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CONTACT US

subscribers@chemwatch.net
tel +61 3 9572 4700
fax +61 3 9572 4777

1227 Glen Huntly Rd
Glen Huntly
Victoria 3163 Australia

CHEMICAL EFFECTS

Enhancing bio-hydrogen and bio-methane production of concentrated latex wastewater (CLW) by Co-digesting with palm oil mill effluent (POME): Batch and continuous performance test and ADM-1 modeling

2023-09-21

This study aimed at investigating the biohydrogen and biomethane potential of co-digestion from palm oil mill effluent (POME) and concentrated latex wastewater (CLW) in a two-stage anaerobic digestion (AD) process under thermophilic (55 ± 3 °C) and at an ambient temperature (30 ± 3 °C) conditions, respectively. The batch experiments of POME:CLW mixing ratios of 100:0, 70:30, 50:50, 30:70, and 0:100 was investigated with the initial loadings at 10 g-VS/L. The highest hydrogen yield of 115.57 mLH2/g-VS was obtained from the POME: CLW mixing ratio of 100:0 with 29.0 of C/N ratio. While, the highest subsequent methane production yield of 558.01 mLCH4/g-VS was achieved from hydrogen effluent from POME:CLW mixing ratio of 70:30 0 with 21.8 of C/N ratio. This mixing ratio revealed the highest synergisms of about 9.21% and received maximum total energy of 19.70 kJ/g-VS. Additionally, continuous hydrogen and methane production were subsequently performed in a series of continuous stirred tank reactor (CSTR) and up-flow anaerobic sludge blanket reactor (UASB) to treat the co-substate. The results indicated that the highest hydrogen yield of POME:CLW mixing ratio at 70:30 of 95.45 mL-H2/g-VS was generated at 7-day HRT, while methane production was obtained from HRT 15 days with a yield of 204.52 mL-CH4/g-VS. Thus, the study indicated that biogas production yield of CLW could be enhanced by co-digesting with POME. In addition, the two-stage AD model under anaerobic digestion model no. 1 (ADM-1) framework was established, 9.10% and 2.43% of error fitting of hydrogen and methane gas between model simulation data and experimental data were found. Hence, this research work presents a novel approach for optimization and feasibility for co-digestion of POME with CLW to generate mixed gaseous biofuel potentially.

Authors: Marisa Raketh, Rusnee Kana, Prawit Kongjan, Syed Anuar Faua'ad Syed Muhammad, Sompong O-Thong, Chonticha Mamimin, Rattana Jariyaboon

Full Source: Journal of environmental management 2023 Sep 21;346:119031. doi: 10.1016/j.jenvman.2023.119031.

This study aimed at investigating the biohydrogen and biomethane potential of co-digestion from palm oil mill effluent (POME) and concentrated latex wastewater (CLW) in a two-stage anaerobic digestion (AD) process under thermophilic (55 ± 3 °C) and at an ambient temperature (30 ± 3 °C) conditions, respectively.

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Chemical recycling of plastic wastes with alkaline earth metal oxides: A review

2023-09-21

Plastics have been widely used in daily life and industries due to their low cost and high durability, leading to huge production of plastics and tens of millions of plastic wastes every year. Chemical recycling can recycle contaminated and degraded plastics (that mechanical recycling cannot deal with) to obtain value-added products, which potentially solve the environmental problems caused by plastics and realize a circular economy. Alkaline earth metal oxides, as a category of cost-effective and multi-functional materials, have been widely used in chemical recycling of common plastics, acting as three roles: catalyst, template, and absorbent. Among five commercial plastics, polyethylene terephthalate is suitable for pyrolysis and solvolysis. Polyethylene and polypropylene, which are ideal precursors for synthesis of carbon nanotubes, could be combined with biomass for co-pyrolysis. Polyvinyl chloride needs to be pretreated to reduce chloride content prior to pyrolysis. Depolymerization of polystyrene into monomers is attractive. This review summarized the chemical recycling approaches of commercial plastics and the strategies with alkali earth metal oxides for the development of efficient recycling processes. It will aid understanding of the advances and challenges in the field and promote the future research.

Authors: Shaoqin Chen, Yun Hang Hu

~sFull Source: The Science of the total environment 2023 Sep 21;167251. doi: 10.1016/j.scitotenv.2023.167251.

Plastics have been widely used in daily life and industries due to their low cost and high durability, leading to huge production of plastics and tens of millions of plastic wastes every year.

ENVIRONMENTAL RESEARCH

Detection, fate and transport of the biohazardous agent Toxoplasma gondii in soil water systems: Influence of soil physicochemical properties, water chemistry and surfactant

2023-09-22

A series of laboratory experiments were conducted to study the fate and transport of Toxoplasma gondii oocysts in soils as a function of soil physicochemical properties and soil water chemistry properties. Soil columns were homogeneously packed with loamy sand soils (Lewiston and Greenson series) and sandy loam soils (Sparta and Gilford series), and subject to hydrologic conditions characterized by the absence and presence of an anionic surfactant-Aerosol 22 in the artificial rainfall. Quantitative polymerase chain reaction (qPCR) was utilized for the

detection and enumeration of oocysts in soil leachates to evaluate their breakthrough and in soil matrices to examine their spatial distribution. Differences in the rate and extent of transport of oocysts were observed as a function of physical and chemical parameters tested. The breakthrough of oocysts was observed for all the soils irrespective of the presence of surfactant. However, in the absence of surfactant, the predominant fate of oocysts in soils subject to simulated rainfall was their retention in the soil profile. The presence of surfactant induced a change in the fate of oocysts in these soils exposed to rainfall simulation as the predominant fate of oocysts was found to be in the soil leachates.
Authors: Erin N Kinsey, Caroline Korte, Sohib Gouasmia, Coralie L'Ollivier, Jitender P Dubey, Aurélien Dumètre, Christophe J G Darnault
Full Source: Environmental microbiology reports 2023 Sep 22. doi: 10.1111/1758-2229.13204.

Estimating of gases emission from waste sites to generate electrical energy as a case study at Al-Hillah City in Iraq

2023-09-14
Methane (CH4) is a greenhouse gas resulting from human activities, especially landfills, and it has many potential environmental issues, such as its major role in global warming. On the other hand, methane can be converted to liquid fuel or electricity using chemical conversion or gas turbine generators. Therefore, reusing such gases could be of great environmental and economic benefit. In this context, this study aims to estimate the emissions of methane gas from the landfills in Al-Hillah City, Iraq, from 2023 to 2070 and the producible electric energy from this amount. The estimating process was carried out using the Land GEM model and compared with traditional models. The obtained results demonstrated that the total estimated landfill methane emissions for 48 years are 875,217 tons, and the average annual methane emission is 18,234 tons based on a yearly waste accumulation rate of 1,046,413 tons and a total waste amount of 50,227,808 tons. The anticipated loads of methane gas can be utilized to generate about 287,442 MW/year of electricity from 2023 to 2070. In conclusion, the results obtained from this study could be evidence of the potential environmental and economic benefits of harvesting and reusing methane gas from landfills.
Authors: Ali Chabuk, Udai A Jahad, Ali Majdi, Hasan S H Majdi, Mubeen Isam, Nadhir Al-Ansari, Jan Laue
Full Source: Scientific reports 2023 Sep 14;13(1):15193. doi: 10.1038/s41598-023-42335-3.

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PHARMACEUTICAL/TOXICOLOGY

Recent innovations in microplastics and nanoplastics removal by coagulation technique: Implementations, knowledge gaps and prospects

2023-09-10
Recently, microplastics (MPs) and nanoplastics (NPs) contamination is a worldwide problem owing to the immense usage of plastic commodities. Thus, the environmental risks by MPs and NPs demand the application of innovative, efficient, and sustainable technologies to control the pollution of plastic particles. Regarding this, numerous technologies, including adsorption, coagulation, filtration, bioremediation, chemical precipitation, and photocatalysis, have been engaged to eradicate MPs and NPs from contaminated waters. However, the coagulation technique is getting much attention owing to its simplicity, higher removal performance, low carbon footprint, and low operational and maintenance cost. Therefore, this paper has been designed to critically summarize the recent innovations on the application of coagulation process to eradicate MPs and NPs from both synthetic and real sewage. More importantly, the effect of pertinent factors, including characteristics of coagulants, MPs/NPs, and environmental medium on the elimination performances and mechanisms of MPs/NPs have been critically investigated. Further, the potential of coagulation technology in eliminating MPs and NPs from real sewage has been critically elucidated for the first time, for better execution of this technique at commercial levels. Finally, this critical review also presents current research gaps and future outlooks for the improvement of coagulation process for eradicating MPs and NPs from water and real sewage. Overall, the current review will offer valuable knowledge to scientists in selecting a suitable technique for controlling plastic pollution.
Authors: Imran Ali, Xiao Tan, Yue Xie, Changsheng Peng, Juying Li, Iffat Naz, Zhipeng Duan, Peng Wan, Jiang Huang, Jia Liang, Zhu Rui, Yinlan Ruan
Full Source: Water research 2023 Sep 10;245:120617. doi: 10.1016/j.watres.2023.120617.

Recently, microplastics (MPs) and nanoplastics (NPs) contamination is a worldwide problem owing to the immense usage of plastic commodities.

US drinking water quality: exposure risk profiles for seven legacy and emerging contaminants

2023-09-22
Background: Advances in drinking water infrastructure and treatment throughout the 20th and early 21st century dramatically improved water reliability and quality in the United States (US) and other parts

of the world. However, numerous chemical contaminants from a range of anthropogenic and natural sources continue to pose chronic health concerns, even in countries with established drinking water regulations, such as the US.
Objective/methods: In this review, we summarize exposure risk profiles and health effects for seven legacy and emerging drinking water contaminants or contaminant groups: arsenic, disinfection by-products, fracking-related substances, lead, nitrate, per- and polyfluorinated alkyl substances (PFAS) and uranium. We begin with an overview of US public water systems, and US and global drinking water regulation. We end with a summary of cross-cutting challenges that burden US drinking water systems: aging and deteriorated water infrastructure, vulnerabilities for children in school and childcare facilities, climate change, disparities in access to safe and reliable drinking water, uneven enforcement of drinking water standards, inadequate health assessments, large numbers of chemicals within a class, a preponderance of small water systems, and issues facing US Indigenous communities.
Results: Research and data on US drinking water contamination show that exposure profiles, health risks, and water quality reliability issues vary widely across populations, geographically and by contaminant. Factors include water source, local and regional features, aging water infrastructure, industrial or commercial activities, and social determinants. Understanding the risk profiles of different drinking water contaminants is necessary for anticipating local and general problems, ascertaining the state of drinking water resources, and developing mitigation strategies.
Impact statement: Drinking water contamination is widespread, even in the US. Exposure risk profiles vary by contaminant. Understanding the risk profiles of different drinking water contaminants is necessary for anticipating local and general public health problems, ascertaining the state of drinking water resources, and developing mitigation strategies.
Authors: Ronnie Levin, Cristina M Villanueva, Daniel Beene, Angie L Cradock, Carolina Donat-Vargas, Johnnye Lewis, Irene Martinez-Morata, Darya Minovi, Anne E Nigra, Erik D Olson, Laurel A Schaider, Mary H Ward, Nicole C Deziel
Full Source: Journal of exposure science & environmental epidemiology 2023 Sep 22. doi: 10.1038/s41370-023-00597-z.

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Europium(III) as luminescence probe for interactions of a sulfate-reducing microorganism with potentially toxic metals

2023-09-14
Microorganisms show a high affinity for trivalent actinides and lanthanides, which play an important role in the safe disposal of high-level radioactive waste as well as in the mining of various rare earth elements. The interaction of the lanthanide Eu(III) with the sulfate-reducing microorganism Desulfosporosinus hippei DSM 8344T, a representative of the genus Desulfosporosinus that naturally occurs in clay rock and bentonite, was investigated. Eu(III) is often used as a non-radioactive analogue for the trivalent actinides Pu(III), Am(III), and Cm(III), which contribute to a major part of the radiotoxicity of the nuclear waste. D. hippei DSM 8344T showed a weak interaction with Eu(III), most likely due to a complexation with lactate in artificial Opalinus Clay pore water. Hence, a low removal of the lanthanide from the supernatant was observed. Scanning transmission electron microscopy coupled with energy-dispersive X-ray spectroscopy revealed a bioprecipitation of Eu(III) with phosphates potentially excreted from the cells. This demonstrates that the ongoing interaction mechanisms are more complex than a simple biosorption process. The bioprecipitation was also verified by luminescence spectroscopy, which showed that the formation of the Eu(III) phosphate compounds starts almost immediately after the addition of the cells. Moreover, chemical microscopy provided information on the local distribution of the different Eu(III) species in the formed cell aggregates. These results provide first insights into the interaction mechanisms of Eu(III) with sulfate-reducing bacteria and contribute to a comprehensive safety concept for a high-level radioactive waste repository, as well as to a better understanding of the fate of heavy metals (especially rare earth elements) in the environment.
Authors: Stephan Hilpmann, Henry Moll, Björn Drobot, Manja Vogel, René Hübner, Thorsten Stumpf, Andrea Cherkouk
Full Source: Ecotoxicology and environmental safety 2023 Sep 14;264:115474. doi: 10.1016/j.ecoenv.2023.115474.

Microorganisms show a high affinity for trivalent actinides and lanthanides, which play an important role in the safe disposal of high-level radioactive waste as well as in the mining of various rare earth elements.

OCCUPATIONAL

Removal of an agricultural herbicide (2,4-Dichlorophenoxyacetic acid) using magnetic nanocomposite: A combined experimental and modeling studies

2023-09-14

This study focused on modeling the removal of one of the widely used agricultural herbicides known as 2,4-Dichlorophenoxyacetic acid (2,4-D) using polypyrrole-coated Fe2O3 nanoparticles (Fe2O3@PPy). The Fe2O3@PPy nanocomposite was synthesized by surface-coating the Tabebuia aurea leaf extract synthesized Fe2O3 nanoparticles with polypyrrole. After characterization, the adsorptive potential of the nanocomposite for removing 2,4-D from aqueous solution was examined. Central composite design (CCD) was employed for optimizing the adsorption, revealing an adsorption efficiency of 90.65% at a 2,4-D concentration of 12 ppm, a dosage of 3.8 g/L, an agitation speed of 150 rpm, and 196 min. Adsorption dataset fitted satisfactorily to Langmuir isotherm (R2: 0.984 & χ2: 0.054) and pseudo-second-order kinetics (R2: 0.929 & χ2: 0.013) whereas the exothermic and spontaneous nature were confirmed via the thermodynamic study. The predictive models, including adaptive neuro-fuzzy inference system (ANFIS), artificial neural network (ANN), and response surface methodology (RSM), demonstrated good precision for the prediction of 2,4-D adsorption, with respective R2 of 0.9719, 0.9604, and 0.9528. Nevertheless, statistical analysis supported ANFIS as the better forecasting tool, while RSM was the least effective. The maximum adsorption capacity of 2,4-D onto the Fe2O3@PPy nanocomposite was 7.29 mg/g, significantly higher than a few reported values. Therefore, the Fe2O3@PPy nanocomposite could serve as a competent adsorbent to remove 2,4-D herbicide from aqueous streams.

Authors: Sridevi H, Ramananda Bhat M, Raja Selvaraj

Full Source: Environmental research 2023 Sep 14;238(Pt 1):117124. doi: 10.1016/j.envres.2023.117124.

This study focused on modeling the removal of one of the widely used agricultural herbicides known as 2,4-Dichlorophenoxyacetic acid (2,4-D) using polypyrrole-coated Fe2O3 nanoparticles (Fe2O3@PPy).

Nanoparticles and nanofiltration for wastewater treatment: From polluted to fresh water

2023-09-14

Water pollution poses significant threats to both ecosystems and human health. Mitigating this issue requires effective treatment of domestic wastewater to convert waste into bio-fertilizers and gas. Neglecting

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liquid waste treatment carries severe consequences for health and the environment. This review focuses on intelligent technologies for water and wastewater treatment, targeting waterborne diseases. It covers pollution prevention and purification methods, including hydrotherapy, membrane filtration, mechanical filters, reverse osmosis, ion exchange, and copper-zinc cleaning. The article also highlights domestic purification, field techniques, heavy metal removal, and emerging technologies like nanochips, graphene, nanofiltration, atmospheric water generation, and wastewater treatment plants (WWTPs)-based cleaning. Emphasizing water cleaning's significance for ecosystem protection and human health, the review discusses pollution challenges and explores the integration of wastewater treatment, coagulant processes, and nanoparticle utilization in management. It advocates collaborative efforts and innovative research for freshwater preservation and pollution mitigation. Innovative biological systems, combined with filtration, disinfection, and membranes, can elevate recovery rates by up to 90%, surpassing individual primary (<10%) or biological methods (≤50%). Advanced treatment methods can achieve up to 95% water recovery, exceeding UN goals for clean water and sanitation (Goal 6). This progress aligns with climate action objectives and safeguards vital water-rich habitats (Goal 13). The future holds promise with advanced purification techniques enhancing water quality and availability, underscoring the need for responsible water conservation and management for a sustainable future.

Authors: Tomy Muringayil Joseph, Hussein E Al-Hazmi, Bogna Śniatała, Amin Esmaeili, Sajjad Habibzadeh

Full Source: Environmental research 2023 Sep 14;238(Pt 1):117114. doi: 10.1016/j.envres.2023.117114.

Few studies are available on associations between metal mixture exposures and disrupted thyroid hormone homeostasis; particularly, the role of iodine status was ignored.

Associations of metal mixtures with thyroid function and potential interactions with iodine status: results from a cross-sectional study in MEWHC

2023-09-16

Few studies are available on associations between metal mixture exposures and disrupted thyroid hormone homeostasis; particularly, the role of iodine status was ignored. Here, we aimed to explore the cross-sectional relationship of blood cell metals with thyroid homeostasis and explore the potential modifying effect of iodine status. Among 328 workers from the manganese-exposed workers healthy cohort (MEWHC), we detected thyroid function parameters: thyroid stimulating hormone (TSH), total triiodothyronine (TT3), free triiodothyronine (FT3), total tetraiodothyronine (TT4), free tetraiodothyronine (FT4) as well as

calculated sum activity of peripheral deiodinases (GD) and thyroid's secretory capacity (GT). Inductively coupled plasma mass spectrometry (ICP-MS) was used to measure 22 metal concentrations in blood cells. Based on the consistent results of least absolute shrinkage and selection operator (LASSO) and Bayesian kernel machine regression (BKMR) analyses, there were significant positive associations between copper and TSH (β = 2.016), iron and FT4 (β = 0.403), titanium and GD (β = 0.142), nickel and GD (β = 0.057), and negative associations between copper and FT4 (β = - 0.226), selenium and GD (β = - 0.332), among the participants. Interestingly, we observed an inverted-U shape relationship between magnesium and FT4. Furthermore, we found a synergistic effect between arsenic and copper on the TSH level, while antagonistic effects between nickel and copper as well as nickel and selenium on the TSH level. We observed a modified effect of iodine status on association between strontium and GD (Pinteraction = 0.026). It suggests metal mixture exposures can alter thyroid homeostasis among the occupational population, and deiodinase activity had a modified effect on association between strontium and GD. Validation of these associations and elucidation of underlying mechanisms require further researches in the future.

Authors: Xiaoting Ge, Junxiu He, Sencai Lin, Yu Bao, Yuan Zheng, Hong Cheng, Haiqing Cai, Xiuming Feng, Wenjun Yang, Sihan Hu, Lin Wang, Qijing Liao, Fei Wang, Cahoqun Liu, Xing Chen, Yunfeng Zou, Xiaobo Yang

Full Source: Environmental science and pollution research international 2023 Sep 16. doi: 10.1007/s11356-023-29682-4.