DIFFERENCES IN HYDRAULIC FRACTURING DISTRIBUTIONS, TREATMENTS, AND WATER UTILIZATION VOLUMES IN THE U.S. FROM 1947 – 2010

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Abstract

Contrary to generalized descriptions of hydraulic fracturing (HF) that appear in news media and popular science articles, HF attributes, characteristics, and occurrences are quite variable depending on reservoir properties, rock and hydrocarbon type, temperature, pressure, and sensitivity of the reservoir systems to water. A spatial and temporal analysis of over 1.6 million HF treatments applied to nearly one million wells drilled in the United States from 1947 through 2010 highlights the variations in HF trends in drill-hole direction, proppant use, treatment fluids, additives, and water usage. Prior to 2000, most hydraulically fractured wells were vertically drilled and fracture stimulation was largely used to enhance oil production. More recently (2000 through 2010), gas wells represent the majority of hydraulically fractured wells. Hydraulic fracturing has been (and still is) used for both conventional and unconventional reservoirs. As of 2010, HF was still primarily applied to vertical wells; however, the use of horizontal and directional drilling rapidly emerged and expanded production in low-permeability reservoirs. In addition, the composition of the HF treatment fluids and the number and types of additives to the fluids are very different today than in the past. With the advent of slick-water HF, water management challenges arise, especially in horizontal wells as they use the largest volumes of water. Between 2000 and 2010, the greatest number of HF treatments were applied to wells drilled within the Appalachian, Gulf Coast, and Permian Basins; however, HF is in widespread use in most of the major oil and gas basins of the conterminous U.S. for the development of unconventional (continuous) oil, natural gas, and natural gas liquid accumulations. These trends and differences in drill-hole directions, use of proppants, treatment fluids, additives, and water provide a context for understanding the costs and benefits of increased oil and gas production, water management, and environmental impact concerns.