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Program & Abstracts

Wave sequences for solid fuel adiabatic in-situ combustion in porous media

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We consider a simplified mathematical model for forward combustion due to injection of air into a porous medium containing solid fuel. We consider the Arrhenius law for the reaction rate. In the adiabatic case studied here, reaction at the back of the combustion zone ceases due to complete lack of fuel. Ahead of the combustion zone we consider that there is abundant fuel, under two distinct conditions surrounding the combustion front. The first condition is the oxygen controlled case, where there is a complete oxygen consumption. The second condition is the temperature-controlled case, where the temperature is considered to be the same as the initial reservoir temperature. For this second case we consider a cut-off in the Arrhenius law to simplify the mathematical analysis. As there is interaction between the combustion wave and other waves, we focus on the solution of the Riemann problem with combustion taking into account all possible waves. Given initial reservoir and injection conditions, we prove that there is a unique time asymptotic sequence of three waves for combustion with complete oxygen consumption while for the temperature-controlled case, there is a one parameter family of wave speeds and strengths.

References

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How to predict soil water holding capacity using physically based equations?

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The soil surface and porosity govern the capacity of soil to hold water. In soil science, many functions were developed to estimate parameters of equations to describe soil water retention and soil hydraulic properties. These functions were created using statistical techniques based in soil properties parameters less laborious and cheaply obtained than the direct measurements of soil hydraulic parameters. These functions are called *pedotransfer functions (PTF)* and fill the gap between the available soil data and the properties required for modeling soil water fluxes. The physically based equations approach to obtain functions of water retention and hydraulic conductivity of the porous media (soils) may be advantageous, as the predictors will not be select by statistical procedures and be strongly influenced by the available data base and technique used, moreover the predictors will have also a physical meaning. Examples of physically based equations to predict soil water content in function of dielectric conductivity in soils is given and the demand of physically based equation to predict soil water hold capacity and soil hydraulic conductivity is addressed.

Investigation for the Recovery of Medium-Heavy Oil by Gas Injection

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Enhanced oil recovery by CO_2 injection is becoming increasingly important means to improve the recovery of (medium-heavy) oil reservoir. In this paper will discuss core-flood tests done to investigate the potential of several CO_2 and N_2 injection schemes. CO_2, N_2, and brine were injected either (1) on continuous mode or (2) in a water-alternating-gas (WAG) mode into Bentheimer sandstone cores previously saturated with an heavy oil, having a viscosity in the range of 700 to 1,000 mPa·s and a density ranging from 16 to 17 °API. The injection strategies tested resulted in substantial incremental oil recovery (relative to OIIP), but values hereof varied from strategy to strategy. The core-flood test with continuous CO_2 injection following extensive water flooding resulted in an incremental recovery of 31.1 % over tertiary CO_2 flooding stage. Continuous N_2 and CO_2 injection in a secondary mode resulted in incremental recoveries of respectively 14.8 % and 24.5 % over secondary drainage stage. Subsequent long water slugs resulted in both cases in further increase of the recovery by 48.1 % and 29.2 %. N_2 and CO_2 WAG with WAG ratios and slug sizes chosen based on optimized reservoir simulations resulted in similar recovery factors. Overall recoveries for five schemes used in core-floods were in the range of 49.6 to 65.9 %. The paper discusses the possible mechanisms responsible for the oil displacement for each injection strategy and discusses conceptual ideas for mathematical and numerical modeling.