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ingeniería y diseño industrial

NOTICIAS DE INVESTIGACIÓN

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NÚMERO 5 SEPTIEMBRE –OCTUBRE DE 2018

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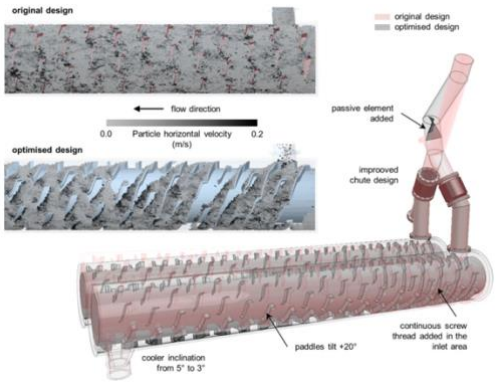
Este boletín informativo electrónico de periodicidad bimestral tiene como objetivo informar de las actividades de investigación desarrolladas en la ETS de Ingeniería y Diseño Industrial y recopilar los resúmenes de los artículos publicados en la Web of Science (WoS) de los que son autores o coautores investigadores de la Escuela.

PUBLICACIONES.

Analysis and Optimization of Material Flow inside the System of Rotary Coolers and Intake Pipeline via Discrete Element Method Modelling.



There is hardly any industry that does not use transport, storage, and processing of particulate solids in its production process. In the past, all device designs were based on empirical relationships or the designer's experience. In the field of particulate solids, however, the discrete element method (DEM) has been increasingly used in recent years. This study shows how this simulation tool can be used in practice. More specifically, in dealing with operating problems with a rotary cooler which ensures the transport and cooling of the hot fly ash generated by combustion in fluidized bed boilers. For the given operating conditions, an analysis of the current cooling design was carried out, consisting of a non-standard intake pipeline, which divides and supplies the material to two rotary coolers. The study revealed shortcomings in both the pipeline design and the cooler design. The material was unevenly dispensed between the two coolers, which combined with the limited transport capacity of the coolers, led to overflowing and congestion of the whole system. Therefore, after visualization of the material flow and export of the necessary data using DEM design measures to mitigate these unwanted phenomena were carried out.

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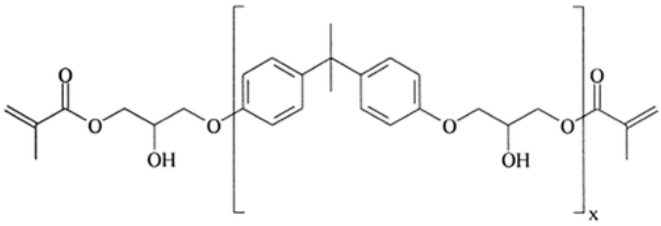
DOI: 10.3390/en11071849

Effect of Adding Different Amounts of Graphite Nanoplatelets on Structural, Thermal, Mechanical and Viscoelastic Properties of Vinylester Based Composites Cured at 25 degrees C.

Different amounts (0.1–5wt%) of graphite nanoplatelets (GNs) were added to vinylester (VE) for improving the properties of the composites cured at 25°C. The addition of 0.1wt% GN only increased the Tg and the thermal stability of the composite cured at 25°C. Furthermore, the addition of GN increased both the tensile strength and elongation-at-break of the composites cured at 25°C, but the effect of adding GN was less important when cured at 100°C. The improved properties of the composites were ascribed to the interactions between the oxygen species on the GN edges and the C==O and OH groups in the VE monomer, and to the higher fraction of the partially crosslinked polymer within the matrix. POLYM. COMPOS., 39:E1381–E1390, 2018. © 2017 Society of Plastics Engineers



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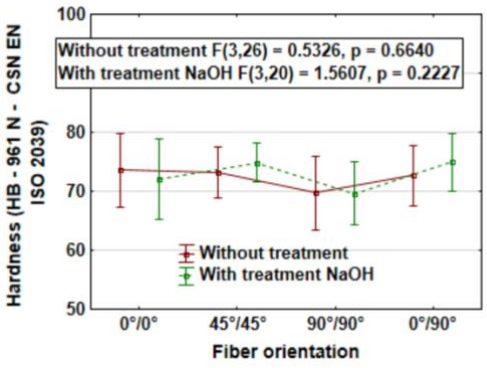
Musa textilis Cellulose Fibres in Biocomposites - An Investigation of Mechanical Properties and Microstructure.

The mechanical characteristics of cellulose fibres in biocomposites (epoxy resin/Musa textilis) were investigated relative to the microstructure of these fibres as determined by porosimetry and electron microscopy in terms of their utilization in composite systems. The influence of the chemical treatment via alkali (NaOH) on the change in surface properties and the interfacial interaction of fibres with an epoxy resin was investigated as well as mechanical characteristics of abaca/epoxy composites. The porosity of abaca fibres reached 57% on average, and the averaged tensile strength value was 641 MPa and a Young modulus of 26 MPa. Evaluated composite systems were prepared through a vacuum infusion in which various orientations of long ordered fibres in these composites were evaluated along with the influence of a 6% NaOH chemical treatment on the resultant mechanical properties. The alkali treatment increased the tensile strength of the observed composite systems by up to 16 MPa. The chemical treatment of the abaca fibres led to an increase in the interfacial interaction, which was evaluated with electron microscopy.



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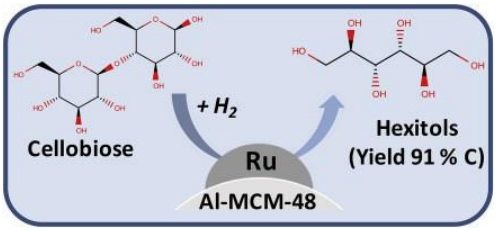
One-pot catalytic hydrolysis/hydrogenation of cellobiose into hexitols over Ru/Al-MCM- 48.

The simultaneous catalytic hydrolysis and hydrogenation of cellobiose, as a model constituent of biomass has been studied over Ru/Al-MCM-48. The catalyst, presenting both acidic and hydrogenating functions has been synthesized and characterized by means of N2 adsorption-desorption, SAXS, H2-TPR, XRD, TEM and NH3-TPD. A kinetic model is proposed, and possible reaction pathways and key intermediate compounds of conversion of cellobiose to hexitols are discussed. In the kinetic study the effects of pressure, temperature and time on the one-pot reaction were evaluated. A maximum yield around 91% of hexitols was achieved at 180 °C, 5 MPa of H2 and 7 min, where sorbitol was the main compound in the final product with 82% yield. Cellobitol was the main reaction intermediate. Temperatures in the range of 140–180 °C and pressures in the range of 3–5 MPa of H2 were studied and it was concluded that higher temperatures and pressures had a positive effect in order to maximize the production of hexitols. The developed kinetic model predicted with high accuracy the concentration of the different compounds involved in the proposed reaction pathway and served to calculate the reaction rate constant and activation energy values for the different steps of the catalytic process.



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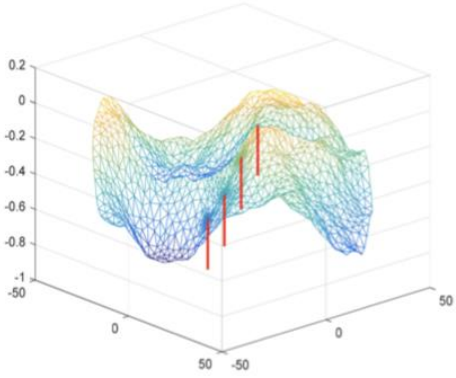
Unidimensional Vertical Electrical Soundings involving uneven soil surfaces: improving the apparent resistivity measurements for soil modelling.

The influence of a non-flat uneven soil surface on the soil apparent resistivity measurements in unidimensional Vertical Electrical Sounding is analysed. The sounding in a real uneven soil surface is simulated by using a soil model, which allows the semi-analytical expressions valid for perfectly plane soils to be used. In addition, real Wenner electrodes properly calibrated are used, and the differences with a sounding in an equivalent soil with a flat surface are highlighted. Due to the loss of symmetry around the centre of the Wenner array, measurements along different directions are needed and the mean value of the distributions of the measures is assigned to the value of the apparent resistivity. Furthermore, for the purpose of reducing the width of such distribution, the use of electrodes of increasing length is suggested within limits. Finally, the proposal of a multi-layered soil model with an uneven surface based on the Wenner measurements is discussed.



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ORTE: Robot for Upper Limb Rehabilitation. Biomechanical Analysis of Human Movements.

This work presents ORTE, an upper limb rehabilitation system that includes: 1) a three-dimensional musculoskeletal model of the upper limb in order to study normal and pathological movements and to simulate a particular shoulder injury and its effect in muscular force, ranges of movement and muscle length changes; and 2) a 5 degrees-of-freedom upper limb robotic exoskeleton that can serves as a tool for the treatment of different injuries in the human arm. We performed the simulation of several upper arm movements of a healthy subject and one with upper brachial plexus injury in a postoperative state to compare and study the differences between them. The development of the musculoskeletal model and the results obtained by the simulations was used to design an adaptable exoskeleton prototype. Tests with different subjects was carry out and the functionality of the rehabilitation system can be demonstrated to assist in the diagnosis and treatment of upper limb injuries.

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Development of a web graphic model with fuzzy-decision-making Trial and Evaluation Laboratory/Multi-criteria-Spatial Decision Support System (F-DEMATEL/MC-SDSS) for sustainable planning and construction of rural housings.

There is often a complicated process for planning and constructing rural housings under the influence of (mass)-tourism in reservoir areas, involving multiple evaluation criteria use and geographical information analysis. With some methodologies within a unique framework considering current increasing construction sprawls and ecological consequences, these approaches will overcome existing shortcomings, especially spatial decision and visual impact problems on sustainable rural housing planning and construction. This paper presents a distinct web-based graphic model of sustainable rural housing planning and construction with a Fuzzy-DEcision-MAking Trial and Evaluation Laboratory/Multi-Criteria-Spatial Decision Support System (F-DEMATEL/MC-SDSS) method in a Geographic Information System (GIS) environment applied to Alange, Spain as a case study. The aim of this methodology is to optimally eco-design rural housings under (mass)-tourism in reservoir areas, as for their sensitivity and effect. The methodology presents herein the combined method of GIS and Multi-Criteria Decision Aid (MCDA) together with F-DEMATEL method. Because of the technological improvements in the area of information systems, it has a great necessity to study in what way to combine GIS, MCDA, Weighted Linear Combination (WLC), sensitivity analysis, the Internet, modeling, and database, targeting to generate MC-SDSS based on a web-based platform. A methodological framework named as web-based F-DEMATEL/MC-SDSS is suggested by means of a totally united GIS and definite MCDA model by programed in ArcGIS software's Visual Basic for Applications (VBA) and Model View Controller (MVC) to be an object-oriented system. These program languages interact on an algorithmic web server that processing the MCDA products. The model consists of four main modules: the general overview module, the F-DEMATEL/MC-SDSS module, the sensitivity analysis module, and, finally, the final result module especially with the buildings suitability option, which users can access consecutively. Through the web graphic model developed, seven rural housings constructed in the area can be checked their suitability based on the selected criteria of decision-makers. Therefore, the results can be used to verify sustainable housings' sites and designs differentiated parts of space as the asynchronous process of decision-makings. Thus, this model can be a channel to collaborate and communicate the spatial design and visual impact strategies of sustainable housings for decision-makers, who have practical and specific purposes. (C) 2018 Elsevier Ltd. All rights reserved.

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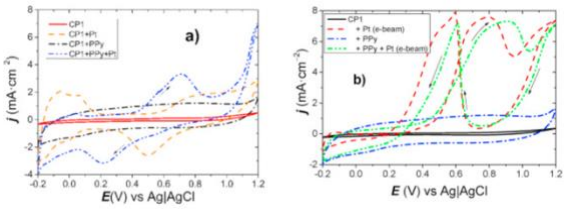
Polypyrrole and platinum deposited onto carbon substrate to enhance direct methanol fuel cell electrodes behaviour.

The aim of this work is to study the ability of polypyrrole to reduce the platinum load of low temperature methanol fuel cell electrodes. Platinum was deposited onto carbon paper and a layer of polypyrrole electrodeposited onto carbon paper, using electron beam evaporation and electrodeposition by pulses. Subsequently, the morphology and electrochemical behaviour of the synthesised samples were analysed in sulphuric acid solution, determining their electrochemically active surface area; and in a solution of sulphuric acid and methanol, to analyse their catalytic performance. The electrochemical measurements showed that the electrochemically active surface area and the catalytic performance of the electrodes prepared by evaporating platinum are increased when prepared on the polypyrrole film. Electrodes prepared using the pulse electrodeposition technique presented fairly homogeneous coatings that led to the reduction of the oxidation potential of methanol and the increase of their resistance to CO poisoning. (C) 2018 Hydrogen Energy Publications LLC. Published by Elsevier Ltd. All rights reserved.



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Some Considerations about the Use of Contact and Confocal Microscopy Methods in Surface Texture Measurement.

Surface metrology employs various measurement techniques, among which there has been an increase of noteworthy research into non-contact optical and contact stylus methods. However, some deeper considerations about their differentiation and compatibility are still lacking and necessary. This work compares the measurement characteristics of the confocal microscope with the portable stylus profilometer instrumentation, from a metrological point of view (measurement precision and accuracy, and complexity of algorithms for data processing) and an operational view (measuring ranges, measurement speed, environmental and operational requirements, and cost). Mathematical models and algorithms for roughness parameters calculation and their associated uncertainties evaluation are developed and validated. The experimental results demonstrate that the stylus profilometer presents the most reliable measurement with the highest measurement speed and the least complex algorithms, while the image confocal method takes advantage of higher vertical and horizontal resolution when compared with the employed stylus profilometer.

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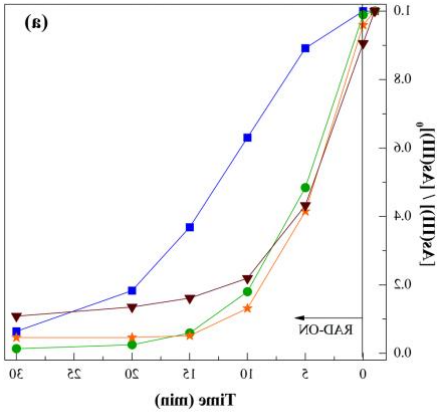
DOI: 10.3390/ma11081484

Application of a micro-meso-structured reactor (NETmix) to promote photochemical UVC/H2O2 processes - oxidation of As(iii) to As(v).

A micro-meso-structured reactor (NETmix) was used for the first time to promote photochemical UVC/H2O2 processes. The NETmix photoreactor consists of a network of chambers and channels, where the liquid flows, sealed with a quartz slab with high UVC transparency. Due to the small size of channels and chambers, the NETmix presents a uniform irradiance through the entire reactor depth, short molecular diffusion distances and large specific interfacial areas, maximizing the pollutant/oxidant contact. In this study, the NETmix photoreactor was evaluated for As(iii) oxidation to As(v) using a photochemical UVC/H2O2 system. The effect of the UVC lamp power (4, 6 or 11 W), the number of UVC lamps (2 or 3 lamps) and the UVC lamp layout (parallel or perpendicular to the flow direction) was evaluated, in order to ensure uniform irradiation of the entire reaction mixture. The optimum H2O2 concentration for each light distribution system was also evaluated. At the best configuration, 3 lamps of 11 W positioned parallel to the flow direction, total As(iii) oxidation ([As(iii)](0) = 1.33 x 10(-2) mM) was achieved in 15 min with an absorbed photon flux density of 1.9 x 10(-1) einstein per m(3) per s. Significant differences were highlighted between the photon flux actually received in the photoreactor and the radiant power emitted by the lamp. A kinetic model able to represent the As(iii) oxidation employing UVC radiation and H2O2 in a micro-meso-structured reactor was presented. The photochemical space time yield (PSTY) values obtained for the micro-meso-structured reactor are higher than for conventional batch reactors, showing that the NETmix technology can be a good solution for application in photochemical processes.



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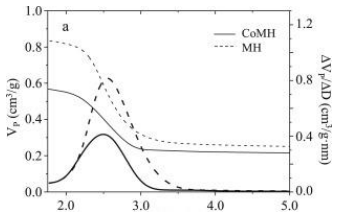
DOI: 10.1039/c8pp00006a

Superparamagnetism in CoFe2O4 nanoparticles: An example of a collective magnetic behavior dependent on the medium.



Cobalt ferrite particles with homogeneous microstructure have been prepared encased in MCM-41 (Mobil Composition Matter) and SBA-15 (Santa Barbara Amorphous) silica mesoporous structures. In addition, it was possible to obtain ferrite nanowires once the silica matrix was dissolved. The variety of samples prepared has allowed to deeply analyze the matrix effect in the magnetic behavior of these particles that behave as superparamagnetic at room temperature. It was found at 5 K, a drastic magnetic hardening of the encased ferrite particles due to the employment of such matrices, while no matrix effect was observed at 250 K.

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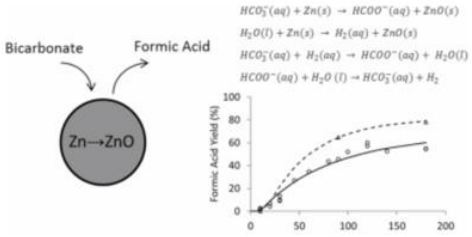
DOI: 10.1016/j.jallcom.2018.07.096

2Hydrothermal CO2 conversion using zinc as reductant: Batch reaction, modeling and parametric analysisof the process.



Hydrothermal CO2 reduction using Zn as reductant was investigated. This process has the advantage of avoiding the use of hydrogen with all its safety and environmental concerns, and allows an easy integration with CO2 capture as NaHCO3. In this work, this reaction was studied in batch reactors at temperatures from 275 to 325 degrees C. Conversions up to 60% were obtained with 100% selectivity towards formic acid, at reaction times between 10 and 180 min. A mathematical model correlated with data from literature was developed and is able to correctly predict both experimental and literature data with an averaged error of 3.5%. Main variables of the process were analyzed: temperature, Zn/HCO3- ratio, heating rate, Zn particle size, pressure, etc. The optimum reaction conditions found were 300 degrees C with a rapid heating, and particle sizes of 10 mu m. Zn excess dramatically improves the yield, but a lower excess can be compensated at high pressures.

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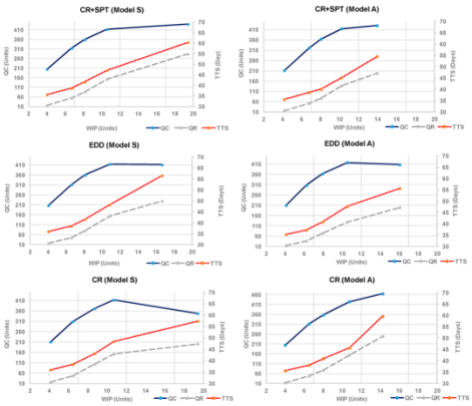
DOI: 10.1016/j.supflu.2018.07.003

Joint Optimization of Process Flow and Scheduling in Service-Oriented Manufacturing Systems.



Customer-oriented management of manufacturing systems is crucial in service-oriented production and product service systems. This paper develops the selection of dispatching rules in combination with alternative process flow designs and demand mix, for a maintenance, repair and overhaul center (MRO) of turbo shaft engines, both for complete engines and engine modules. After an initial systematic screening of priority dispatching rules, the design of experiments and discrete-event simulation allows a quantitative analysis of the better rules for the alternative process flows with internal and service metrics. Next, the design of experiments with analysis of variance and the Taguchi approach enables a search for the optimal combination of process flow and dispatching rules. The consideration of extra costs for overdue work orders into the costing breakdown provides a quantitative evaluation of the optimum range of load for the facility. This facilitates the discussion of the significant trade-offs of cost, service, and flexibility in the production system and the operational management alternatives for decision-making.

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DOI: 10.3390/ma11091559

Delphi Prospection on Additive Manufacturing in 2030: Implications for Education and Employment in Spain.

The term additive manufacturing (AM) groups together a set of technologies with similar characteristics forming part of the Fourth Industrial Revolution. AM is being developed globally, as evidenced by the standards published by and the agreements between the ISO and the ASTM in 2013. The purpose of this paper is to anticipate the main changes that will occur in AM by 2030 as forecast by more than 100 Spanish experts through Delphi prospection performed in 2018. In this way, the areas, aspects, and business models with the greatest probabilities of occurrence are obtained. The need for technical experts with specific knowledge and skills requires changes to current training syllabuses. Such changes will enable students to have the profiles foreseen in these job trends. The encouragement of STEAM (Science, Technology, Engineering, Arts, and Mathematics) training through the introduction of AM in study plans may be an appropriate alternative. Finally, the consequences of the Fourth Industrial Revolution for the employment market and on jobs, particularly in Spain, are set out and the latest Spanish Research, Development, and Innovation (R&D + I) plans are summarized as the framework for the possible implementation and development of AM.

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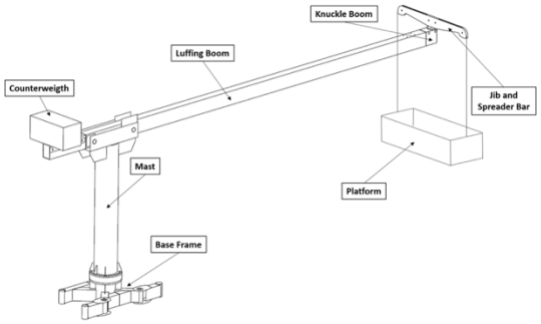
DOI: 10.3390/ma11091500

Integration of cutting time into the structural optimization process: application to a spreader bar design.



Nowadays, there is no doubt about the suitability and efficiency of structural optimization techniques and the improvement achieved in the design process when they are applied. However, if we look to the product design process, do we really believe that it is an unbeatable improvement? Current structural optimization methods (based on metrics such as stress, mass or compliance) have reached a high level of development, but their integration with other factors as manufacturing processes is still at an early stage of development. In many cases, those designs suggested applying only structural optimization are found to be difficult and/or expensive to manufacture. This situation is further accentuated in the case of cutting processes, where it is well-known that structural optimization significantly affects to the cutting time and commonly produces manufacturing overcost. In this sense, this paper tries to fill the gap between structural optimization and manufacturing-based design applied to the case of cutting processes. For this purpose, the authors propose a methodology that allows including those parameters that affect to the cutting time within structural optimization phase. Additionally, to obtain a fair conclusion about its performance the method is applied to a real industrial component manufactured by a cutting process as it is the Abrasive Waterjet Cutting (AWJ).

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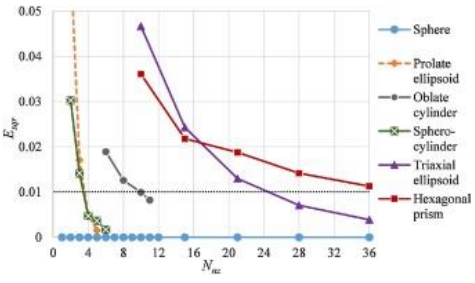
Semi-analytical models of non-spherical particle shapes using optimised spherical harmonics

Determining particle shape is vital for many industrial processes such as those found in the pharmaceutical, agricultural, and bioenergy industries. With modelling being an essential tool to acquire an understanding of the behaviour of particulates in industrial processes, numerical methods such as DEM are needing numerical solutions to formulate and implement particle shape models that overcome current limitations. Whereas pharmaceutical particles have a regular shape, agricultural and biomass particles often are specific, irregular and non-analytic. Because the diversity of real shapes is enormous, a variety of methods for describing particle shapes currently exist. Recently, the series of spherical harmonics (SHs) has gained much interest through their application in many other fields. This paper focuses on the application of the semi-analytical SH technique and addresses the development of a universal modelling tool for describing different particle shapes using a finite number of SHs. The results obtained from modelling pharmaceutical, agricultural, and biomass particles prove the applicability of SHs to regular as well as irregular shapes. In this regard, their optimised description by minimising the number of non-zero expansion coefficients is demonstrated. To proceed with a smaller number of low-order SHs, surface segmentation is introduced. Sufficient accuracy in the shape description of the particles selected was achieved with less than 16 SHs.



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Characterization of partial discharge measuring instruments by the generation of reference insulation defects in an experimental setup.

Partial discharge (PD) measurement has become an effective laboratory and on-site test for the detection, identification and location of defects in the dielectrics of high-voltage (HV) electrical systems and thus to assess their insulation condition. Several PD instruments have been developed to carry out, in situ, on-line temporary or monitoring measurements. However, no standard exists to define what type of evaluation should be required to check the effectiveness of the PD measuring and diagnosis instrumentation implemented. The instruments used for on-line PD measurements must incorporate specific functional features to cope with the following drawbacks, in order to perform a proper diagnosis: the existence of high levels of background electrical noise, the simultaneous presence of multiple PD sources, and the difficulty of identifying the insulation defects and of determining their location. To overcome these drawbacks, adequate selection of the measuring technique and the implementation of effective signal processing tools is essential. In the research presented in this paper, a new method for the evaluation and qualification of the functional features of PD measuring and diagnostic instruments is presented. For the application of the proposed method, a scale modular HV setup has been designed and manufactured. In this setup reference time series of PD pulses are generated in a repetitive and controlled way in individual test cells with real insulation defects.

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Development of a programmable partial discharge generator for the evaluation of partial discharge measuring devices.

Partial discharges (PD) measurement provide valuable information for assessing the condition of the insulation elements in high voltage (HV) electrical grids. During the last three decades, several instruments integrated with specific technical functionalities have been developed in order to perform accurate diagnostics when temporary or monitoring measurements are carried out on-site and on-line. Some electrical utilities, maintenance companies and large electricity consumers have defined technical specifications trying to select the most appropriate PD measuring systems, but in general, no tests are performed to check their capability to perform appropriate and accurate diagnostics. Furthermore, no standard exists to define what type of evaluation should be required to assess the efficacy of this type of instrumentation. In this paper, a reference PD generator developed for the evaluation of the functional features of PD measuring and diagnostic instruments is presented. This PD generator enables the characterization of the technical functionalities of commercial PD instruments in a controlled and homogenous way and without the requirement of apply HV in a test facility. Reference analogue PD time series with superimposed electrical noise time sequences are generated simulating real acquisitions of on-line PD measurements.

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