3rd International Conference on Dynamics, Games and Science

DGS III 2014 - International Conference on Dynamics, Games and Science III

17 - 21 February 2014

University of Porto — Portugal

Keynote Speakers

Alberto Álvarez López, UNED, Spain
Alberto Pinto, University of Porto, Portugal
Athanasios Yannacopoulos, Athens University of Economics and Business, Greece
Bruno Oliveira, INESC TEC, Portugal
Carlos Braumann, University of Evora, Portugal
Charles Pugh, U.C. Berkeley, USA)
David Zilberman, University of California, USA
Diogo Pinheiro, Brooklyn College, USA
Elvio Accinelli, UASLP, Mexico
Filipe Martins, INESC TEC, Portugal
Flávio Ferreira, ESEIG, Polytechnic Institute of Porto, Portugal
Frank Riedel, Bielefeld University, Germany
Isabel Labouriau, University of Porto, Portugal
Jérôme Renault, Université de Toulouse, France
João Gama, University of Porto, Portugal
João Paulo Almeida, INESC TEC, Portugal
Jorge M. Pacheco, University of Minho
José Fernando Oliveira, University of Porto / INESC TEC, Portugal
José Martins, INESC TEC, Portugal
Marta Faias, NOVA University of Lisbon, Portugal
Mohammad Choubdar Soltan Ahmadi, University of Porto, Portugal
Nico Stollenwerk, University of Lisbon, Portugal
Onesimo Hernandez-Lerma, CINVESTAV-IPN, Mexico
Penelope Hernandez, University of Valencia, Spain
Rabah Amir, University of Arizona, USA
Renato Soeiro, University of Porto, Portugal
Robert MacKay, University of Warwick, UK
Rolf Jeltsch, ETH Zurizh, Switzerland
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Keynote Speakers
Thematic Sessions
Book of Abstracts
Conference Schedule

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MODELLING OF INTUMESCENT COATINGS KINETICS AND DYNAMICS OF SWELLING

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Abstract:

Intumescent coatings are reactive fire protection materials used to protect structural elements, increasing the fire resistance time and the structural integrity of the building for a standard period of time. During the fire exposure the intumescent paint start to decompose, beginning to melt, bubble and to swell, forming a multi-cellular charred layer which decreases the heat transfer from the fire to the substrate. The process is highly non-linear and geometrically characterized by a free boundary, in contact with the fire gases, and a moving boundary, that divides the char and the virgin layers, which may be considered a generalized Stefan problem.

The intumescent coating behaviour is based on the energy and mass conservation equations for the gas and solid fractions, and the transport of gas through the porous char by empirical Darcy's law. The numerical method is based on an approximation by finite differences with local and adaptive space refinement (r-h), with a decoupled time evolution of the energy and mass equations by the method of lines (MOL).

The methodology is applied to the one-dimensional two-phase Stefan problem and the viscid Burger equation. The results presented shows the mesh adaptation to the solution, increasing or decreasing the number of nodes with the "error" estimation. Also a comparison of expansion and temperature between the numeric and experimental results is made for intumescent coatings exposed to the standard fire curve (ISO834) on a fire resistance furnace.

Key Words: *Intumescent coatings, Fire protection, Modelling, Moving boundary, Adaptive mesh.*