Numerical and Laboratory Investigations for Maximization of Production from Tight/Shale Oil Reservoirs: From Fundamental Studies to Technology Development and Evaluation

REPORT ON
Definition of Metrics and Methodology for Screening Production Strategies

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Background

The definition of metrics and methodology for the screening of production strategies is the subject of Task 2 in the project. This task aims to define the feasibility parameters, the specific objectives and metrics of the screening study, and the corresponding methodology for the evaluation of the various strategies to be investigated. This task includes discussions among the members of the LBNL group, interactions with academia and discussions with industry specialists from companies with significant shale oil properties that are actively involved in low-viscosity fluid production from oil shale reservoirs.

Status and Conclusions

Work on Task 2 is completed. Several internal discussions of the LBNL team have led to the identification (and quantification, where appropriate) of the parameters, objectives and metrics of the study, as well as the methodology.

The first step involved the determination of the reference (base) cases, and the LBNL team decided that these have to be two: the first is the case of production from unfractured or naturally fractured reservoirs, and the second is that of production from a hydraulically (or pneumatically) fractured reservoir. Thus the first reference case provides the minimum level of the possible production from these systems. The presence of the induced fractures in the second reference case is expected to result in a significant improvement of production over that in the first reference case. After significant discussions, the consensus was that it would not be possible to ignore either reference case because they both define needed baselines: that for a non-stimulated system, and the current standard for ultra-low permeability systems. Any improvement of production by any of the technologies under investigation has to be measured against these references.

The next issue the LBNL team considered was the definition of the concept of recovery under conditions of ultra-low permeability. Activities in this task involved internal discussions, as well as discussions with researchers in industry and academia. After several iterations, the LBNL agreed on a definition of "success" of recovery of shale oil that involves an increase in production (rate **and** cumulative) of at least 50% higher than that realized in the 2nd reference case (i.e., the one involving hydraulic or pneumatic

fracturing) over a period that corresponds to the economically productive life of a shale oil well. On current evidence, this period is expected to be in the 3 to 5 year range.

Additionally, the LBNL team reached a conclusion that it is not possible to use a single metric/approach to quantify recovery. Thus, recovery in this study will no longer be represented by a single number or a range of numbers, but will instead be represented by a time-variable function (i.e., a graph) of the following two quantities:

(a) The remaining fraction of the original oil-in-place of the volume of the reservoir subdomain defined by the well spacing (assuming standard horizontal wells)
(b) The remaining fraction of the original oil-in-place of the volume of the Stimulated Reservoir Volume (SRV - usually smaller than that defined by the well spacing)

Note that there other issues affecting these metrics of recovery (e.g., difficulties in describing drainage areas in heterogeneous systems), stage and cluster spacing, etc.), but it is expected that the complexities of these issues are attenuated over the chosen period of evaluation, i.e., 3-5 years.