Postdoctoral position

Modeling and experimental study of multiphase heat and mass transport in porous media for soil remediation using microwave heating

Job location: Orléans-France

Start date: December 2020 (or January 2020)

Contract duration: 12 months

Application: Send CV, motivation letter, and the names of two references to
h.davarzani@brgm.fr

Context and objectives

Microwave heating presents a promising technique for remediation of volatile and semi-volatile contaminated soil providing short time treatment and keeping high efficiency. However, contrary to the conventional thermal conduction heating technique, the moisture plays an important role in the absorption of microwave and the distribution of heat. The objective of this study is to understand better how the soil temperature changes during microwave heating and what is the influence of the type and saturation of liquid, and also soil type on the temperature evolution and remediation efficiency.

The first step will be to study microwave heating of moist soil in a large and well-instrumented 3D column. The main objective is to determine the heat propagation and soil drying homogeneity. Then, a Darcy-scale numerical model of soil microwave heating, using COMSOL Multiphysics®, will be developed taking into account the coupled phenomena of electromagnetic heating, heat, and mass transfers with

phases changes in porous media. The model will then be validated by the data obtained experimentally in the laboratory. The model should take into account the strong couplings that exist between wave propagation and heat transfer by taking into account the latent heat of vaporization including boiling phenomena, two-phase (gas, water), and three-phase (gas, water, and pollutant) flow in porous media. The validated model will then be used to model the microwave heating using an antenna in a real case.

Work summary

- State-of-the-art on coupled multiphase flow phenomena (water/pollutant/air) during classical conductive heating and microwave heating,

- Perform experiments in laboratory conditions

- Development of a numerical model using COMSOL Multiphysics® for coupled multiphase flow and microwave propagation,

- Validation of numerical approach with experimental data.

Requirements

- Ph.D. degree in multiphase flow and transport in porous media or fluid mechanics
- Publications in international peer-reviewed journals
- Solid background in numerical simulation and interest in experimental studies
- Experience in modeling multiphase flow and transport in porous media
- Fluency in English, writing scientific papers
- Highly motivated and self-directed person

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