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## **A New Approach to IPR Curves of Horizontal Wells in Two-Phase Reservoirs**

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### **Abstract**

The inflow performance of 31 theoretical solution-gas-drive reservoirs was simulated. The reservoirs contained a wide range of rock and fluid properties, relative permeability characteristics, and the wells were assigned with various skin effects. Two types of inflow performance relationships (IPRs) were developed from about 13,500 data points. The first type, using traditional IPR nomenclature, represents normalized pressure versus the normalized oil flow rate from a horizontal well to its maximum flow rate which is allowed to be damaged. The second relates normalized pressure with the ratio of the flow rate to the maximum theoretical, undamaged flow rate.

Results show that Type 1 IPRs are strongly dependent on bubble-point pressure and reservoir depletion effects. Skin has serious effects only on un-normalized, Type 2 curves.

Nonlinear regression techniques were used to develop new equations that fit normalized flow rate as a function of normalized pressure, depletion, and bubble-point pressure. Type 2 equations were developed that included the effects of skin, depletion, and bubble-point pressure. The resulting equations proved to be robust and generally are significantly more accurate than traditional IPR approaches for horizontal wells.

### **Introduction**

One of the most important problems confronting a petroleum engineer is predicting pressure/production behavior of a horizontal well in an oil and gas reservoir given a host of possible operating schemes. By predicting the response of an oil reservoir for various hardware and pressure scenarios, a first-case estimate to maximize profitable reserves development can be achieved.

Computer solutions for the performance prediction of solution-gas-drive reservoirs have evolved since the early 1950's. However, most methods were algebraically intensive and required considerable computation time. At first work was done for vertical wells and it has been repeated for horizontal wells in the last decade. By plotting the bottom-hole flowing pressure versus flow rate of a horizontal well, a useful method for estimating oil-well productivity, known as the IPR, can be established.

This study has tried to examine several factors that affect the calculation of IPR curves for horizontal wells. For simulation and calculations important variables include reservoir rock properties, fluid properties, bubble-point pressure, and depletion. Also, near-well damage can dramatically decrease well productivity.

By calculating the performance of numerous solution-gas-drive reservoir cases, improved correlations can be developed that could reproduce the actual well performance. With the inclusion of skin, one may accurately predict the level of response that might be achieved by decreasing the severity of well bore damage by a stimulation technique, such as matrix acidizing or fracturing.