Adsorption

1- Adsorption-based atmospheric water harvesting

By:
Ejeian, M (Ejeian, M.) [1] ; Wang, RZ (Wang, R. Z.) [1]
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Abstract

Atmospheric water harvesting (AWH) is a promising solution to the world's water shortage. Meanwhile, adsorption-based atmospheric water harvesting (ABAWH) has shown a higher ability to supply water in arid areas using clean and cheap energy. Numerous modern adsorbents for this application have been introduced so far, and many prototypes have been provided. However, there is still a long way to go for widespread and practical use of this technology. Dedicated designs, operating strategies, environmental compatibility, and energy supply are issues that still need further consideration. This article has tried to summarize what has been achieved so far in ABAWH, analyze the challenges ahead, and provide solutions to continue the path.

Keywords
Keywords Plus
METAL-ORGANIC FRAMEWORKSCOMPOSITE DESICCANT MATERIALHUMID AIRDROPWISE CONDENSATIONAMBIENT HUMIDITYPOTABLE WATERMOIST AIRDESALINATIONSYSTEMENERGY

Adsorption

2- Adsorption kinetic models: Physical meanings, applications, and solving methods

By:
Wang, JL (Wang, Jianlong) [1] , [2] ; Guo, X (Guo, Xuan) [1]
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Abstract

Adsorption technology has been widely applied in water and wastewater treatment, due to its low cost and high efficiency. The adsorption kinetic models have been used to evaluate the performance of the adsorbent and to investigate the adsorption mass transfer mechanisms. However, the physical meanings and the solving methods of the kinetic models have not been well established. The proper interpretation of the physical meanings and the standard solving methods for the adsorption kinetic models are very important for the applications of the kinetic models. This paper mainly focused on the physical meanings, applications, as well as the solving methods of 16 adsorption kinetic models. Firstly, the mathematical derivations, physical meanings and applications of the adsorption reaction models, the empirical models, the diffusion models, and the models for adsorption onto active sites were analyzed and discussed in detail. Secondly, the model validity evaluation equations were summarized based on literature. Thirdly, a convenient user interface (UI) for solving the kinetic models was developed based on Excel software and provided in supplementary information, which is helpful for readers to simulate the adsorption kinetic process.

Keywords
Author Keywords
AdsorptionKinetic modelPhysical meaningSolving method
Keywords Plus
SURFACE-DIFFUSION MODELAQUEOUS-SOLUTIONACTIVATED CARBONMASS-TRANSFERWASTE-WATERLANGMUIR KINETICSHEAVY-METALSPHOSPHATE ADSORPTIONNONLINEAR-REGRESSIONELOVICH EQUATION

Adsorption

3- Current scenario and challenges in adsorption for water treatment

By:
Dotto, GL (Dotto, Guilherme L.) [1] ; McKay, G (McKay, Gordon) [2]
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Abstract

In this opinion paper, the current scenario and the main challenges in adsorption for water treatment are presented shortly. It is expected that this discussion paper will serve as a fast literature directive to support new ideas and novel investigations in the field. A general background about the topic is first presented. Subsequently, some important aspects that are well developed in literature are discussed, including adsorbent materials, adsorption operation mode, modeling, regeneration, and process operation with real samples. In the last section, it has been pointed out what should likely be the next steps required to advance in this knowledge.

Keywords
Author Keywords
adsorbent materialsadsorptionmodelingprocesseswater treatment
Keywords Plus
INORGANIC HYBRID SORBENTPERSONAL CARE PRODUCTSEQUILIBRIA. WRONG USEFIXED-BED ADSORPTIONLOW-COST ADSORBENTSVANT HOOF EQUATIONURBAN WASTE-WATERREACTIVE RED 141AQUEOUS-SOLUTIONACTIVATED CARBON

Adsorption

4- Adsorption isotherm models: Classification, physical meaning, application and solving method

By:
Wang, JL (Wang, Jianlong) [1] , [2] ; Guo, X (Guo, Xuan) [1]
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Abstract

Adsorption is widely applied separation process, especially in environmental remediation, due to its low cost and high efficiency. Adsorption isotherm models can provide mechanism information of the adsorption process, which is important for the design of adsorption system. However, the classification, physical meaning, application and solving method of the isotherms have not been systematical analyzed and summarized. In this paper, the adsorption isotherms were classified into adsorption empirical isotherms, isotherms based on Polanyi's theory, chemical adsorption isotherms, physical adsorption isotherms, and the ion exchange model. The derivation and physical meaning of the isotherm models were discussed in detail. In addition, the application of the isotherm models were analyzed and summarized based on over 200 adsorption equilibrium data in literature. The statistical parameters for evaluating the fitness of the models were also discussed. Finally, a user interface (UI) was developed based on Excel software for solving the isotherm models, which was provided in supplemental material and can be easily used to model the adsorption equilibrium data. This paper will provide theoretical basis and guiding methodology for the selection and use of the adsorption isotherms.

Keywords

Author Keywords

Adsorption

AdsorptionIsotherm modelsPhysical meaningSolving methodUser interface

Keywords Plus

IMMOBILIZED SACCHAROMYCES-CEREVISIAEMETAL IONIC CHARACTERISTICSAQUEOUS-SOLUTIONWASTE-WATERHEAVY-METALSDUBININ-RADUSHKEVICHDYE ADSORPTIONTHERMODYNAMIC PARAMETERSPOTENTIAL BIOSORBENTEFFICIENT ADSORBENT

Adsorption

5- Guidelines for the use and interpretation of adsorption isotherm models: A review

By:
Al-Ghouti, MA (Al-Ghouti, Mohammad A.) [1] ; Da'ana, DA (Da'ana, Dana A.) [1]
View Web of Science ResearcherID and ORCID
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Abstract

Adsorption process is considered as one of the most used separation and purification processes, in which adsorption occurs by the formation of the physical or chemical bonds between a porous solid medium and a mixture of liquid or gas multi-component fluid. By taking into consideration the equilibrium data and the adsorption properties of both the adsorbent and the adsorbate, adsorption isotherm models can describe the interaction mechanisms between the adsorbent and the adsorbate at constant temperature. Therefore, understanding modelling of the equilibrium data is a very essential way of predicting the adsorption mechanisms of various adsorption systems. Furthermore, adsorption isotherms in batch experiments can be used for the determination of the solid-water distribution coefficient (K-id). This review paper discusses the guidelines of using mono/multi-parametric isotherm models with different applications. The aim of this paper is to establish criteria for choosing the optimum isotherm model through a critical review of different adsorption models and the use of various mathematically error functions such as linear regression analysis, nonlinear regression analysis, and error functions for adsorption data optimization. In this paper, 15 mono-parametric adsorption isotherm models having one, two, three, four and five parameters were investigated. In addition, 10 multi-parameter isotherm models were reviewed as well as addressing their applications.

Keywords
Author Keywords

Adsorption

Adsorption isotherm modelsAdsorption isotherm interpretationAdsorption mechanismsLinear and nonlinear isotherm models

Keywords Plus

DETERMINING SURFACE-AREASZINC(II) METAL-IONSBAGASSE FLY-ASHCOEFFICIENT K-DACTIVATED CARBONAQUEOUS-SOLUTIONSHEAVY-METALSEQUILIBRIUM ISOTHERMMETHYLENE-BLUEPHYSICAL ADSORPTION

Adsorption

6- 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.

Adsorption

Keywords
Author Keywords
Modified biocharEmerging contaminantsAdsorption mechanismsModification

Adsorption

7- Interfacial adsorption-insertion mechanism induced by phase boundary toward better aqueous Zn-ion battery

By:
Shan, LT (Shan, Lutong) [1] ; Wang, YR (Wang, Yiren) [1] ; Liang, SQ (Liang, Shuquan) [1] ; Tang, BY (Tang, Boya) [2] ; Yang, YQ (Yang, Yongqiang) [1] ; Wang, ZQ (Wang, Ziqing) [1] ; Lu, BA (Lu, Bingan) [3] ; Zhou, J (Zhou, Jiang) [1]
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Abstract

Biphasic and multiphasic compounds have been well clarified to achieve extraordinary electrochemical properties as advanced energy storage materials. Yet the role of phase boundaries in improving the performance is remained to be illustrated. Herein, we reported the biphasic vanadate, that is, Na1.2V3O8/K2V6O16 center dot 1.5H(2)O (designated as Na0.5K0.5VO), and detected the novel interfacial adsorption-insertion mechanism induced by phase boundaries. First-principles calculations indicated that large amount of Zn2+ and H+ ions would be absorbed by the phase boundaries and most of them would insert into the host structure, which not only promote the specific capacity, but also effectively reduce diffusion energy barrier toward faster reaction kinetics. Driven by this advanced interfacial adsorption-insertion mechanism, the aqueous Zn/Na0.5K0.5VO is able to perform excellent rate capability as well as long-term cycling performance. A stable capacity of 267 mA h g(-1) after 800 cycles at 5 A g(-1) can be achieved. The discovery of this mechanism is beneficial to understand the

performance enhancement mechanism of biphasic and multiphasic compounds as well as pave pathway for the strategic design of high-performance energy storage materials.

Keywords
Author Keywords
aqueous zinc-ion batterycathodeenergy storage mechanismphase boundaryvanadium-based materials
Keywords Plus
ENERGY-STORAGEHIGH-CAPACITYCATHODEINTERCALATIONPERFORMANCE

Adsorption

8- A critical review on VOCs adsorption by different porous materials: Species, mechanisms and modification methods

By:
Zhu, LL (Zhu, Lingli) [1] ; Shen, DK (Shen, Dekui) [1] ; Luo, KH (Luo, Kai Hong) [2]

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Abstract

Volatile organic compounds (VOCs) have attracted world-wide attention regarding their serious hazards on ecological environment and human health. Industrial processes such as fossil fuel combustion, petrochemicals, painting, coatings, pesticides, plastics, contributed to the large proportion of anthropogenic VOCs emission. Destructive methods (catalysis oxidation and biofiltration) and recovery methods (absorption, adsorption, condensation and membrane separation) have been developed for VOCs removal. Adsorption is established as one of the most promising strategies for VOCs abatement thanks to its characteristics of cost-effectiveness, simplicity and low energy consumption. The prominent progress in VOCs adsorption by different kinds of porous materials (such as carbon-based materials, oxygen-contained materials, organic polymers and composites is carefully summarized in this work, concerning the mechanism of adsorbate-adsorbent interactions, modification methods for the mentioned porous materials, and enhancement of VOCs adsorption capacity. This overview is to provide a comprehensive understanding of VOCs adsorption mechanisms and up-to-date progress of modification technologies for different porous materials.

Keywords
Author Keywords
VOCs treatmentPorous materialsAdsorption mechanismModification
Keywords Plus
VOLATILE ORGANIC-COMPOUNDSACTIVATED CARBON-FIBERHYPERCROSSLINKED POLYMERIC ADSORBENTSHELL-BASED CARBONCOAL FLY-ASHOF-THE-ARTTOLUENE ADSORPTIONMESOPOROUS SILICAENHANCED ADSORPTIONMETHANE ADSORPTION

Adsorption

Adsorption

9- 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
AQUEOUS-SOLUTIONACTIVATED CARBONORGANIC FRAMEWORKSREMOVALBIOSORPTIONIONSPERFORMANCEGRAPHENECHROMIUM(VI)ADSORBENTS

Adsorption

10- A review of metal organic framework (MOFs)-based materials for antibiotics removal via adsorption and photocatalysis

By:
Du, CY (Du, Chunyan) [1] , [2] ; Zhang, Z (Zhang, Zhuo) [1] ; Yu, GL (Yu, Guanlong) [1] , [2] ; Wu, HP (Wu, Haipeng) [1] , [2] ; Chen, H (Chen, Hong) [1] , [2] ; Zhou, L (Zhou, Lu) [1] , [2] ; Zhang, Y (Zhang, Yin) [1] ; Su, YH (Su, Yihai) [1] ; Tan, SY (Tan, Shiyang) [1] ; Yang, L (Yang, Lu) [1] ; ...More
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Abstract

Antibiotic abuse has led to serious water pollution and severe harm to human health; therefore, there is an urgent need for antibiotic removal from water sources. Adsorption and photodegradation are two ideal water treatment methods because they are cheap, simple to operate, and reusable. Metal organic frameworks (MOFs) are excellent adsorbents and photocatalysts because of their high porosity, adaptability, and good crystal form. The aim of this study is to suggest ways to overcome the limitations of adsorption and photocatalysis treatment methods by reviewing previous applications of MOFs to antibiotic adsorption and photocatalysis. The different factors influencing these processes are also discussed, as well as the various adsorption and photocatalysis mechanisms. This study provides a valuable resource for researchers intending to use MOFs to remove antibiotics from water bodies. (C) 2021 Elsevier Ltd. All rights reserved.

Keywords
Author Keywords
AbsorbentAntibioticsMetal organic frameworks (MOFs)Photodegradation
Keywords Plus

Adsorption

ADVANCED OXIDATION PROCESSESPH-RESPONSIVE RELEASEONE-STEP SYNTHESISEFFICIENT REMOVALFLUOROQUINOLONE ANTIBIOTICSNITROIMIDAZOLE ANTIBIOTICSMIL-101(FE)/TIO2 COMPOSITERECYCLABLE ADSORBENTNANOPOROUS CARBONAQUEOUS-SOLUTION

Adsorption

11- High efficiency removal of heavy metals using tire-derived activated carbon vs commercial activated carbon: Insights into the adsorption mechanisms

By:
Shahrokhi-Shahraki, R (Shahrokhi-Shahraki, Rahim) [1] ; Benally, C (Benally, Chelsea) [2] ; El-Din, MG (El-Din, Mohamed Gamal) [2] ; Park, J (Park, Junboum) [1]
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Abstract

In this study, activated carbon was derived from pulverized waste tires using carbonization and chemical activation techniques. Single and competitive batch adsorption experiments for the removal of three synthetic heavy metal ions (Pb2+' Cu2+ and Zn2+) from an aqueous solution were performed to benchmark the efficiency of the Tire-derived Activated Carbon (TAC) in comparison to that of commercial activated carbon (CAC), which was used as the reference material. The sorbents physicochemical properties with corresponding adsorption mechanisms were evaluated by different experimental techniques. TAC exhibited great potential to adsorb heavy metals, with monolayer adsorption capacities as high as 322.5, 185.2, and 71.9 mg g(-1) for Pb2+, Cu2+ and Zn2+, respectively, which were significantly higher than the adsorption capacities exhibited by CAC, which were 42.5, 15.0, and 14.0 mg.g(-1) for Pb2+, Cu2+ and Zn2+, respectively. Competitive adsorption results demonstrated the adsorption ability of sorbents is restricted by presence of other ions, and was decreased compared to the single sorption. Sorption kinetics data, with better fit to the pseudo-second order kinetics model, revealed that TAC had faster sorption rate in comparison to CAC. The adsorption capacities of TAC and CAC were reduced to half of their initial capacities after three successive adsorption-desorption cycles. Zeta potential, FT-IR, and XPS analyses revealed that electrostatic attraction and surface complexation mechanisms, as two metal-

adsorbing mechanisms, were more influential for TAC. For CAC, a higher cation exchange capacity (CEC) value indicated that the removal of heavy metals by ion exchange was the predominant mechanism.

Keywords
Author Keywords
TACCACAdsorptionDesorptionHeavy metals
Keywords Plus
AQUEOUS-SOLUTIONSCOMPETITIVE ADSORPTIONTYRE PYROLYSISWASTEBIOCHARIONSOPTIMIZATIONPERFORMANCESORPTIONCADMIUM

Adsorption

12- Facile ball-milling synthesis of CeO2/g-C3N4 Z-scheme heterojunction for synergistic adsorption and photodegradation of methylene blue: Characteristics, kinetics, models, and mechanisms

By:
Wei, XQ (Wei, Xiaoqian) [1] , [2] ; Wang, X (Wang, Xin) [1] ; Pu, Y (Pu, Yu) [1] ; Liu, AN (Liu, Annai) [1] ; Chen, C (Chen, Chong) [1] ; Zou, WX (Zou, Weixin) [1] ; Zheng, YL (Zheng, Yulin) [2] ; Huang, JS (Huang, Jinsheng) [2] ; Zhang, Y (Zhang, Yue) [2] ; Yang, YC (Yang, Yicheng) [2] ; ...More
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Abstract

As a green solvent-free process, ball milling has attracted considerable attention in fabricating nanocomposites. Herein, we synthesized novel Z-scheme heterojunction CeO2/g-C3N4 nanocomposites by simply direct ball milling CeO2 and g-C3N4 at three different mass ratios (3:7, 7:3, and 9:1). In comparison to individual CeO2 and g-C3N4, the ball-milled nanocomposites showed stronger UV light response, higher charge carrier separation efficiency, greater photodegradation potential, higher photocurrent intensity, and faster electron transfer, indicating much better photocatalytic activity. When used as photocatalysts to remove methylene blue (MB) under UV light irradiation, 70% CeO2/g-C3N4 exhibited the highest removal rate (90.1%), much better than that of CeO2 (6.2%) or g-C3N4 (45.7%). The synergistic interact between adsorption and photodegradation of the CeO2/g-C3N4 nanocomposites was simulated by kinetic models, and a strong positive correlation (r = 0.834 and r(s) = 0.777) between

adsorption and photocatalysis was identified. The results indicate that adsorption can promote photodegradation by accelerating the kinetics, while photodegradation can regenerate adsorption sites. This work provides not only a facile synthesis of Z-scheme heterojunction photocatalysts but also a novel perspective for better understanding the synergy between adsorption and photocatalysis.

Keywords

Author Keywords
Ball milling synthesisZ-scheme heterojunctionCeO2/g-C3N4Adsorption-photocatalytic degradationSynergistic interaction
Keywords Plus
PHOTOCATALYTIC ACTIVITYWASTE-WATERDEGRADATIONREDUCTIONG-C3N4PERFORMANCECOMPOSITESPOLLUTANTSOXIDEDYE

Adsorption

13- Adsorption of congo red and methylene blue dyes on an ashitaba waste and a walnut shell -based activated carbon from aqueous solutions: Experiments, characterization and physical interpretations

By:
Li, ZC (Li, Zichao) [1] ; Hanafy, H (Hanafy, Hassan) [2] , [3] ; Zhang, L (Zhang, Lei) [1] , [4] ; Sellaoui, L (Sellaoui, Lotfi) [4] ; Netto, MS (Netto, Matias Schadeck) [5] ; Oliveira, MLS (Oliveira, Marcos L. S.) [6] , [7] ; Seliem, MK (Seliem, Moaaz K.) [8] ; Dotto, GL (Dotto, Guilherme Luiz) [5] ; Bonilla-Petriciolet, A (Bonilla-Petriciolet, Adrian) [9] ; Li, Q (Li, Qun) [1]
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Abstract

Activated carbons were prepared from ashitaba waste and a walnut shell to study the adsorption mechanism of congo red and methylene blue dyes in aqueous solution. These adsorbents were characterized via XRD, FTIR and SEM techniques and the dye adsorption isotherms at three temperatures were quantified. A statistical physics model was applied to interpret the adsorption mechanism of tested dyes and adsorbents. Modeling results showed that these dyes were practically separated in the solution leading to an absence of the aggregation process. Adsorption orientations of dye molecules on the adsorbents changed depending on the temperature and nature of systems. The adsorption capacity of ashitaba waste activated carbon for the removal of congo red was significant thus indicating strong interactions between this dye and tested adsorbent. Calculated adsorption energy varied from 7.25 to 20.43 kJ/mol and they showed that the adsorption of both adsorbates occurred via physical interactions at different temperatures where the removal process was endothermic.

Keywords
Author Keywords
Ashitaba wasteWalnut shellMethylene blueCongo redPhysical modelingActivated carbon
Keywords Plus

Adsorption

CHEMICAL-PROPERTIESREMOVALMECHANISMREGENERATIONKINETICSBIOMASSOPTIMIZATIONEQUILIBRIUMISOTHERMSIBUPROFEN