Tight Gas Sands

Tight gas sands are defined as sandstone formations with less than 0.1 millidarcy permeability. The millidarcy is a unit of measurement related to the ability of a fluid to pass through a porous medium. The degree of permeability depends upon the size and shape of the pores, the size and shape of their interconnections, and the extent of the latter. It has been estimated that total-gas-in-place in the United States may exceed 15,000 trillion cubic feet. The size, location, and quality of the resource varies.

Tight gas sands are considered to be unconventional continuous reservoirs, as opposed to conventional discrete reservoirs that have provided the major part of oil and gas production since the first well was drilled by Col. Drake in Pennsylvania. Continuous reservoirs include not only tight gas sands, but coalbed methane, as well as the tight Devonian Shale reservoirs of the Appalachian and Illinois Basins. Where tight gas sands reservoirs differ from the other unconventional continuous reservoirs is in the nature of the rock, and its very low permeability, < 0.1 millidarcy.

Exploration for tight gas sand reservoirs differs from conventional reservoirs in that tight gas sands are continuous, consisting of a stacking of sedimentary layers that are charged with oil or gas much in the same way that an aquifer is charged with water. Conventional reservoirs have much more limited boundaries, and well as a down-dip water contact, which is absent from the continuous reservoirs. Also, the great preponderance of continuous reservoirs are charged with gas, rather than crude oil.

While the continuous tight gas sands reservoirs may be completely charge with gas, it is not to say that a well drilled anywhere into the reservoir will be as good a well as one drilled somewhere else. There are “sweet spots” where wells of greater productivity may be found.

Finding the sweet spots is vital to drilling wells that will be economically producible. The tools that explorationists use include 3-D seismic, gravity and magnetic surveys, as well as specialized wire line logs, conventional and sidewall cores, and reservoir engineering data. Higher prices and new technology have stimulated development resulting in current production of around 2.5 trillion cubic feet of gas per year. This amounts to 13% of current gas production in the lower 48 states.

Wells are drilled into the sweet spots with rotary rigs much in the conventional way. However, drilling with coiled tubing and down-hole hydraulic drill-motors have reduced the time and cost of drilling operations. Drilling and completion costs, however, are very high. A typical well drilled in the San Juan Basin costs $800,000 for drilling operations and $2,000,000 for a series of hydraulic fracturing operations.

While some continuous reservoirs may be found at a relative shallow depth, many are located at substantially greater depths of 15,000 to 20,000 feet. Natural fracturing in the formation rock increases the production potential. Following completion of drilling operations, reservoir stimulation by hydraulic fracturing is used to enlarge existing fractures and to create new ones.

Well spacing size has become reduced as more is learned about the producing nature of the reservoirs. At one time, well spacing for gas wells were one well per 320 or 640 acres. Today, companies are requesting that regulatory commissions allow the drilling of one well per 20 to 10 acres. Well density then becomes a problem, and an environmental consideration. Some operators are drilling a number of wells from one drill-site pad, thereby reducing the footprint of drilling and producing operations upon the land.