



SPE 114375

Analysis of Reservoir Performance of the Messoyakha Gas Hydrate Reservoir

Tarun Grover, Schlumberger; George J. Moridis, Lawrence Berkeley National Laboratory; Stephen A. Holditch, Texas A&M University

Copyright 2008, Society of Petroleum Engineers

This paper was prepared for presentation at the 2008 SPE Annual Technical Conference and Exhibition held in Denver, Colorado, USA, 21–24 September 2008.

This paper was selected for presentation by an SPE program committee following review of information contained in an abstract submitted by the author(s). Contents of the paper have not been reviewed by the Society of Petroleum Engineers and are subject to correction by the author(s). The material does not necessarily reflect any position of the Society of Petroleum Engineers, its officers, or members. Electronic reproduction, distribution, or storage of any part of this paper without the written consent of the Society of Petroleum Engineers is prohibited. Permission to reproduce in print is restricted to an abstract of not more than 300 words; illustrations may not be copied. The abstract must contain conspicuous acknowledgment of SPE copyright.

Abstract

The Messoyakha Gas Field is located in Siberian permafrost. The field has been described as a free gas zone, overlaid by hydrate layer and underlain by an aquifer of unknown strength. The field was put on production in 1970 and has produced intermittently since then. Some characteristic observations were increase in average reservoir pressure during shut-in, perforation blocking due hydrate formation and no change in gas-water contact. It is believed the increase in reservoir pressure was caused by the hydrate layer dissociation, rather than aquifer influx. The objective of this study is to use numerical model to analyze the observed production data from the Messoyakha field. In this study, a range of single-well 2D cross-sectional models representative of Messoyakha have been developed using Tough + Hydrate reservoir simulator. The simulation results were analyzed and compared with various field observations. Further, we have done a parametric study of reservoir properties of hydrate capped gas reservoir. We have used Tough + Hydrate to simulate the observed gas production and reservoir pressure data at Messoyakha. We simulated various scenarios that help to explain the field behavior. We have evaluated the effect of various reservoir parameters on gas recovery from hydrates. Our work should be beneficial to others who are investigating how to produce gas from hydrate capped gas reservoir. We were able to generate results that are very similar to the reported flow rates and pressure behavior in Messoyakha Field. The value of absolute permeability in the hydrate layer and the lower free gas layer substantially affects the continued dissociation of hydrates during shut-down. We also modeled the formation of secondary hydrates near the wellbore that can cause the reduced gas flow rates. The important parameters affecting the gas production are the formation permeability in the gas layer, the effective gas vertical permeability in hydrate layer, the location of perforations, and gas hydrate saturation. We have described various scenarios which are beneficial as well as detrimental in producing gas from hydrate capped gas reservoirs. We have also listed various parameters that should be carefully measured for accurate modeling work.

Introduction

Natural gas hydrates have been the subject of active research in the oil and gas industry since their role in blocking fluid flow in oil and gas pipelines was demonstrated by Hammerschmidt (1934). Later, Makogon (1965) proposed that naturally occurring gas hydrates could exist in the earth's subsurface. Since 1965, a number of research projects have been performed to estimate and quantify the volume of naturally occurring gas hydrates. Although there is uncertainty over the quantity and distribution of naturally occurring hydrates in the earth, there is general agreement that substantial volumes of gas hydrates do exist in nature (Sloan and Koh, 2008). According to the latest data gathered by various expeditions for hydrates, the gas resource in hydrate ranges from 10^5 to 10^6 Tcf (US Department of Energy, 2007).

Natural gas hydrates (NGH) are crystalline compounds formed by the association of molecules of water with natural gas. NGHs are a subset of substances known as clathrates, which means "cage like structures". The formation of natural gas hydrates depends upon pressure, temperature, gas composition, and the presence of inhibitors such as salts. NGHs are found in the subsurface in two distinct types of settings. One is the permafrost in arctic regions and the second is in deepwater marine environments.