In-situ thermal upgrading of bitumen and shale oil by radio frequency (RF) electrical heating

Richard Snow

PyroPhase Inc, Chicago IL, USA

Production of oil from shale is inherently a pyrolysis process, breaking down kerogen to oil, whereas oil sands are normally heated enough to lower the viscosity so it can be produced by gravity flow. But when oil sands are heated to 250°C pyrolysis occurs as well, resulting in product with a lighter distillation curve.

Upgrading of produced bitumen is usually done in aboveground cokers by heating to 300-350°C at short residence time. In-situ upgrading avoids the cost of the aboveground reactor and of reheating, and it simplifies the refinery flow sheet. Pyrolysis increases the hydrogen/carbon ratio by leaving a portion of the carbon behind as coke. In-situ upgrading sequesters extra carbon by leaving it in the original deposit and avoids production of CO2 from burning the coke. Pyrolysis of oil shale shows that portions of the sulfur and nitrogen are also sequestered, improving oil quality.

Reports on kinetics of coking will be reviewed. These have focused on short reaction times at high temperatures. The slower field test results fall on a similar Arrhenius-temperature curve, and are also similar to curves for oil shale pyrolysis. Free-radical reaction mechanisms have been proposed to explain the results.