Evaluation of different in-situ production strategy from oil shale using a general purpose thermal simulator

Chung-Kan Huang, Yi-Kun Yang and Milind D. Deo Department of Chemical Engineering, University of Utah, Salt Lake City, Utah

According to EIA, there are 2.9 trillion barrels of recoverable oil from oil shale, of which about 750 billion barrels are in the United States.

The two main methods of recovering oil from shale are mining and extraction, and in-situ production. There are a number of in-situ production possibilities. In this paper, a K-value based general purpose thermal model of subsurface flow and reaction processes is used to study two in-situ production processes. The first one is the direct heating process, which converts the organic matter in shale into oils and gases slowly by using an embedded heat source, with subsequent production of hydrocarbons generated. The second one is the in-situ combustion option in which the oils are the products of combustion reactions. In the simulator used, it is assumed that the shale initially consist of kerogen (solid), associated water, and other inorganic matter. As kerogen is converted to oils by pyrolysis or combustion, some fundamental changes occur in the structure of shale. The conversion of kerogen to oils is assumed to be a series of thermal pyrolysis reactions starting from the kerogen in the slow heating process, and a set of parallel reactions of pseudo-components in the in-situ combustion process. This paper presents the formulation details and numerical solution procedures of the simulation and the compositional results from the two different recovery strategies using a hypothetical field example. In addition, the sensitivities of properties of the shale and fluids to oil production and operational strategies are examined.