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Research Article **Published Date:- 2023-10-17**

Non-variant phenomena in heterogeneous systems. New type of solubility diagrams points

The article gives a general classification of non-invariant points in phase equilibrium diagrams of all possible types. The complete topological isomorphism of the diagrams of fusibility, solubility, and liquid-vapor equilibria in various sets of variables is demonstrated. The stability of mono-variant equilibria near the non-variant points is investigated. Recurrent formulas for calculating the number of topological elements of phase diagrams are given. A previously undescribed type of non-invariant points and phase processes in the solubility diagrams is described and characterized. The last ones have no topological analogs in other types of diagrams. Thus, we have carried out, as far as is available to the authors, a complete classification of invariant points and invariant processes in phase equilibrium diagrams of an arbitrary type and with an arbitrary number of components.

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Qualitative Identification of Secondary Metabolites and Determination of the Toxicity of Extracts Obtained from the Flower of Kalanchoe Pinnata

Kalanchoe pinnata, also known as air leaf or life leaf, is a plant used in traditional medicine in different world regions. In Mexico, it is included in the Atlas de la Medicina Tradicional Mexicana with a wide variety of applications, such as antimicrobial, anti-inflammatory, anticancer, and antihistamine, among others. However, neither a secondary metabolite profile of the flower has been reported nor information on its possible toxicity. The latter is the purpose of this work. A phytochemical profile of extracts with solvents of different polarity (aqueous, methanol, ethanol, and ether) was carried out. In this profile, the structural compounds could be qualitatively determined by chemical reactions, and some changes in coloring or precipitation were observed. The acute toxicity test of the extracts was performed with an aquatic organism, Artemia sp, and a terrestrial organism Eisenia foetida, as well as the evaluation of the antioxidant capacity of the extracts in the organism of Eisenia foetida. The ABTS radical method and TROLOX were applied as synthetic antioxidants for the evaluation of the inhibition percentage. Most important secondary metabolites were qualitatively identified in the extracts of K. pinnata flowers. Mainly in the alcoholic extracts (methanol and ethanol) tannins, alkaloids, and flavonols were found. As mentioned above, they are reported to have toxicological effects. The toxicity and antioxidant activity tests confirm the preliminary results obtained in the identification of secondary metabolites. It is therefore concluded that the flower of Kalanchoe pinnata contains secondary metabolites that may be of great therapeutic interest.

Research Article **Published Date:- 2023-08-28**

Neural Network Calculator of Rubber Characteristics with Improved Properties

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A new technique for the use of Artificial Neural Networks (ANN) for the generalization and visual presentation of the results of experimental studies is proposed. The possibility of using ANN for cases for which their use was previously considered impossible is shown. ANN calculators have been created that summarize the results of experimental studies on the effect of trans-polynorbornene and basalt fiber on the characteristics of a rubber compound based on general-purpose rubbers (isoprene SKI-3, butadiene-methylstyrene SKMS-30ARK and butadiene SKD), which also contained vulcanizing agents (N, N?-dithiodimorpholine, thiuram D), vulcanization accelerators (sulfenamide C, 2-mercapto-benzothiazole), vulcanization activators (zinc white, stearic acid), emollients (industrial oil I-12A, rosin) and antioxidants (acetonanil H, diaphene FP). The rubber mixture was prepared on laboratory rollers LB 320 160/160. Subsequently, the rubber mixture was vulcanized in a P-V-100-3RT-2-PCD press. For the resulting vulcanizates, the physical and mechanical properties and their changes were determined after daily exposure to air and in a standard SZhR-1 hydrocarbon liquid at a temperature of 100 °C. We also studied the change in the mass of vulcanizates after exposure to industrial oil I-20A and water. The dynamic parameters (modulus of elasticity and mechanical loss tangent) of vulcanizates, which characterize their noise and vibration-absorbing properties, were studied on a Metravib VHF 104 dynamic mechanical analyzer. The created ANN calculators allow solving a direct problem - interpolating the dependences of all rubber characteristics on the content of basalt fiber, as well as solving inverse problems - to determine the required content of basalt fiber to create rubber with the required performance properties. The autonomous executable modules of the calculators developed by ANN were made and can be passed to everyone.

Research Article **Published Date:- 2023-07-19**

Water Purification Using Ceramic Pots Water Filter

In this study, ceramic pot filters are made from clay and burn-out materials (sawdust) that give pore sizes capable of capturing contaminants. Manufacturing specifications were selected to achieve some results. Clay and sawdust are mixed in a 50% volume ratio each and sawdust was subjected to hot water extraction to give a treated sample. Filters produced comprised of untreated, treated, and a mixture of treated and untreated sawdust samples, some of which were dipped in a solution of silver nanoparticles while others were not dipped (treated undipped, treated dipped, mixed dipped, mixed undipped, untreated undipped, untreated dipped). The effectiveness of the produced filters for the removal of contaminants such as dissolved solids, turbidity, and metals was tested using water collected from the Ikeji Arakeji River in Osun, Nigeria. The results showed the filter with treated sawdust undipped in a solution of silver nano gave the best result in the removal of the contaminants. Also, the filter with the mixtures of treated and untreated sawdust gave a better result compared to the standard. While the standard gave a better result than the untreated undipped ceramic filter pot. In conclusion, with proper cleaning and maintenance of the filters, they can effectively provide treated water suitable for drinking to rural people affected by polluted water sources.

Research Article **Published Date:- 2023-06-20**

Buffer Solutions of known Ionic Strength

pH buffer solutions are those in which minimal pH variations occur when moderate amounts of strong acids or bases are added or diluted. The most common buffers are those used in the intermediate pH zone and are made up of an acid-base conjugate pair (HA/A-), with Ca and Cb as analytical concentrations of acid and base respectively. The buffer capacity of a solution is the measure of its effectiveness in preserving the pH value when adding an acid or a base. Three new programs working under the Windows 10 environment have been developed. The first one, the BUFFER program, allows to prepare buffers of known ionic strength without the need of adding an inert electrolyte, calculating the pH and buffering capacity. On the other hand, the BRÖMSTED method allows calculating the pH of conjugated acid-base systems applying the Newton-Raphson method. In this work two more programs are described, one applying the Brömsted method to monoprotic acids and another new one to diprotic acids.

Mini Review **Published Date:- 2023-04-17**

Nuclear science and magnetic carbon: a promising way from a chemical method to detect and fight cancer and tumors/neoplasms

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In 2005 we reported for the first time on a chemical route aiming to synthesize stable magnetic carbon/graphite. By using the Nuclear Magnetic Resonance (NMR) technique we have verified that its magnetism is an intrinsic property of this synthesized material and not originated from ferromagnetic impurities of any kind. Through direct measurement of the local magnetic field using Carbon-13, we have concluded that its magnetism originated from defects in the structure. From its biocompatibility, we have been working on the use of magnetic carbon/graphite to deliver many compounds aiming to fight different diseases. Despite all the scientific and technological advances of the present day, cancer is a multifactorial and difficult-to-treat disease, killing hundreds of thousands of people a year worldwide. Therefore, the development of a new and efficient drug delivery system to fight cancer – among other diseases - is as important as the discovery of a novel active molecule. In this review of our own work, we show the drug delivery system named MAGUS® (an acronym for Magnetic Graphite Universal System) we have built based on nanostructured magnetic carbon/graphite. This is an innovative and promising system composed of a biocompatible nanostructured particle of magnetic carbon/graphite functionalized with different molecules and materials. MAGUS®, depending on what we link to its structure, is so versatile and can be used to detect a wide range of specimens, from tumors and cancers to chemical and biological agents used as non-conventional weapons. That is why we call it universal. In the present work, MAGUS® will be acting as a biosensor, where the magnetic carbon/graphite is functionalized with radioactive particles of Iodine-131 and antibodies of different types of cancer. Then, by focusing on both the antigen-antibody interaction and the spatial guiding through an external magnetic field we are providing our drug delivery system a double way to detect and reach just the target. Based on these strategies, the functionalized magnetic carbon/graphite will reach only the neoplasm and not the surrounding healthy cells around. In a general view, it means that we are giving specificity to the MAGUS® drug delivery system as a pioneering and effective way to detect and treat cancers. We are also working on this unprecedented and efficient drug delivery system using the principles of Boron Neutron Capture Therapy (BNCT) with Boron-10 instead of Iodine-131. BNCT technique uses neutrons as the external source and is frequently employed to treat specific tumors that are radio resistant or very difficult to kill using conventional radiation therapy. In summary, we show here for the first time that our Magnetic Graphite Universal System associated with nuclear techniques can be successfully used as a biosensor to detect and fight cancers and tumors with powerful features that conventional delivery drug systems and other treatments do not have at all.

Research Article **Published Date:- 2023-03-15**

Natural color performance from nine species origins of lowland wood wastes

In the past, natural pigments derived from plant-biomass wastes had been widely used for coloring purposes (e.g. fabrics/batik), before finally getting pushed aside by the imported synthetic/inorganic pigments. Thorough attempts to revive the use of such natural pigments then deserve carrying out. Relevantly, conducting storage of liquid/wet or dry natural coloring pigments, extracted from wood wastes; and use of fixatives for batik fabrics intended to impart fabric-color variations. Wood wastes (i.e. leaves and barks) were obtained from nine plant species (Acacia mangium Willd, Avicenia marina L, Caesalpinia sappan L, Ceriop tagal Perr. CB. Rob, Pelthophorum ferruginum Benth, Rhyzophora mucronata Lamk, Tectona grandis Linn.f., Terminalia catappa L and Xylocarpus granatum KD Koenig.), prevalently growing on plain/lowland areas; and their wood portions commonly utilized by wood industries, which generate similar wastes enormously. The pigments in liquid/wet and then in dry forms were produced from those wastes. The production process of pigments adopted traditions by local batik crafters in Bogor. Variations occurring in fabric colors could be due to fixatives, i.e. lime ($CaCO_3$), ferrous sulphate/tunjung ($FeSO_4$); and various wastes. Six-month storage insignificantly changed the coloring qualities of natural coloring pigments applied to fabrics, compared to those of corresponding initially produced pigments. Leaf wastes always contained green-colored compounds, while bark wastes appeared aptly brownish in color. Color performances of bark extracts at fabrics with ferro-sulfat fixative brought about strong grey colors, and with lime fixative produced brown colors. Coloring of fabrics using leaf waste extracts with ferro-sulfat fixative aptly exhibited greenish grey; while with lime fixative became reddish brown. Testing results on the leaching resistance of pigment-colored and fixative-treated fabrics against rubbing and exposure to sunlight revealed a very good category (4-5), but against detergent, washing was very low (2-3).

Review Article **Published Date:- 2023-03-14**

Importance of the radiations in water splitting for hydrogen generation

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The review article examines the production of molecular hydrogen from the decomposition of water by various irradiation methods. The article shows different types of radiation: UV radiation, visible radiation, gamma radiation, X-ray radiation and neutron radiation. Electrons generated by radiation inside a nanoparticle of radius R suspense in fluid water are diffused with equal probability in all directions inside the particle and gradually lose their kinetic energy as a result of elastic and inelastic collisions. Some of these electrons are transported to the nanoparticle surface during the physical and physicochemical stages of the process and emitted into the water. It is extremely important for the formation of nanostructured materials after exposure to ordered nanostructure from the new phase with a period of a few nanometers, promoting the preservation of the properties of materials under high irradiation.

Research Article **Published Date:- 2023-02-14**

Surface energy of micro- and nanowire

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Review Article **Published Date:- 2023-01-31**

Eco-friendly microplastic removal through physical and chemical techniques: a review

A growing number of synthetic plastics derived from fossil fuels are produced, and improper plastic waste management has caused a lot of pollution problems. There are many microplastics in the environment, and they disintegrate slowly in soil and water. The properties of microplastics (MPs) include long residence times, high stability, high fragmentation potential, and the ability to adsorb other contaminants. Invertebrates and planktonic organisms are easily able to accumulate microplastics in aquatic species. Therefore, microplastics (MPs) must be removed from the water and other media. This paper aims to review the occurrence, raw polymers and additives, and remediation methods for removing microplastics from the environment. Several methods are available for removing contaminants, including sorption, filtration and chemical treatments. Various removal methods are discussed along with their methods, efficiency and advantages.

Research Article **Published Date:- 2023-01-05**

Rapid determination of PCDDs, PCDFs and DL-PCBs in foods, feeding stuffs and vegetable oils using new modified acid silica

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Polychlorinated dibenzo-p-dioxins, dibenzofurans and dioxin-like polychlorinated biphenyls are persistent organic pollutants (POPs), which in recent years received huge attention due to their extreme stability, high potential toxicity and bioaccumulation in food chains. The main source of human exposure to these compounds is discovered in foods of animal origin, especially foods rich in fat. The target of the present study was to set up an analytical method for the determination of PCDDs/PCDFs and DL-PCB in vegetable oils, sunflower meals, sunflower seeds, rapeseeds and milk powder. The first step consisted of a semi-automatic Soxhlet extraction for 3 hours, by using a mixture of Hexane: Acetone – 80:20, followed by acid digestion with 55% acid silica and filtration. After concentration, the extract is purified on a multilayer column (silica gel, silica-KOH, silica-H_2SO_4 anhydrous Na_2SO_4) followed by an alumina column separation in two fractions (first fraction containing PCDDs/PCDFs and second containing only PCBs). The purified extract was then analyzed by GC/MS/MS. The newly developed approach in our lab was capable to reduce the overall time of sample preparation to seven hours/ per sample. Since the method shows good mean recoveries for all labeled congeners spiked in the samples (for PCDDs/PCDFs – 80% - 110%, for DL-PCBs – 70% - 85%), we assumed the absence of overestimation or underestimation in the analyzed samples.