

Author's Reply to Discussion of A Prediction Technique for Immiscible Process Using Field Performance Data

SPE 13793 L

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Startzman and Wu indicated that from a limited number of field studies the "semilog WOR" plot is as good as or even superior to the "frontal advance plot." In response I would like to bring to their attention the following points.

1. To assume that log WOR vs. E_R is a straight line means to assume a relationship such as

$$\ln(\text{WOR}) = a E_R + b, \dots \dots \dots (1)$$

where a and b are constants. From the equation $E_R = mx + n$ derived in Ref. 2, to make Eq. 1 true, one has to assume that the term $(1 + \text{WOR})/\text{WOR}$ is constant for the entire range of the recovery curve as shown below.

Since

$$x = \ln\left(\frac{1}{f_w} - 1\right) - \frac{1}{f_w},$$

$$\ln(\text{WOR}) = \frac{1}{m} E_R + \frac{1 + \text{WOR}}{\text{WOR}} - \frac{1}{n} \dots \dots \dots (2)$$

Since this assumption is not justified, there is really no theoretical basis for a "semilog plot of WOR vs. recovery except at very high WOR's.

2. If the semilog plot of WOR vs. recovery has worked for a few cases, one should not assume that it is universally applicable to all conditions.

3. The "cut-cum" plot technique presented in Refs. 2 and 3 was recommended explicitly for mature waterfloods. For the ranges of WOR above unity, the assumption of a straight line of log (k_w/k_o) vs. S_w is quite acceptable from laboratory and field data. To prepare a straight line plot for log (WOR) vs. recovery including WOR's below unity requires the assumption of log (k_w/k_o) vs. S_w to be a straight line from S_{wir} up. This is an erroneous assumption and can lead to serious errors. I have included an example of log (WOR) vs.

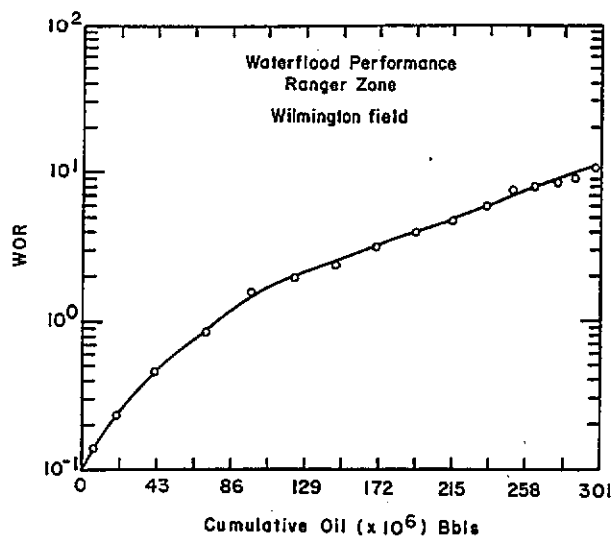


Fig. R-1—WOR plot for Ranger zone, Wilmington field.

recovery for a mature waterflood in the Wilmington field (Fig. R-1). The errors caused by extrapolation of the early waterflood data to estimate future recoveries are quite substantial.

References

1. Startzman, R.A. and Wu, C.H.: "Discussion of Empirical Prediction Technique for Immiscible Processes," *J. Pet. Tech.* (Dec. 1984).
2. Ershaghi, I. and Omeregic, O.: "A Method for Extrapolation of Cut vs. Recovery Curves," *J. Pet. Tech.* (Feb. 1978) 203-04.
3. Ershaghi, I. and Abdassah, D.: "A Prediction Technique for Immiscible Processes Using Field Performance Data," *J. Pet. Tech.* (April 1984) 664-70.

SI Metric Conversion Factor

$$\text{bbl} \times 1.589 873 \quad \text{E-01} = \text{m}^3$$

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