Riemann Solution for system of balance law modeling steam injection with several components and phases into a porous medium.

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Abstract

Generally, more than 50% of all the oil contained in the reservoirs cannot be recovered by primary and secondary techniques. In the case of the heavy oil, the recovered amount is not 30% of the total.

This is a problem, because most of the reserves that are discovered nowadays consist basically of this type of hydro-carbon. With the decline of the light oil reserves, the exploration of heavy oil and similar will be indispensable for the maintenance of the demand each day increasing of this material in the world.

The great difficulty of the recovery of the heavy oil is basically because this is very viscous relatively to the injected fluid to dislocate it in the secondary process (in general gas or water) and therefore has little mobility. An applied sufficiently useful form for the reduction of viscosity is the heating of the oil in the well and one technique applied for that is the vapor co-injection.

These physical phenomena are modeled by a class of balance equations where the balance represents the mass interchange between phases in porous media.

We present a new general theory which deals with Riemann solution for a large class of balance equations. As applications of this theory, we present a model of steam/water/nitrogen injection in a horizontal porous media. The systems of equations are based on mass balance, energy conservation and Darcy law of force. We neglect compressibility, heat conductivity and capillarity effects. We develop the general theory for a 4x4 system of balance equations. We solve the Riemann problem with application to clean up sites.