PREFACE: TRANSFERS IN POROUS MEDIA

This special issue contains mainly invited papers which were presented at the 15th International Heat Transfer Conference held on August 10–15, 2014 in Kyoto, Japan. This conference is an important one in the field of heat transfer, held every four years, covering almost every aspect of heat transfer. From over 700 papers including around 30 keynote lectures, approximately 30 authors were invited to submit their papers within the scope of *Transfers in Porous Media*.

Contained herein, the comprehensive review paper "*Transfers in Porous Media*" by Prof. Quintard summarized multiple-scale methods for modeling transport in porous media and several methodologies to upscale the equations at a lower-scale to upper-scale model. The more general and classical problem of heat transfer in porous media was reviewed in this paper, with the emphasis on the fact that different behaviors and hence different models emerge at a given macro-scale, depending on the interplay of the various characteristic times and lengths characterizing the problem. Extensions to more complicated problems of transfer in porous media were then discussed, including coupling with mass diffusion, effects of heat sources, radiation, boiling, and so on. The article "*Adsorption and Transport of Water in Mesoporous Silica-Adsorption Measurements and Molecular Simulations*" by Daiguji et al. studied the adsorption–desorption isotherms and relaxation rates of water in Zr-doped two-dimensional hexagonal mesoporous silica with pore diameters of 3.8 nm. The measured relaxation rates at 298 K using a gravimetric method agreed with the molecular dynamic results in trend as well. The article "*Effect of Variable Porosity on Composite Heat Transfer in a Boundary Layer Flow*" by Dr. Nagaraju compared heat transfer in porous media for three different situations, namely (1) variable porosity, (2) constant porosity, and (3) absence of porous medium. Their results show that the rise in temperature in variable porosity medium is about 25% more in comparison with the absence of porous medium, and that the total heat flux in the variable porosity medium is about 79% more as compared with constant porosity medium. The article "*Thermal Conductivity of Ceramic Sponges at Temperatures up to 1000°C*" by Dietrich et al. reported about high-temperature heat transfer in ceramic sponges with open-celled solid network structures. The temperature was varied up to 1000°C, where thermal radiation has to be considered as one important heat transfer mechanism. The article "*Numerical Modeling of Three-Dimensional Heat Transfer and Fluid Flow Through Interrupted Plates Using Unit Cell Scale*" by Zhang et al. numerically studied the anisotropic pressure drop by the traditionally used Darcy and inertial terms, with the addition of another term representing mixing effect. Heat transfer between the fluid and plates was formulated in terms of Nusselt number vs. Reynolds number and approach angle of the mean flow. The article "*Discussion about Thermal Conductivity of Carbon Black Filled Rubber*" by Song et al. studied the thermal conductivity of carbon black filled natural rubber, where the heat conduction mechanism was explored based on the properties of carbon black and the distribution of carbon black in rubber. The article "*Turbulent Heat Transfer Modeling in Porous Media with a Multi-scale Second Moment Closure*" by Kuwata and Suga predicted the turbulent heat transfer in porous media by double (volume and Reynolds) averaged transport equations. The proposed models are evaluated in the thermal fields of fully developed square rod array flows, whose results suggest that the present models are promising for both conjugate and isothermal heat transfer conditions at the solid surfaces.

For applications in geothermal resources, the article "*Ground Heat Transfer from a Drainage Trench*" by Bottarelli et al. studied the energy performance of a drainage trench as a shallow ground heat exchanger coupled with a heat pump. Groundwater flow and heat transfer in the porous domain surrounding the trench were analyzed via a 3D numerical model, performing a 3-year simulation. The trench shows a good specific energy production and a significant capacity of smoothing thermal waves, and can be considered a convenient alternative in similar applications. For applications in environments, the article "*Thermal Transport Model of a Packed-bed Reactor for Solar Thermochemical CO_2, Capture*" by Reich et al. proposed a dual-cavity solar thermochemical reactor concept to capture carbon dioxide via the calcium oxide based calcination-carbonation cycle. The reactor is oriented beam-up wherein concentrated solar energy enters an aperture located at the bottom of the reactor. For applications in petroleum exploration and development, the article "*Experimental Evaluation of Water Sensitivity in Porous Media Using CT Scanning Method*" by Lv

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et al. proposed a new method in characterization and microscopic analysis of water sensitivity by the aid of CT scanning technology. Three formation core samples drilled from the same layer were used for waterflooding, gasflooding, and "designing waterflooding" experiments. The results show that the formation damage occurs only near the inlet end where the average porosity decreases 10% to 15%. Porosity reduction of large pore area was relatively higher than that of small pore area by comparing initial porosity histogram with final virtual porosity histogram. Microscopic understanding of water sensitivity is better understood in terms of materials produced in the reaction between brine and clay minerals and the porosity reduction.

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