СЕКЦІЯ НАФТОГАЗОВОЇ ІНЖЕНЕРІЇ ТА ТЕХНОЛОГІЇ

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HYDROCARBON RECOVERY BY FRACTIONAL FLOW CURVES

The technique commonly used is to predict the expected oil recovery through continued flooding using one of the standard calculation procedures (Stiles, Dykstra –Parson, Johnson, Buckley-Leverett, etc.) [1-2]. Typically, a common calculation technique predicts expected oil recovery through continued flooding. The Buckley-Leverett calculation uses relative permeability data and fluid viscosities to obtain displacement efficiency estimates. Frontal displacement theory involves using fractional flow and frontal advance equations. By combining the fractional flow equation with Darcy's equation, we construct the fractional flow curve as a function of water saturation. Further, we plot the water saturation profile as a function of distance and time by using the frontal advance equation. For the chosen water-oil and gas-oil relative permeability curves and viscosities, with a dip angle set to zero and estimated water and gas injection rates [3-4].

The Buckley-Leverett (1942) equation describes a two-phase immiscible displacement in a linear system. The Buckley-Leverett fractional flow equation for both gas and water floods is given by Eq 1. We assume that in a gas flooding, gas is displacing phase. Thus gas rate, qg, replace water rate, gw, when considering gas instead of water flooding. We use the same equation for water and gas displacement processes:

$$f_l = \frac{q_l}{q_o + q_l},\ l = w, g \qquad (1)$$

For *l*=*w*:

$$f_w = \frac{1}{1 + \frac{\mu_w\, k_{ro}}{k_{rw}\, \mu_o}} \qquad (2)$$

$$f_{ws} = \frac{q_w/B_w}{q_w/B_w + q_o/B_o} \qquad (3)$$

Welge (1952) presented a straight line drawn from Swc (assuming that Swi=Swc) tangent to the fractional flow curve, fl, l=w,g. The saturation value at the tangent point is the breakthrough, BT time saturation [5].

Buckley-Leverett One-Dimensional Displacement Results

Oil recovery with water injection at breakthrough, BT, is 71% compared to an oil recovery of 60% with gas injection. An additional gas flood advantage is that BT time is achieved after only 6,274 days, compared to the water BT time of 12,390 days. Even though the GI flood in PV is ten times less permeable (as explained below in Summary and Conclusions), the gas BT time is almost half the water BT time, as shown in Fig. 1. The BT time for cumulative rates also differentiates, and thus water BT time is twice as long as the gas BT time.

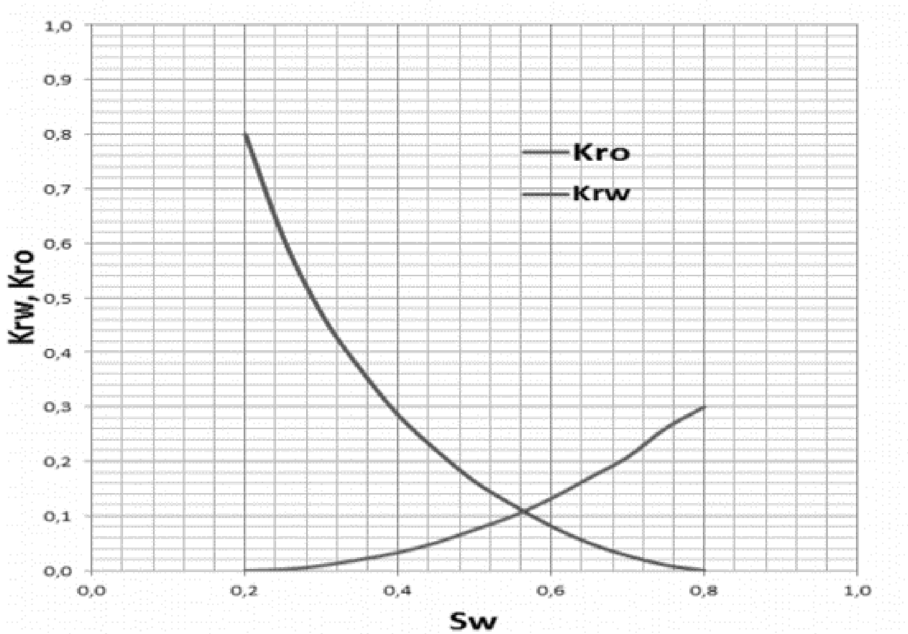

Fig. 1. Relative Permeability Curves for Water Displacements

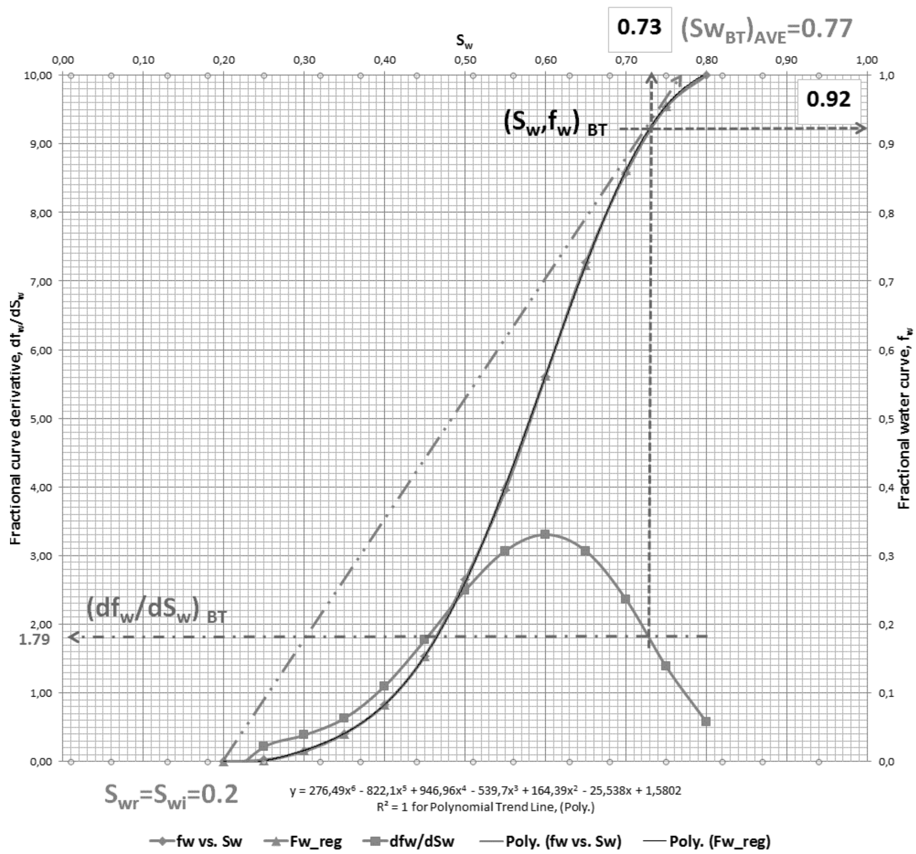

Fig. 2. The Fractional Flow Curve for Water Displacing Oil

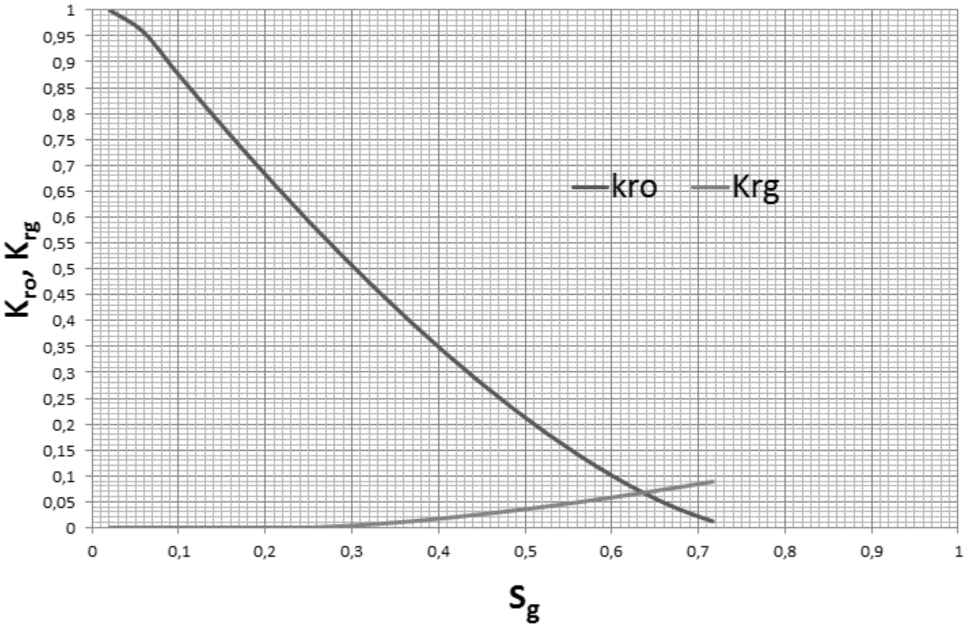

Fig. 3. Relative Permeability Curves for Gas Displacements

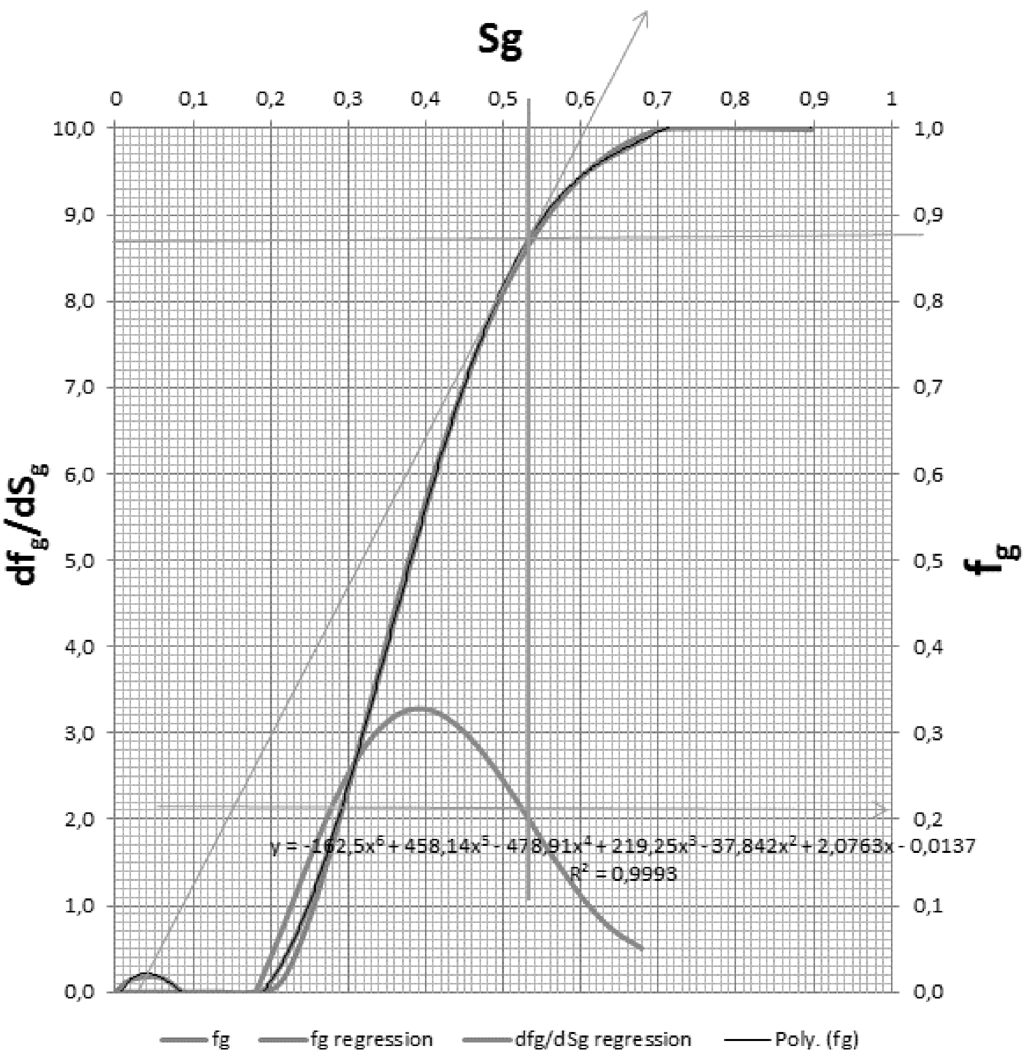

Fig. 4. Fractional Flow Curve for Gas Displacement

This study illustrates the screening techniques for water and gas injection recovery methods for producing a given segment of a North Sea Reservoir. This study provides the preliminary screening as a necessary first step before using more in-depth laboratory experimentation and numerical simulation studies for further engineering considerations.

The study investigated recovery, production rates, and cumulative production profiles for water and gas displacements. It relates to homogeneous porous media. Thus, further investigation should use additional heterogeneous methods developed by Craig, Stiles, and Slider [6].

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ОСОБЛИВОСТІ ВИДОБУВАННЯ ВИСОКОВ'ЯЗКИХ НАФТ ШЛЯХОМ ПРОВЕДЕННЯ ЦИКЛІЧНОГО ЗАВОДНЕННЯ

Споживання великої кількості нафтопродуктів у всьому світі зростає з року в рік, але ефективність вилучення флюїду з нафтоносних пластів за допомогою промислових методів розробки в багатьох країнах вважається незадовільною. Багато родовищ вступили в останню – завершальну – стадію розробки, яка характеризується значним зниженням дебіту свердловин, що пов'язана з різними проблемами, зокрема з обводненням.

Сучасні методи підвищення нафтовидобування переважно базуються на заводненні. Проте гідродинамічні методи регулювання охоплення пластів застосовні лише за певних геолого-фізичних та технологічних умовах, тобто не володіють універсальністю і не забезпечують повне