tetW) and ermB genes were the ARGs commonly reported in WWTPs. There was a positive correlation between antibiotics and ARGs commonly detected in WWTPs, except for beta-lactam antibiotics and bla genes. The genes bla were found frequently, despite beta-lactam antibiotics were seldom detected owing to the hydrolysis. Most of antibiotics had lower levels in the period 2010-2019 in Asian countries than that in period 1999-2009 in North American and European countries. In the effluent of secondary treatment, the concentration of trimethoprim was the highest (138 ng/L in median) and the concentration of other antibiotics remained at lower than 80 ng/L, while the relative abundance of ARGs ranged 2.9-4.6 logs (copies/mL, in median). Future researches on the development of effective antibiotic removal technologies, such as advanced oxidation processes, are suggested to focus on antibiotics frequently detected and their corresponding ARGs in WWTPs. (C) 2020 Elsevier B.V. All rights reserved.

Keywords
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Wastewater

Biological treatmentPharmaceuticalAntimicrobial resistanceOrganic pollutantsDisinfection

Keywords Plus

SEWAGE-TREATMENT PLANTSTANDEM MASS-SPECTROMETRYCARE PRODUCTS PPCPSFENTON-LIKE DEGRADATIONSOLID-PHASE EXTRACTIONTREATMENT SYSTEMSESCHERICHIA-COLIRISK-ASSESSMENTANTIMICROBIAL RESISTANCEPHARMACEUTICAL COMPOUNDS

Wastewater

22- Synthesis, characterization and application of Co/Co3O4 nanocomposites as an effective photocatalyst for discoloration of organic dye contaminants in wastewater and antibacterial properties

By:
Yousefi, SR (Yousefi, Seyede Raheleh) [1] ; Alshamsi, HA (Alshamsi, Hassan Abbas) [2] ; Amiri, O (Amiri, Omid) [3] ; Salavati-Niasari, M (Salavati-Niasari, Masoud) [1]
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Abstract

Contamination of surface water with dye chemical compounds and/or biological substances, even in small amounts, can affect the health of humans and other organisms. The photocatalytic oxidation process has been considered as a commercial technique to remove environmental pollutants. In the current study, we reported the synthesis of Co/Co3O4 nanocomposites investigated for their photocatalytic and antimicrobial activities. The affecting parameters (various surfactants and calcination) on the synthesis process were investigated. The synthesis of Co/Co3O4 nanocomposites was confirmed via methodical characterization such as SEM, FT-IR, XRD, VSM, EDX, CV and DRS investigations. Well diffusion assay and bacterial cell viability assay were executed against clinical pathogens to prepare the antibacterial activity of synthesized Co/Co3O4 nanocomposites. Also, the photocatalytic activity of nano-catalysts was concluded against the organic colors (acid blue 92 and acid red 151). Cobalt oxide nanoparticles (NPs) synthesized in the presence of SDBS as an anionic template showed the highest decolorization of 93% over acid red 151 after 120 min of illumination. The results showed a minimum bacterial inhibitory concentration for bacteria P. aeruginosa, and B. subtilis is about 31.25 mu g/mL and 125 mu g/mL, respectively. The Co/Co3O4 nanocomposites exhibited vigorous antibacterial activity against gram-negative microorganisms mentioned like Pseudomonas aeruginosa. (C) 2021 Elsevier B.V. All rights reserved.

Wastewater

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Antibacterial activityPhotocatalytic activityDye degradationMagnetic nanocomposites
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HYDROTHERMAL SYNTHESISNANOPARTICLESNANOCRYSTALSALCOHOL

Wastewater

23- Reproducibility and sensitivity of 36 methods to quantify the SARS-CoV-2 genetic signal in raw wastewater: findings from an interlaboratory methods evaluation in the US

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Abstract

In response to COVID-19, the international water community rapidly developed methods to quantify the SARS-CoV-2 genetic signal in untreated wastewater. Wastewater surveillance using such methods has the potential to complement clinical testing in assessing community health. This interlaboratory assessment evaluated the reproducibility and sensitivity of 36 standard operating procedures (SOPs), divided into eight method groups based on sample concentration approach and whether solids were removed. Two raw wastewater samples were collected in August 2020, amended with a matrix spike (betacoronavirus OC43), and distributed to 32 laboratories across the U.S. Replicate samples analyzed in accordance with the project's quality assurance plan showed high reproducibility across the 36 SOPs: 80% of the recovery-corrected results fell within a band of +/- 1.15 log(10) genome copies per L with higher reproducibility observed within a single SOP (standard deviation of 0.13 log(10)). The inclusion of a solids removal step and the selection of a concentration method did not show a clear, systematic impact on the recovery-corrected results. Other methodological variations (e.g., pasteurization, primer set selection, and use of RT-qPCR or RT-dPCR platforms) generally resulted in small differences compared to other sources of variability. These findings suggest that a variety of methods are capable of producing reproducible results,

though the same SOP or laboratory should be selected to track SARS-CoV-2 trends at a given facility. The methods showed a 7 log(10) range of recovery efficiency and limit of detection highlighting the importance of recovery correction and the need to consider method sensitivity when selecting methods for wastewater surveillance.

Keywords

Keywords Plus

INACTIVATION