# REACTING POROUS MEDIA - SIMULATION OF THERMAL CONVERSION OF WOOD

KAMIL KWIATKOWSKI[1,2], PAWEL J. ZUK[3]
[1]*Institute of Theoretical Physics, Faculty of Physics, University of Warsaw, kamil.kwiatkowski@fuw.edu.pl*
[2]*Interdisciplinary Centre for Mathematical and Computational Modeling, University of Warsaw*
[3]*Institute of Theoretical Physics, Faculty of Physics, University of Warsaw, pawel.zuk@fuw.edu.pl*

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It is a common situation when mass and/or heat flow in porous medium drives chemical reactions, thermal processes or other conversions of the material. As a result reacting porous medium is evolving and its properties are changing in time. Evolution of porous medium in turn has an impact on the flow and heat transfer and possibly modifies whole process.
An industrial example of such situation is a process of pyrolysis and gasification of wood or other biomass. A complex evolution of porous structure of wood takes place while lignocellulose porous material is conversed into flammable gas, spectrum of liquids and charcoal. Classic variants of this process like charcoal preparation or wood gas production are well known but modern industrial application requires real breakthrough in technology and understanding. For a long time a main, but limited, sources of knowledge were laboratory experiments but recently new impulse came from numerical simulations.
We shortly review the approaches in modelling of reacting porous media in currently available in *OpenFOAM* and *foam* with an emphasis put on the thermal conversion of biomass (processes for fluidized-bed are beyond the scope of this contribution). We discuss their advantages and stress their limitations. For detail simulation of thermal conversion of single, thermally thick particle or fixed-bed the new approach is needed handling complex evolution of materials, their properties and structures.
With this in mind, we present a revised solver *biomassGasificationFoam* together with a complementary library *biomassGasificationMedia* working with *foam-3.1*. The solver is developed to simulate conversion of reacting porous materials with constantly evolving structure, composition and parameters.
The solver is based on transport equations spatially averaged inside computational domain both inside and outside porous medium. The porous medium is introduced as a volumetric porosity field with corresponding permeability tensor. The equations are the same for whole computational domain, but at a surface of the porous medium physical parameters present in solved equations are discontinuous like in a fictitious domain approach. For example in the momentum equation both the dArcy term and the usual viscous term of a Newtonian fluid are formally present inside and outside the porous medium, but permeability has a jump across the interface. The solid impacts on flow as an additional isotropic or anisotropic d'Arcy resistance, which is zero outside the porous material.
We fine-tuned and tested this solver to simulate pyrolysis and gasification of wood in a regimes of thermally thin and thermally thick particles.