# WELL – A new inversion method to interpret profiles From Distributed Temperature and Pressure Measurements in Horizontal Wells - 2007

* The use of distributed temperature and pressure measuring devices in intelligent well completions is increasing. It represents a mean to monitor the inflow profiles without any well intervention. The profiles of pressure and temperature are affected by the inflow profiles of the various phases being produced.
* This inversion process is more challenging for horizontal wells than for the vertical ones.
* Water and gas production have a unique temperature signature
* In well logging and monitoring, the principle parameters that are measured are pressure, temperature and flow rate.
* The fiber optics promotes pressure and temperature measurement accurately and inexpensively by DTS and DPS. (1993)
* Metering flow rate is still difficult. However, to take full advantages of intelligent well completions, real-time monitoring of the downhole flow conditions such as flow rate profiles and locations of excessive water or gas influx is essential.
* The research proposes an inversion method to obtain downhole inflow conditions from temperature and pressure profile data
* The cooling effect by gas is much larger than of water because the gas temperature actually cools off below the geothermal temperature while oil and water warm up.

# WELL – A Comprehensive Model of Temperature Behavior in a Horizontal Well – 2005

* Use of DTS is becoming common for monitoring producing wells through a real-time measurement of temperature profile; this information can be inverted to infer the types and amounts of fluid entering along the wellbore.
* That information is essential for reservoir management to identify excessive water or gas influx, to guide the action of sliding sleeves (standard component for the completion of producing gas or oil wells used to shut off flow from a reservoir zone), or other downhole flow control devices.
* Recently (2000), interpretations of temperature profiles in horizontal wells are reported to be useful to identify types of fluid flowing to a wellbore
* Current fiber optic measurements can provide a near-continuous profile of distributed temperature in the wellbore with a resolution less than 0.1 ºC, over a distance of several kilometers, with a spatial resolution of one meter, and with a measurement time of less than a few minutes.
* Reservoir and wellbore temperature models are necessary to identify the causes of a measured temperature variation and relate it to the inflow profile of the well. These models should account for all the subtle thermal energy effects including the Joule-Thomson expansion, viscous dissipative heating and thermal conduction.
* The reservoir and temperature are intimately coupled and this coupling should be included in the model of the process.
* Temperature anomalies can be interpreted to define phase inflow profiles.
* Results from the 1D analytical reservoir solution indicate that the inflow temperature can change from the geothermal temperature (at the reservoir boundary) by a few degrees Fahrenheit.
* There is heat transfer from the reservoir to the wellbore, so we must account for it by a coupled wellbore and reservoir model.
* There are little changes on the temperature profiles if the liquid flow rate is quite small or if the pressure drop along the well is small for gas production.
* The temperature profile shows strong discontinuity in its slope when we pass between zones that are producing different fluids.
* Temperature measurements can be used to infer fluid inflow when we have oil wells flowing at a high rate, gas wells or in wells with a small diameter.

# WELL – Interpretation of Temperature and Pressure Profiles Measured in Multilateral Wells Equipped with Intelligent Completions

* Intelligent wells: a technology that is rapidly evolving to continuously and permanently monitor downhole temperature, pressure and volumetric flow.
* Important phenomena involving flow rate prediction from the pressure and temperature profiles: Joule-Thompson effect (heating of oil and the cooling of gas).
* In vertical or near vertical wells, the wellbore pressure is usually dominated by hydrostatic difference and the wellbore temperature by the geothermal temperature, both of which change with depth.
* For horizontal or near-horizontal wells, both pressure and temperature profiles are almost constant.
* Even when there is no gravitational pressure drop, regarding wellbore pressure as constant results in errors in estimated production profiles. When dealing with temperature profiles one has to have even more care.

# RESERVOIR – An equation of state Compositional Model

* Describes an implicit, three-dimensional formulation for simulating compositional-type reservoir problems. Applicability of this model ranges from depletion or cycling of volatile oil and gas condensate to miscible flooding operations.
* This formulation uses an equation of state for PHASE EQUILIBRIUM and for PROPERTY CALCULATIONS. The EOS provides consistency and smoothness as gas- and oil-phase compositions and properties converge near a critical point. This avoids computational problems near a critical point associated with the use of different K-value correlations.
* Black-oil reservoir allows an assumption that reservoir gas and oil have different but fixed compositions, with the solubility of gas in oil being dependent on pressure only
* The reservoir problems requiring compositional treatment can be divided into two types. The first type is depletion and/or cycling of volatile oil and gas condensate reservoirs, the second type is miscible flooding.
* In this model, hydrocarbon-phase relative permeability and capillary pressure are dependent on IFT in addition to saturation.

# RESERVOIR – A generalized Compositional Approach for Reservoir Simulation – 1983

* Black-oil models are used to study conventional recovery techniques in reservoirs for which fluid properties can be expressed as a function of pressure and bubble-point pressure.
* Compositional models are used when either the in-place or injected fluid causes fluid properties to be dependent on composition also.
* The paper describes a compositional modeling approach useful for simulating both black-oil and compositional problems. The approach is based on the use of explicit flow coefficients.

# RESERVOIR MANAGEMENT – What is Reservoir Management?

* Reservoir management practice relies on use of financial, technological, and human resources, while minimizing capital investments and operating expenses to maximize economic recovery of oil and gas from a reservoir. The purpose of reservoir management is to control operations to obtain the maximum possible economic recovery from a reservoir on the basis of facts, information, and knowledge.
* During 70’s and 80’s synergism between geoscientists and reservoir engineering proved to be very successful. The value of detailed reservoir description with geological, geophysical, and reservoir-simulation techniques is emphasized. Even though the values of other disciplines, e.g., production operations and drilling and other engineering functions like facilities engineering were not realized to their fullest extent.
* Reservoir management has now matured to the point where great emphasis is place on working as a crossfunctional team, involving all technical areas, management, economics, legal, and environmental groups.
* Using numerical simulation, the reservoir engineer today seeks more data, both in quantity and quality, from the geoscientists. On the other hand, history matching of the reservoir’s performance and utilization of a numerical simulation model can lead to feedback of geological information to the geologist.
* Current reservoir management approaches look at integration of data, tools, technology and people.
* Geostatistics modeling of reservoir heterogeneities is playing an important role in generating more accurate reservoir models. It is useful in modeling the variability of reservoir properties and the correlation between related properties
* Geostatistics enables geologists to put their valuable information in a format that can be used by reservoir engineers.
* Geochemistry identifies reservoir fluids
* Reservoir simulation model should be developed jointly by engineers and geoscientists
* The need for accurate input data in reservoir simulation should always be analyzed in the light of the sensitivity of computed results to variations in those data
* “Select the least complicated model and grossest reservoir description that will allow the desired estimation of reservoir performance”
* Economic optimization is the ultimate goal of reservoir management