AN INTRODUCTION TO TORP'S "FUNDAMENTALS OF COALBED METHANE PRODUCTION" MANUAL

Since the early 1980s, natural gas has been intentionally produced from coalbeds. Spurred on initially by significant tax credits, this sub-industry has grown rapidly in recent years, now contributing approximately 10% of the nation's natural gas production. The term "coalbed methane" is derived from the coal mining industry, describing the gas which is a common hazard in coal mining operations. Methane typically comprises 95 to 100 percent of the hydrocarbon constituents present in coalbed gas, although it is not unusual for the mixture to contain a number of different gases.

In the early Twentieth century, "shale gas" was commonly produced in the Mid-continent oil and gas fields. The source of this gas was later proven to be the coalbeds, which are prevalent in the region. Coalbed methane reservoirs of the Mid-continent are high, volatile bituminous A, B, and C coals. Gas can be produced from coals of nearly every rank; however, some of the less attractive coals (e.g., lignite) may require substantial thicknesses of coal to develop adequate reserves. The industry continues to grow, and is active in nearly every sedimentary basin in the United States, primarily the San Juan, Black Warrior, and Raton basins.

Coal, a very complex mixture of organic and inorganic compounds, differs from other sedimentary reservoirs as the gas is adsorbed within the matrix of the rock rather than compressed in pore spaces. A typical one-foot thickness of coal six hundred feet deep is capable of containing as much gas as a typical sandstone reservoir five thousand feet deep. Another unique characteristic of coalbed production is its producing behavior. In most cases, initial production of gas is quite low while water production may be high. As the water is withdrawn, and the bottom-hole pressure decreases in the reservoir near the wellbore, gas production gradually increases. During the first few producing months the water-producing rate will continue to decrease accompanied by an increase in the gas-producing rate, until a pseudo-steady state occurs for both phases.

Due to its unique characteristics, coalbed evaluation requires methods not prevalent in other oil and gas producing operations. Coal rank is determined by measuring the light reflected from the surface of coal samples – vitrinite reflectance. Drill cuttings or core samples are analyzed for gas-in-place content by means of a canister test. Proximate analyses of coals, the same method utilized by the mining industry to determine coal quality, are a usable tool to estimate gas absorbing potential of various coals. The plot of a laboratory measurement of a coals gas-absorbing capability, the isotherm, is useful in determining the gas-content of coals, critical pressures, and estimating residual gas at abandonment.

Completions of coalbed wells require unconventional methods in most cases. Chemical treatments, cementing, and hydraulic fracturing require a knowledge of the coal, otherwise substantial reservoir damage may occur. Casing installation should be designed to prevent damage and allow space for adequate phase separation and pumping equipment.

Coalbed gas reserves, not unlike conventional reservoirs, may be estimated by analogy, volumetric methods, material balance calculations, or decline curve extrapolation.

This manual is intended to provide the operator of Mid-continent coalbed methane wells with a usable document which will provide information concerning 1) the properties of coal, 2) the occurrence of natural gas in coal, 3) reservoir engineering characteristics of coalbed methane production, 4) drilling, completing and equipping coalbed methane wells, and 5) developing and managing the coalbed methane prospect from defining the geology to marketing the gas.