World Academy of Science, Engineering and Technology
International Journal of Energy and Environmental Engineering
Vol:9, No:10, 2015

Water Dumpflood into Multiple Low-Pressure Gas Reservoirs

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Abstract : As depletion-drive gas reservoirs are abandoned when there is insufficient production rate due to pressure depletion, waterflooding has been proposed to increase the reservoir pressure in order to prolong gas production. Due to high cost, water injection may not be economically feasible. Water dumpflood into gas reservoirs is a new promising approach to increase gas recovery by maintaining reservoir pressure with much cheaper costs than conventional waterflooding. Thus, a simulation study of water dumpflood into multiple nearly abandoned or already abandoned thin-bedded gas reservoirs commonly found in the Gulf of Thailand was conducted to demonstrate the advantage of the proposed method and to determine the most suitable operational parameters for reservoirs having different system parameters. A reservoir simulation model consisting of several thin-layered depletion-drive gas reservoirs and an overlying aquifer was constructed in order to investigate the performance of the proposed method. Two producers were initially used to produce gas from the reservoirs. One of them was later converted to a dumpflood well after gas production rate started to decline due to continuous reduction in reservoir pressure. The dumpflood well was used to flow water from the aquifer to increase pressure of the gas reservoir in order to drive gas towards producer. Two main operational parameters which are wellhead pressure of producer and the time to start water dumpflood were investigated to optimize gas recovery for various systems having different gas reservoir dip angles, well spacings, aquifer sizes, and aquifer depths. This simulation study found that water dumpflood can increase gas recovery up to 12% of OGIP depending on operational conditions and system parameters. For the systems having a large aquifer and large distance between wells, it is best to start water dumpflood when the gas rate is still high since the long distance between the gas producer and dumpflood well helps delay water breakthrough at producer. As long as there is no early water breakthrough, the earlier the energy is supplied to the gas reservoirs, the better the gas recovery. On the other hand, for the systems having a small or moderate aquifer size and short distance between the two wells, performing water dumpflood when the rate is close to the economic rate is better because water is more likely to cause an early breakthrough when the distance is short. Water dumpflood into multiple nearly-depleted or depleted gas reservoirs is a novel study. The idea of using water dumpflood to increase gas recovery has been mentioned in the literature but has never been investigated. This detailed study will help a practicing engineer to understand the benefits of such method and can implement it with minimum cost and risk.

Keywords : dumpflood, increase gas recovery, low-pressure gas reservoir, multiple gas reservoirs
Conference Title : ICGPE 2015 : International Conference on Geosciences and Petroleum Engineering
Conference Location : Osaka, Japan
Conference Dates : October 08-09, 2015