Hypothetical Approach to Estimate Recovery of Shale Gas in Lower Cretaceous Sember Formation of Lower Indus Basin, Pakistan, Using Simulation Techniques

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Abstract

Production of natural gas from tight shale reservoirs, known as "shale gas", has an important extent of maintaining natural gas prices as a result of valuable supply and pressure demands. Shale gas has proved as a big challenge for Pakistan in meeting the energy needs due to over population and high economic demand. Controlling the country's energy requirements needs to utilize both unconventional and conventional energy resources.

The purpose of taking this topic as aresearch is to understand the role and importance of unconventional plays to explain the technologies involved in the production of shale gas, potential impacts of its production and to estimate the producible gas. The objective of our work was to develop the data sets, methodology and tools to determine values of original gas in place (OGIP), technically recoverable resources (TRR), recovery factor (RF) and economic viability in highly uncertain and risky shale gas reservoirs. To complete our research objective, we used reservoir simulator to estimate the original volume of gas in place, production performance prediction and estimate the amount of TRR that are economically recoverable resources (ERR) for a variety of economic situations.

Shale is a clastic sedimentary rock that often carries siltstone and mudstone and under the specific conditions of temperature and pressure gas is formed within these rocks that are known as the shale gas. Actually the shale is the soft formation that usually formed of the pre-existing rocks which have been deposited, elated, worn out and transported into new area and takes into new rock form. The organic matter that is present in shale rock is that, which was deposited with the fragments of pre-existing rocks. Shale is easily found in those areas where normal conventional plays are present but it is found in the original rock or sometimes in the reservoir rock where this organic material has migrated upward. Shale is usually considered as unconventional source of energy. Unconventional and conventional resources are totally two different stories, the conventional resources or formations contain a large amount of natural gas and crude oil while the unconventional formation specifically tight gas and shale gas has very less permeability that limits the natural flow of hydrocarbon from them.

Estimation of contacted gas-in-place/reserves in unconventional (low/ultra-low permeability) gas reservoirs is a problematic issue, and the uncertainty associated with the estimate is relatively high. Gas shales have become an attractive target because they represent a huge resource and as the price of gas rises, the economic challenge of their development is reduced. Multiple operators are currently leasing and evaluating gas shale properties throughout the world. Key reservoir parameters for gas shale deposits include: 1) thermal maturity, 2) reservoir thickness, 3) total organic carbon (TOC) content, 4) adsorbed gas fraction, 5) free gas fraction within the pores and fractures and 6) permeability. The first two parameters are routinely measured. A number of simulation cases were run. Various physical assumptions were used for the saturations and properties**.**

For calculating and evaluating the maximum possible recovery, a hypotheticalmodel containing the parameters of the lower Indus Basin is evaluated. For the optimum purpose, a 3D simulation model with different reservoir properties such as porosity, permeability, depth etc. as simulator input, is used. The study reveals potential and characteristics of shale reservoir to grade the areas in term of shale thickness, its hydrocarbon generation potential, current depth and maturity for shale gas exploitation.

The study reveals that, how can we produce shale gas in an economic and appropriate way? Exploitation and exploration of shale gas in Pakistan with optimum production will overcome the energy crises and energy requirements. Development of shale gas will be capable to overcome the gas needs for almost next 50 years. The applications also include the estimation of the maximum/ minimum production rate to acquire maximum recovery of shale gas.

Shale gas potential of lower cretaceous sember formation in lower Indus Basin was studied with theoretical concept and different logs were used to estimate the TOC, composition, vitrinite reflectance etc. of shale gas. This research reveals the maximum recovery of shale gas in an economic and valuable way to meet the energy requirements. The study explores that how optimum recovery of shale gas will be obtained, along with the possible production rates while taking in account the permeability (both horizontal and vertical) of tight shale reservoirs.