Fluid Dynamics and Materials Processing • *Open Access* • Volume 17, Issue 2, Pages 385 - 395 • 2021

Document type
Article • *Gold Open Access*

Source type
Journal

ISSN
1555256X

DOI
10.32604/fdmp.2021.011784

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Zeolite A Synthesized from Geothermal Waste Using Conventional and Microwave Heating for the Hydrothermal Treatment

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Abstract

Zeolite A has been successfully synthesized from geothermal waste with natrium aluminate and natrium silicate using conventional (C-H) and microwave heating (M-H) for the hydrothermal treatment. The products obtained for different aging times have been characterized using X-Ray Diffraction (XRD), Fourier transformation infrared spectroscopy (FTIR), and scanning electron microscopy (SEM). It is shown that with the M-H process, zeolite can be formed at relatively low temperature (100°C) in a relatively short time (40 min). The crystallization of zeolite A has been found to be generally promoted by an increase of aging and synthesis time; however, it has also been observed that relative long aging times can transform it into sodalite. Zeolite A produced through the M-H process generally displays a smaller and more homogeneous crystal size with respect to that obtained with the C-H method. © 2021. All Rights Reserved.

Author keywords

conventional-hydrothermal; Geothermal waste; microwave-hydrothermal; zeolite A

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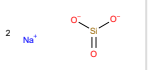
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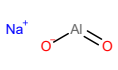
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The Journal is intended to cover some "frontier" aspects of materials science and, in particular, the most modern and advanced processes for the production of inorganic (semiconductors and metal alloys), organic (protein crystals) materials and "living" (in vitro) biological tissues, with emphasis on the fluid-dynamic conditions under

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Analysis of a Composite Admixture Based on Ready-Mixed Concrete Waste Residuals

FDMP-Fluid Dynamics & Materials Processing, Vol.19, No.8, pp. 1983-1995, 2023, DOI:10.32604/fdmp.2023.026023

(This article belongs to this Special Issue: Advances in Solid Waste Processing and Recycling Technologies for Civil Engineering Materials)

Abstract Reasonable treatment and utilization of waste residuals discharged during the production of ready-mixed concrete is an important problem in the cement industry. In this study, a composite admixture was prepared by using ready-mixed concrete waste residuals, furnace slag, and water granulated slag. The grinding characteristics of such material were investigated. Moreover, the effect of such admixture on cement hydration and pore structure was analyzed by X-ray diffraction, thermogravimetric-differential scanning calorimetry, scanning electron microcopy and mercury intrusion porosimetry. As shown by the results: The grinding characteristics of the waste residuals can be improved significantly by mixing them with furnace slag and… More >

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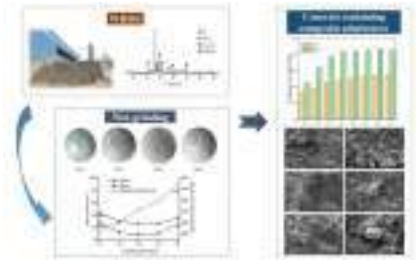

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A Model for Predicting the Erosion Rate Induced by the Use of a Selective Catalytic Reduction Denitrification Technology in Cement Kilns Flue Gas

FDMP-Fluid Dynamics & Materials Processing, Vol.19, No.8, pp. 1997-2011, 2023, DOI:10.32604/fdmp.2023.026373

Abstract Selective catalytic reduction (SCR) is a technology by which nitrogen oxides are converted with the aid of a catalyst into diatomic nitrogen and water. It is known that the catalyst can be easily eroded if a cement kiln with a high-dust content is considered. To understand this process, numerical simulations have been carried out considering a single catalyst channel in order to study the collision and erosion of fly ash and catalysts at meso scale. Based on a response surface methodology, the effects of five factors on the erosion rate have been studied, namely, the catalyst particle velocity, the particle… More >

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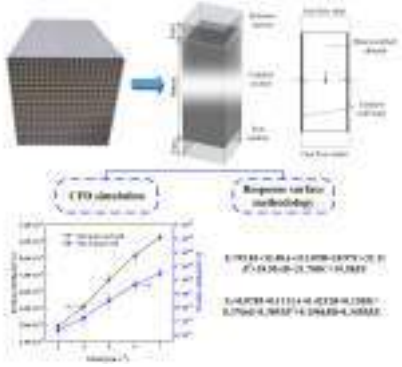

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Numerical Analysis of the Thermal Properties of Ecological Materials Based on Plaster and Clay

FDMP-Fluid Dynamics & Materials Processing, Vol.19, No.8, pp. 2013-2026, 2023, DOI:10.32604/fdmp.2023.026929

Abstract Most of the energy savings in the building sector come from the choice of the materials used and their microphysical properties. In the present study, through numerical simulations a link is established between the thermal performance of composite materials and their microstructures. First, a two-phase 3D composite structure is modeled, then the RSA (Random Sequential Addition) algorithm and a finite element method (FE) are applied to evaluate the effective thermal conductivity of these composites in the steady-state. In particular, building composites based on gypsum and clay, consolidated with peanut shell additives and/or cork are considered. The numerically determined thermal conductivities… More >

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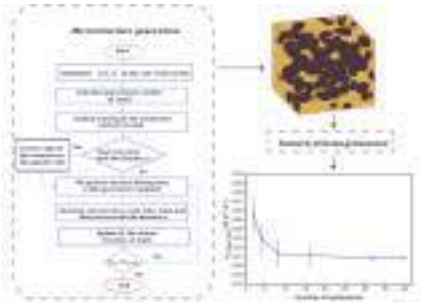

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Enhancing Heavy Crude Oil Flow in Pipelines through Heating-Induced Viscosity Reduction in the Petroleum Industry

FDMP-Fluid Dynamics & Materials Processing, Vol.19, No.8, pp. 2027-2039, 2023, DOI:10.32604/fdmp.2023.027312
(This article belongs to this Special Issue: Recent advancements in thermal fluid flow applications)

Abstract The process of transporting crude oil across pipelines is one of the most critical aspects of the midstream petroleum industry. In the present experimental work, the effect of temperature, pressure drop, and pipe diameter on the flow rate of heavy crude oil have been assessed. Moreover, the total discharge and energy losses have been evaluated in order to demonstrate the improvements potentially achievable by using solar heating method replacing pipe, and adjusting the value of the initial pressure difference. Crude oil of API = 20 has been used for the experiments, with the studied pipelines sections connecting the separator unit to… More >

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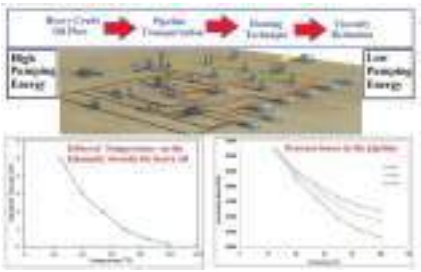

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Influence of High-Robustness Polycarboxylate Superplasticizer on the Performances of Concrete Incorporating Fly Ash and Manufactured Sand

FDMP-Fluid Dynamics & Materials Processing, Vol.19, No.8, pp. 2041-2051, 2023, DOI:10.32604/fdmp.2023.027399
(This article belongs to this Special Issue: Advances in Solid Waste Processing and Recycling Technologies for Civil Engineering Materials)

Abstract Using ethylene glycol monovinyl polyoxyethylene ether, 2-acrylamido-2-methylpropane sulfonic acid (AMPS) and acrylic acid as the main synthetic monomers, a high robustness polycarboxylate superplasticizer was prepared. The effects of initial temperature, ratio of acid to ether, amount of chain transfer agent, and synthesis process on the properties of the superplasticizer were studied. The molecular structure was characterized by GPC (Gel Permeation Chromatography) and IR (Infrared Spectrometer). As shown by the results, when the initial reaction temperature is 15°C, the ratio of acid to ether is 3.4:1 and the acrylic acid pre-neutralization is 15%, The AMPS substitution is 10%, the amount of… More >

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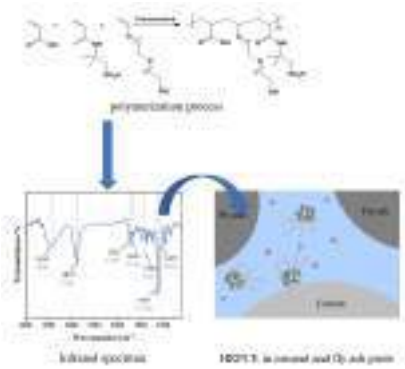

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Influence of Wellbore Trajectory on Pressure Drop and Fluid Discharge

FDMP-Fluid Dynamics & Materials Processing, Vol.19, No.8, pp. 2053-2066, 2023, DOI:10.32604/fdmp.2023.026301

Abstract An experimental analysis has been conducted to study the process of fluid accumulation for different borehole trajectories. More specifically, five heel angles have been experimentally realized to simulate the borehole trajectory of the sloping section of the formation. The fluid-carrying capacity, pressure drop and fluid discharge volatility have been investigated for these conditions and, accordingly, the relationship between heel angle and wellbore pressure drop fluid-carrying capacity has been determined. The results show that while the reasonable roll angle can increase the pressure loss in the wellbore, it is beneficial to drainage. In terms of pressure loss and liquid-carrying capacity, when… More >

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Improving Crude Oil Flow Using Graphene Flakes under an Applied Electric Field

FDMP-Fluid Dynamics & Materials Processing, Vol.19, No.8, pp. 2067-2081, 2023, DOI:10.32604/fdmp.2023.027156
(This article belongs to this Special Issue: Recent advancements in thermal fluid flow applications)

Abstract Graphene flakes (GF) have been prepared and assessed as a material for improving flow in oil pipelines under the effect of an electric field. In particular, different amounts of GFs have been considered in order to determine the optimal flow conditions. The GFs were prepared from graphite foam, derived from the dehydration of sugar with a particle size of 500–600 μm, which was dispersed in ethanol and exfoliated in a ball mill under a shear force. After 15 h of exfoliation, sonication, and subsequent high-speed centrifugation at 3000 rpm, irregular-shaped GFs of 50–140 nm were produced and characterized using scanning electron microscopy, X-ray… More >

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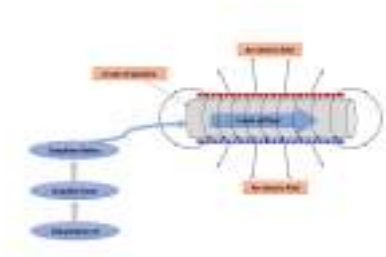

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Fatigue Life Estimation of High Strength 2090-T83 Aluminum Alloy under Pure Torsion Loading Using Various Machine Learning Techniques

FDMP-Fluid Dynamics & Materials Processing, Vol.19, No.8, pp. 2083-2107, 2023, DOI:10.32604/fdmp.2023.027266
(This article belongs to this Special Issue: Recent advancements in thermal fluid flow applications)

Abstract The ongoing effort to create methods for detecting and quantifying fatigue damage is motivated by the high levels of uncertainty in present fatigue-life prediction approaches and the frequently catastrophic nature of fatigue failure. The fatigue life of high strength aluminum alloy 2090-T83 is predicted in this study using a variety of artificial intelligence and machine learning techniques for constant amplitude and negative stress ratios (). Artificial neural networks (ANN), adaptive neuro-fuzzy inference systems (ANFIS), support-vector machines (SVM), a random forest model (RF), and an extreme-gradient tree-boosting model (XGB) are trained using numerical and experimental input data obtained from fatigue tests… More >

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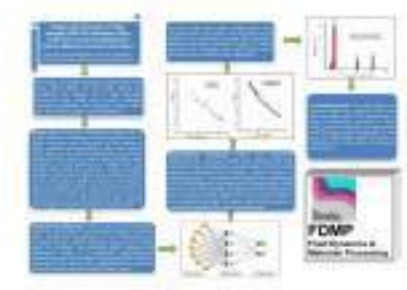

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An Auxiliary Monitoring Method for Well Killing Based on Statistical Data

FDMP-Fluid Dynamics & Materials Processing, Vol.19, No.8, pp. 2109-2118, 2023, DOI:10.32604/fdmp.2023.025342
(This article belongs to this Special Issue: Fluid Flow and Materials Strength related to the Wellbore Safety)

Abstract In the present study, a large set of data related to well killing is considered. Through a complete exploration of the whole process leading to well-killing, various factors affecting such a process are screened and sorted, and a correlation model is built accordingly in order to introduce an auxiliary method for well-killing monitoring based on statistical information. The available data show obvious differences due to the diverse control parameters related to different well-killing methods. Nevertheless, it is shown that a precise three-fold relationship exists between the reservoir parameters, the elapsed time and the effectiveness of the considered well-killing strategy. The… More >

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Weak Expansive Soil Physical Properties Modification by Means of a Cement-Jute Fiber

FDMP-Fluid Dynamics & Materials Processing, Vol.19, No.8, pp. 2119-2130, 2023, DOI:10.32604/fdmp.2023.025444

Abstract Sixteen groups of comprehensive tests have been conducted to investigate the modifications in the physical properties of a weak expansive soil due to the addition of a cement jute fiber. The tests have been conducted to analyze the liquid plastic limit, the particle distribution and the free expansion rate. The results show that: (1) With an increase in the cement-jute fiber content, the free expansion rate of the modified expansive soil gradually decreases, however, such a rate rebounds when the fiber content exceeds 0.5% and the cement content exceeds 6%. (2) With an increase in the cement percentage, the particle… More >

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Foreword International Conference on Materials and Energy (ICOME 2021)

FDMP-Fluid Dynamics & Materials Processing, Vol.19, No.8, pp. 2131-2146, 2023, DOI:10.32604/fdmp.2023.027329

(This article belongs to this Special Issue: Materials and Energy an Updated Image for 2021)

Abstract The International Conference on Materials and Energy (ICOME) was held in Metz on June 2021 following the earlier successful conferences of the same series held in Tunisia in 2019, Spain in 2018, China in 2017, France in 2016 and Morocco in 2015. The 2021 event should be regarded as a late realization of the ICOME 2020 conferences, which had to be delayed due to the pandemic. A significant number of papers presented in the framework of this conference have been selected for publication in the Fluid Dynamics and Material Processing international peer reviewed Journal given the relevance of the treated… More >

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Analysis of the Hydraulic Performances of a New Liquid Emitter Based on a Leaf Vein Concept

FDMP-Fluid Dynamics & Materials Processing, Vol.19, No.8, pp. 2147-2160, 2023, DOI:10.32604/fdmp.2023.025556

Abstract The leaf-vein drip irrigation emitter is a new type of drip emitter based on a bionic structure able to support shunting, sharp turns, and increased dissipation. In the present work, the results of twenty-five tests executed in the framework of an orthogonal design strategy are presented in order to clarify the influence of the geometrical parameters of the flow channel on the hydraulic characteristics of such emitter. The corresponding flow index and head loss coefficient are determined through numerical simulations and model testing. The results show that the flow index of the flow channel is 0.4970~0.5461, which corresponds to good… More >

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Mechanical Analysis of a Multi-Test String in High-Temperature and High-Pressure Deep Wells

FDMP-Fluid Dynamics & Materials Processing, Vol.19, No.8, pp. 2161-2170, 2023, DOI:10.32604/fdmp.2023.026608

(This article belongs to this Special Issue: Fluid Flow and Materials Strength related to the Wellbore Safety)

Abstract The mechanical behavior of the test string in deep wells is generally relatively complex as a result of the high temperature and high pressure, severe dogleg and buckling effects, which in some circumstances can even lead to string failure. Traditional computational methods for the analysis of these behaviors are often inaccurate. For this reason, here a more accurate mechanical model of the test string is introduced by considering variables such as temperature, pressure, wellbore trajectory, and buckling, as well as combining them with the deformation and string constraint conditions brought in by changes in temperature and pressure during the tripping,… More >

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Water Stability Improvement of Acid Fine Aggregate-Based Asphalt Concrete

FDMP-Fluid Dynamics & Materials Processing, Vol.19, No.8, pp. 2171-2180, 2023, DOI:10.32604/fdmp.2023.026892

(This article belongs to this Special Issue: Advances in Solid Waste Processing and Recycling Technologies for Civil Engineering Materials)

Abstract In general, acid aggregates are not used in combination with asphalt concrete because of their poor compatibility with the asphalt binder, which typically results in a scarce water stability of the concrete. In the present study, the feasibility of a new approach based on the combination of acid granite fine aggregate with alkaline limestone coarse aggregate and Portland cement filler has been assessed. The mineral and chemical compositions of these three materials have first been analyzed and compared. Then, the effect of different amounts of Portland cement (0%, 25%, 50%, 75% and 100% of the total filler by weight) on… More >

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Prediction and Optimization of the Thermal Properties of TiO_2/Water Nanofluids in the Framework of a Machine Learning Approach

FDMP-Fluid Dynamics & Materials Processing, Vol.19, No.8, pp. 2181-2200, 2023, DOI:10.32604/fdmp.2023.027299

(This article belongs to this Special Issue: Advances in Nanofluids: Modelling, Simulation and Applications)

Abstract In this study, comparing multiple models of machine learning, a multiple linear regression (MLP), multilayer feed-forward artificial neural network (BP) model, and a radial-basis feed-forward artificial neural network (RBF-BP) model are selected for the optimization of the thermal properties of TiO_2/water nanofluids. In particular, the least squares support vector machine (LS-SVM) method and radial basis support vector machine (RB-SVM) method are implemented. First, curve fitting is performed by means of multiple linear regression in order to obtain bivariate correlation functions for thermal conductivity and viscosity of the nanofluid. Then the aforementioned models are used for a predictive analysis of the… More >

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Numerical Simulation of the Wake Generated by a Helicopter Rotor in Icing Conditions

Guozhi Li[1], Yihua Cao[2,*]

FDMP-Fluid Dynamics & Materials Processing, Vol.17, No.2, pp. 235-252, 2021, DOI:10.32604/fdmp.2021.014814

Abstract The wake generated by the rotor of a helicopter can exert a strong interference effect on the fuselage and the horizontal/vertical tail. The occurrence of icing on the rotor can obviously make this interplay more complex. In the present study, numerical simulation is used to analyze the rotor wake in icing conditions. In order to validate the overall mathematical/numerical method, the results are compared with similar data relating to other tests; then, different simulations are conducted considering helicopter forward flight velocities of 0, 10, 20, 50, and 80 knots and various conditions in terms of air temperature (atmospheric temperature degrading… More >

Open Access REVIEW

A Review on the Evaporation Dynamics of Sessile Drops of Binary Mixtures: Challenges and Opportunities

Pradeep Gurrala[1], Saravanan Balusamy[1], Sayak Banerjee[1], Kirti Chandra Sahu[2,*]

FDMP-Fluid Dynamics & Materials Processing, Vol.17, No.2, pp. 253-284, 2021, DOI:10.32604/fdmp.2021.014126

Abstract The wetting and evaporation dynamics of sessile droplets have gained considerable attention over the last few years due to their relevance to many practical applications, ranging from a variety of industrial problems to several biological systems. Droplets made of binary mixtures typically undergo complex dynamics due to the differential volatility of the considered components and the ensuing presence of thermocapillary effects. For these reasons, many research groups have focused on the evaporation of binary droplets using a variegated set of experimental, numerical, and purely theoretical approaches. Apart from reviewing the state-of-the-art about the existing experimental, analytical, and computational techniques used… More >

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MHD and Viscous Dissipation Effects in Marangoni Mixed Flow of a Nanofluid over an Inclined Plate in the Presence of Ohmic Heating

D. R. V. S. R. K. Sastry[1], Peri K. Kameswaran[2], Mohammad Hatami[3,*]

FDMP-Fluid Dynamics & Materials Processing, Vol.17, No.2, pp. 285-300, 2021, DOI:10.32604/fdmp.2021.014429

Abstract The problem of Marangoni mixed convection in the presence of an inclined magnetic field with uniform strength in a nanofluid (formed by the dispersion of two metallic nanoparticles, i.e., Copper (Cu), and alumina (Al_2O_3) in water) is addressed numerically. The effects of viscous dissipation and Ohmic heating are also considered. The original set of governing partial differential equations is reduced to a set of non-linear coupled ordinary differential equations employing the similarity transformation technique. The simplified equations are numerically solved through MATLAB 'bvp4c' algorithm. The results are presented in terms of graphs for several parameters. It is found that enhancing… More >

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Lattice Boltzmann Simulation of Nanoparticle Transport and Attachment in a Microchannel Heat Sink

Xiaokang Tian[1], Kai Yue[1,2,*], Yu You[1,2], Yongjian Niu[1], Xinxin Zhang[1,2]

FDMP-Fluid Dynamics & Materials Processing, Vol.17, No.2, pp. 301-317, 2021, DOI:10.32604/fdmp.2021.013521

Abstract The heat transfer performances of a microchannel heat sink in the presence of a nanofluid can be affected by the attachment of nanoparticle (NP) on the microchannel wall. In this study, the mechanisms underlying NP transport and attachment are comprehensively analyzed by means of a coupled double-distribution-function lattice Boltzmann model combined with lattice-gas automata. Using this approach, the temperature distribution and the two-phase flow pattern are obtained for different values of the influential parameters. The results indicate that the number of attached NPs decrease exponentially as their diameter and the fluid velocity grow. An increase in the wall temperature leads… More >

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Buoyancy driven Flow of a Second-Grade Nanofluid flow Taking into Account the Arrhenius Activation Energy and Elastic Deformation: Models and Numerical Results

R. Kalaivanan[1], N. Vishnu Ganesh[2], Qasem M. Al-Mdallal[3,*]

FDMP-Fluid Dynamics & Materials Processing, Vol.17, No.2, pp. 319-332, 2021, DOI:10.32604/fdmp.2021.012789
(This article belongs to this Special Issue: Advances in Nanofluids: Modelling, Simulation and Applications)

Abstract The buoyancy driven flow of a second-grade nanofluid in the presence of a binary chemical reaction is analyzed in the context of a model based on the balance equations for mass, species concentration, momentum and energy. The elastic properties of the considered fluid are taken into account. The two-dimensional slip flow of such non-Newtonian fluid over a porous flat material which is stretched vertically upwards is considered. The role played by the activation energy is accounted for through an exponent form modified Arrhenius function added to the Buongiorno model for the nanofluid concentration. The effects of thermal radiation are also… More >

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Computational Fluid Dynamics Simulation of Indoor Air Quality and Thermal Stratification of an Underfloor Air Distribution System (UFAD) with Various Vent Layouts

Neil Stephen Lopez[1,*], Selena Kay Galeos[1], Brian Raphael Calderon[1], David Roy Dominguez[1], Bryan Joseph Uy[1], Rupesh Iyengar[2]

FDMP-Fluid Dynamics & Materials Processing, Vol.17, No.2, pp. 333-347, 2021, DOI:10.32604/fdmp.2021.011213
(This article belongs to this Special Issue: Fluid Mechanics and Green Material Processing)

Abstract The underfloor air distribution (UFAD) system has not been able to penetrate the residential and commercial air conditioning industry significantly until now. To date, the most notable applications are found in datacenters because of their more demanding thermal stratification and cooling requirements. In addition to highlighting the advantages of the UFAD system over the traditional overhead (OH) system, this study compares various ventilation layouts for a UFAD system. Four different UFAD ventilation layouts are compared and one OH layout. The results show that using multiple swirl-type diffusers creates a more uniform floor-to-knee temperature and less air recirculation than the rectangular… More >

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Analysis of the Agglomeration of Powder in a Coaxial Powder Feeding Nozzle Used for Laser Energy Deposition

Chenguang Guo[1,2,*], Yu Sun[1,2], Qiang Li[1], Haitao Yue[1], Chuang Wang[1]

FDMP-Fluid Dynamics & Materials Processing, Vol.17, No.2, pp. 349-370, 2021, DOI:10.32604/fdmp.2021.013535

Abstract

To improve the agglomeration of powder in a coaxial powder feeding nozzle used in the frame of a laser energy deposition technique, the influence of several parameters must be carefully assessed. In the present study the problem is addressed by means of numerical simulations based on a DEM-CFD (Discrete Element Method and Discrete Element Method) coupled model. The influence of the powder flow concentration, powder flow focal length and the amount of powder at the nozzle outlet on the rate of convergence of the powder flow is considered. The role played by the nozzle outlet width, the angle between the… More >

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A Pressure-Drop Model for Oil-Gas Two-Phase Flow in Horizontal Pipes

Xinke Yang[1], Shanzhi Shi[1], Hui Zhang[1], Yuzhe Yang[2,3], Zilong Liu[2,3], Ruiquan Liao[2,3,*], Joseph X. F. Ribeiro[4]

FDMP-Fluid Dynamics & Materials Processing, Vol.17, No.2, pp. 371-383, 2021, DOI:10.32604/fdmp.2021.011486

Abstract The accurate prediction of the pressure distribution of highly viscous fluids in wellbores and pipelines is of great significance for heavy oil production and transportation. The flow behavior of high-viscosity fluids is quite different with respect to that of low-viscosity fluids. Currently, the performances of existing pressure-drop models seem to be relatively limited when they are applied to high-viscosity fluids. In this study, a gas-liquid two-phase flow experiment has been carried out using a 60 mm ID horizontal pipe with air and white oil. The experimental results indicate that viscosity exerts a significant influence on the liquid holdup and pressure… More >

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Zeolite A Synthesized from Geothermal Waste Using Conventional and Microwave Heating for the Hydrothermal Treatment

Sulardjaka Sulardjaka[1,*], Sri Nugroho[1], Norman Iskandar[1], Agus P. Adi[1], Deni F. Fitriyana[2]

FDMP-Fluid Dynamics & Materials Processing, Vol.17, No.2, pp. 385-395, 2021, DOI:10.32604/fdmp.2021.011784

Abstract Zeolite A has been successfully synthesized from geothermal waste with natrium aluminate and natrium silicate using conventional (C-H) and microwave heating (M-H) for the hydrothermal treatment. The products obtained for different aging times have been characterized using X-Ray Diffraction (XRD), Fourier transformation infrared spectroscopy (FTIR), and scanning electron microscopy (SEM). It is shown that with the M-H process, zeolite can be formed at relatively low temperature (100°C) in a relatively short time (40 min). The crystallization of zeolite A has been found to be generally promoted by an increase of aging and synthesis time; however, it has also been observed… More >

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Numerical Simulation of the Mixing and Hydrodynamics of Asphalt and Rubber in a Stirred Tank

Zechen Yao[1], Renfeng Yang[1,*], Haichao An[2]

FDMP-Fluid Dynamics & Materials Processing, Vol.17, No.2, pp. 397-412, 2021, DOI:10.32604/fdmp.2021.012114

Abstract Computational fluid dynamics (CFD) has been used to analyze the mixing process of Asphalt and Rubber (AR) in a stirred tank with a six flat-blade disc turbine (Rushton), a down-pumping 45° pitched-blade turbine (PBTD-6) and a down-pumping propeller (TXL). The two-phase (solid-liquid) flow in the considered stirred tank has been modelled in the framework of an Eulerian-Eulerian approach, a laminar-flow assumption and a multi-reference frame strategy. The following effects have been investigated: The influence of the impeller speed, impeller type, crumb rubber (CR) particle diameter and initial CR particle loading on the quality of the CR particle's suspension. The outcomes… More >

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On the Influence of Vortex-Induced Resistance on Oil-Shale Particle-Slurry Flow in Vertical Pipes

Li-an Zhao[1,*], Tieli Wang[2]

FDMP-Fluid Dynamics & Materials Processing, Vol.17, No.2, pp. 413-426, 2021, DOI:10.32604/fdmp.2021.011205

Abstract The transportation in vertical pipelines of particle slurry of oil shale has important applications in several fields (marine mining, hydraulic mining, dredging of river reservoir, etc.). However, there is still a lack of information about the behavior of coarse particles in comparison to that of fine particles. For this reason, experiments on the fluidization and hydraulic lifting of coarse oil shale particles have been carried out. The experimental data for three kinds of particles with an average size of 5 mm, 15 mm and 25 mm clearly demonstrate that vortices can be formed behind the particles. On this basis, a… More >

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Experimental and Numerical Analysis of Surface Magneto-Hydrodynamic Propulsion Induced by NdFeB Magnets

Zongkai Liu[1,2,*]

FDMP-Fluid Dynamics & Materials Processing, Vol.17, No.2, pp. 427-439, 2021, DOI:10.32604/fdmp.2021.010528

Abstract The so-called surface Magneto-hydro-dynamic (MHD) propulsion relies on the Lorentz force induced in weak electrolyte solutions (such as seawater or plasma) by NdFeB Magnets. The Lorentz force plays an important role in such dynamics as it directly affects the structures of flow boundary layers. Previous studies have mainly focused on the development of such boundary layers and related fluid-dynamic aspects. The main focus of the present study is the determination of electromagnetic field distributions around the propulsion units. In particular dedicated experiments and numerical simulations (based on the finite volume method) are conducted considering a NACA0012 airfoil immersed in seawater.… More >

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A Pull-Out Test Study on the Working State of Fully Grouted Bolts

Ruixin Zhao[1,*], Zhongju Feng[1], Guan Jiang[1], Fuchun Wang[1], Yidong Zhang[2], Changan Zhang[3], Zhenbing Wang[1]

FDMP-Fluid Dynamics & Materials Processing, Vol.17, No.2, pp. 441-453, 2021, DOI:10.32604/fdmp.2021.010595

Abstract The present study examines the working conditions of fully grouted bolts used for the construction and expansion of high slopes. On the basis of a pull out destructive test, the work load and the ultimate load are obtained on site, and the Flac3d numerical simulation method is employed to determine the axial force distribution and the effective anchor length. The test results show that (1) the Q-S (load-displacement) curve of the bolt displays a certain degree of deformation coupled with the creep of the surrounding rock; (2) the working load of the bolt is closely related to the sliding deformation… More >

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Numerical Simulation of Turbulent Swirling Pipe Flow with an Internal Conical Bluff Body

Jinli Song[1], Nabil Kharoua[2,*], Lyes Khezzar[1], Mohamed Alshehhi[1]

FDMP-Fluid Dynamics & Materials Processing, Vol.17, No.2, pp. 455-470, 2021, DOI:10.32604/fdmp.2021.014370

Abstract Turbulent swirling flow inside a short pipe interacting with a conical bluff body was simulated using the commercial CFD code Fluent. The geometry used is a simplified version of a novel liquid/gas separator used in multiphase flow metering. Three turbulence models, belonging to the Reynolds averaged Navier-Stokes (RANS) equations framework, are used. These are, RNG k-ε, SST k-ω and the full Reynolds stress model (RSM) in their steady and unsteady versions. Steady and unsteady RSM simulations show similar behavior. Compared to other turbulence models, they yield the best predictions of the mean velocity profiles though they exhibit some discrepancies in… More >

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A Numerical Study on the Mechanisms Producing Forces on Cylinders Interacting with Stratified Shear Environments

Yin Wang[1,*], Lingling Wang[2], Yong Ji[1], Zhicheng Xi[1], Wenwen Zhang[1]

FDMP-Fluid Dynamics & Materials Processing, Vol.17, No.2, pp. 471-485, 2021, DOI:10.32604/fdmp.2021.014652

Abstract A three dimensional (3D) numerical wave flume is used to investigate carefully the ISWs (Internal solitary wave) forces acting on cylinders interacting with a stratified shear environment. Using the Large-Eddy Simulation (LES) approach and analyzing the distribution of shear stress and pressure along the surface of the cylinder, the differential pressure resistance and the viscous force are obtained. The method of multiple linear regression analysis is adopted and a comprehensive influence coefficient is determined accordingly to account for the dimensionless forces acting on the cylinder. Results show that the differential pressure resistance on a square cylinder is 1.5 times higher… More >

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On the Effect of the Rotating Chamber Reverse Speed on the Mixing of *SiC* Ceramic Particles in a Dry Granulation Process

Dongling Yu[1], Zuoxiang Zhu[1], Jiangen Zhou[1], Dahai Liao[1,*], Nanxing Wu[1,2,*]

FDMP-Fluid Dynamics & Materials Processing, Vol.17, No.2, pp. 487-500, 2021, DOI:10.32604/fdmp.2021.014712

Abstract In order to control the accumulation of *SiC* ceramic particles on the wall of the rotating chamber in the frame of a dry granulation process, the effect of the wall reverse speed on the mixing process is investigated. In particular, an Euler-Euler two-phase flow model is used to analyze the dynamics of both *SiC* particles and air. The numerical results show that by setting a certain reverse rotating speed of the rotating chamber, the accumulation of *SiC* particles on the wall can be improved, i.e., their direction of motion in proximity to the wall can be changed and particles can… More >

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Effect of Al_2O_3 Nanoparticle on Cavitation Strengthening of Magnesium Alloys

Lei Liu[*], Chuanhui Huang, Xinghua Lu, Ping Yu, Longhai Li, Huafeng Guo

FDMP-Fluid Dynamics & Materials Processing, Vol.17, No.2, pp. 501-509, 2021, DOI:10.32604/fdmp.2021.015161

Abstract In order to study the effect of Al_2O_3 nanoparticles in the cavitation-based strengthening process of magnesium alloys, the impact of a micro-jet generated by bubble collapse has been considered. The strengthening mechanism is based on the transfer of the energy of cavitation due to bubble collapse to Al_2O_3 particles, which then undergo collision with the surface of the sample. The hardness, surface morphology, element content and chemical state of the strengthened samples have been analyzed by microhardness tests, SEM (scanning electron microscopy) and XPS (X-ray photoelectron spectroscopy) techniques. The results show that: after 5 min of strengthening, nanoparticles can be… More >

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REVIEW

A Review on the Evaporation Dynamics of Sessile Drops of Binary Mixtures: Challenges and Opportunities

Pradeep Gurrala[1], Saravanan Balusamy[1], Sayak Banerjee[1] and Kirti Chandra Sahu[2,*]

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Received: 01 September 2020 Accepted: 25 January 2021

ABSTRACT

The wetting and evaporation dynamics of sessile droplets have gained considerable attention over the last few years due to their relevance to many practical applications, ranging from a variety of industrial problems to several biological systems. Droplets made of binary mixtures typically undergo complex dynamics due to the differential volatility of the considered components and the ensuing presence of thermocapillary effects. For these reasons, many research groups have focused on the evaporation of binary droplets using a variegated set of experimental, numerical, and purely theoretical approaches. Apart from reviewing the state-of-the-art about the existing experimental, analytical, and computational techniques used to study the evaporation dynamics of binary sessile droplets, we also provide some indications about possible future research directions in this specific area.

KEYWORDS

Wetting dynamics; evaporation; sessile droplet; binary mixture; thermocapillary flow

1 Introduction

The study of the wetting and evaporation dynamics of sessile droplets has seen a lot of advancement in recent years due to its relevance in many practical applications ranging from industrial to biological systems [1–5]. A recent review by Brutin et al. [6] also highlighted the importance of this topic, especially in energy applications, with an increased number of droplet and evaporation publications in recent years. This subject also has applications in several modern technologies, such as spray cooling, DNA analysis, and complex fluid printing. Therefore, it is important to take cognizance of the state-of-the-art knowledge and understanding of this field and its future prospects that have been reviewed in the present study.

The present work undertakes an extensive review of wetting and evaporation dynamics for binary fluids. It is structured into five sections, namely the experimental, the semi-empirical (theoretical), the numerical, the influence of surface and fluid properties, and the future scope. The first three sections cover the various methodologies used in studying sessile binary droplets, and the last two sections discuss the effect of various parameters on the droplet dynamics and future scope, respectively. A deep look into this work shows the complexity involved in actually understanding the entire dynamics of sessile droplet evaporation. There are several ways of looking at a droplet evaporation problem based on the application.

Fluid Dynamics & Materials Processing

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DOI: 10.32604/fdmp.2021.014814

ARTICLE

Numerical Simulation of the Wake Generated by a Helicopter Rotor in Icing Conditions

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Received: 01 November 2020 Accepted: 20 January 2021

ABSTRACT

The wake generated by the rotor of a helicopter can exert a strong interference effect on the fuselage and the horizontal/vertical tail. The occurrence of icing on the rotor can obviously make this interplay more complex. In the present study, numerical simulation is used to analyze the rotor wake in icing conditions. In order to validate the overall mathematical/numerical method, the results are compared with similar data relating to other tests; then, different simulations are conducted considering helicopter forward flight velocities of 0, 10, 20, 50, and 80 knots and various conditions in terms of air temperature (atmospheric temperature degrading from −12°C to −20°C or from −20°C to −26°C). The results indicate that the rotor aerodynamic performance (i.e., the lift-to-drag ratio distribution of the rotor disc) drops significantly once the rotor undergoes ice accretion. More importantly, the icing exerts a different influence of the wake dynamics depending on the atmospheric conditions. Interestingly, the rime-ice firstly occurs on the inner portion of rotor blades and then diffuses outward along the blade radial direction with the decrease in atmospheric temperature.

KEYWORDS

Numerical simulation; helicopter; rotor wake; ice accretion

Nomenclature

a_0 =	Rotor coning coefficient
a_{1c} =	Rotor first-order longitudinal flapping angle
a_{1s} =	Rotor first-order lateral flapping angle
C_l, C_d =	Lift coefficient of rotor-blade airfoil and drag coefficient of the rotor-blade airfoil, respectively
C_T, C_H =	Rotor thrust and horizontal force coefficients
C_Y, C_Q =	Rotor side-force and torque coefficients
$\bar{e}$, σ =	Blade flapping hinge offset and rotor solidity, respectively
f =	Function symbol
g =	Gravitational acceleration
I_b, M_s =	Blade rotational inertia and blade mass, respectively
m_G =	The mass of the helicopter
N_r =	The number of segments along the direction of the blade-spanwise
N_c =	The number of segments along the direction of the blade-chordwise