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Content Highlights

DOI:10.3390/app12031231

The Role of Plant Growth-Promoting Rhizobacteria (PGPR) in Mitigating Plant's Environmental Stresses

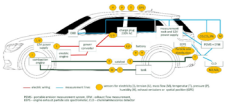
Authors: Marco Vocciante, Martina Grifoni, Danilo Fusini, Gianniantonio Petruzzelli and Elisabetta Franchi

Abstract: Phytoremediation is a cost-effective and sustainable technology used to clean up pollutants from soils and waters through the use of plant species. Indeed, plants are naturally capable of absorbing metals and degrading organic molecules. However, in several cases, the presence of contaminants causes plant suffering and limited growth. In such situations, thanks to the production of specific root exudates, plants can engage the most suitable bacteria able to support their growth according to the particular environmental stress. These plant growth-promoting rhizobacteria (PGPR) may facilitate plant growth and development with several beneficial effects, even more evident when plants are grown in critical environmental conditions, such as the presence of toxic contaminants. For instance, PGPR may alleviate metal phytotoxicity by altering metal bioavailability in soil and increasing metal translocation within the plant. Since many of the PGPR are also hydrocarbon oxidizers, they are also able to support and enhance plant biodegradation activity. Besides, PGPR in agriculture can be an excellent support to counter the devastating effects of abiotic stress, such as excessive salinity and drought, replacing expensive inorganic fertilizers that hurt the environment. A better and in-depth understanding of the function and interactions of plants and associated microorganisms directly in the matrix of interest, especially in the presence of persistent contamination, could provide new opportunities for phytoremediation.

DOI:10.3390/app12031404

Investigating Particulate and Nitrogen Oxides Emissions of a Plug-In Hybrid Electric Vehicle for a Real-World Driving Scenario

Authors: Mario Feinauer, Simone Ehrenberger, Fabius Epple, Tobias Schripp and Tobias Grein



Abstract: Plug-in hybrid electric vehicles (PHEVs) show a high pollutant emission variability that strongly depends on the operating conditions of the internal combustion engine. Additionally, studies indicate that driving situations outside of the real driving emissions boundary conditions can lead to substantial pollutant emission increases. The objective of this study is to measure and analyze the particulate number (PN) and nitrogen oxides (NO_x) emissions of a Euro 6 PHEV for a selected real-world driving test route in the Stuttgart metropolitan area. For this purpose, the vehicle is set out with multiple measurement devices to monitor vehicle internal and external parameters. Particle distribution results show an overall uniform pattern, which allows a comparative analysis of the different test scenarios on the basis of the PN concentration. While the trip-average PN emissions are in good agreement, transient effects during highway driving can substantially increase emissions, whereas the fuel consumption does not necessarily increase in such situations. PN measurements including ultrafine particles (UFP) show a significant increase in urban emissions due to higher cold start emission peaks. Additionally, low ambient temperatures raise the uncertainty of NOx and PN cold start emissions. With regard to future emission regulations, which claim that vehicles need to be as clean as possible in all driving situations, PHEV emission investigations for further situations outside of the current legislations are required.

DOI:10.3390/app12062922

Removal of Emerging Contaminants as Diclofenac and Caffeine Using Activated Carbon Obtained from Argan Fruit Shells

Authors: Badr Bouhcain, Daniela Carrillo-Peña, Fouad El Mansouri, Yassine Ez Zoubi, Raúl Mateos, Antonio Morán, José María Quiroga and Mohammed Hassani Zerrouk

Abstract: Activated carbons from argan nutshells were prepared by chemical activation using phosphoric acid H_3PO_4. This material was characterized by thermogravimetric analysis, infrared spectrometry, and the Brunauer–Emmett–Teller method. The adsorption of two emerging compounds, a stimulant caffeine and an anti-inflammatory drug diclofenac, from distilled water through batch and dynamic tests was investigated. Batch mode experiments were conducted to assess the capacity of adsorption of caffeine and diclofenac from an aqueous solution using the carbon above. Adsorption tests showed that the equilibrium time is 60 and 90 min for diclofenac and caffeine, respectively. The adsorption of diclofenac and caffeine on activated carbon from argan nutshells is described by a pseudo-second-order kinetic model. The highest adsorption capacity determined by the mathematical model of Langmuir is about 126 mg/g for diclofenac and 210 mg/g for caffeine. The thermodynamic parameters attached to the studied absorbent/adsorbate system indicate that the adsorption process is spontaneous and exothermic for diclofenac and endothermic for caffeine.

DOI:10.3390/app12031198

Fertilization and Soil Microbial Community: A Review

Authors: Lucian Constantin Dincă, Paola Grenni, Cristian Onet and Aurelia Onet

Abstract: The present paper reviews the most recent advances regarding the effects of chemical and organic fertilizers on soil microbial communities. Based on the results from the articles considered, some details are presented on how the use of various types of fertilizers affects the composition and activity of soil microbial communities. Soil microbes have different responses to fertilization based on differences in the total carbon (C), nitrogen (N) and phosphorus (P) contents in the soil, along with soil moisture and the presence of plant species. These articles show that the use of chemical fertilizers changes the abundance of microbial populations and stimulates their growth thanks to the nutrient supply added. Overall, however, the data revealed that chemical fertilizers have no significant influence on the richness and diversity of the bacteria and fungi. Instead, the abundance of individual bacterial or fungal species was sensitive to fertilization and was mainly attributed to the changes in the soil chemical properties induced by chemical or organic fertilization. Among the negative effects of chemical fertilization, the decrease in enzymatic activity has been highlighted by several papers, especially in soils that have received the largest amounts of fertilizers together with losses in organic matter.

DOI:10.3390/app12052618

A Comparative Study of Different Sorbents in the Context of Direct Air Capture (DAC): Evaluation of Key Performance Indicators and Comparisons

Authors: Grazia Leonzio, Paul S. Fennell and Nilay Shah

Abstract: Direct air capture can be based on an adsorption system, and the used sorbent (chemisorbents or physisorbents) influences process. In this work, two amine-functionalized sorbents, as chemisorbents, and three different metal organic frameworks, as physisorbents, are considered and compared in terms of some key performance indicators. This was carried out by developing a mathematical model describing the adsorption and desorption stages. An independent analysis was carried out in order to verify data reported in the literature. Results show that the equilibrium loading is a critical parameter for adsorption capacity, energy consumption, and cost. The considered metal organic frameworks are characterized by a lower equilibrium loading (10^{-4} mol/kg) compared to chemisorbents (10^{-1} mol/kg). For this reason, physisorbents have higher overall energy consumptions and costs, while capturing a lower amount of carbon dioxide. A reasonable agreement is found on the basis of the operating conditions of the Climeworks company, modelling the use of the same amine cellulose-based sorbent. The same order of magnitude is found for total costs (751 USD/tonneCO2 for our analysis, compared to the value of 600 USD/tonneCO_2 proposed by this company).

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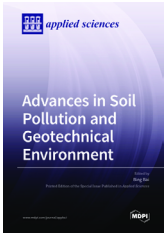

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