

Summary of Liquid Loading Law and Liquid Loading Prediction Model in Gas Well Wellbore

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Abstract: Gas well wellbore effusion is one of the important problems to be solved in the process of gas well development. When the problem of effusion is serious, it will lead to gas well shutdown and water flooding. The key to solve this problem lies in whether the liquid accumulation can be accurately identified and predicted in the early stage of liquid accumulation. This paper summarizes the mainstream methods of liquid accumulation identification, which are mainly divided into droplet model and liquid film model. In terms of droplet model, researchers have proposed a variety of models to predict and identify liquid accumulation in gas wells based on the force balance of droplets in gas flow. The liquid film model analyzes the stability of the liquid film, the change of the thickness of the liquid film and other factors, and establishes a variety of models to predict whether the liquid film will return, so as to determine the location of the liquid loading point and the critical liquid carrying speed. These models are not only widely used in vertical wells, but also studied and applied in complex well types such as inclined wells and horizontal wells. With the advancement of computing technology and the deepening of theoretical research, the application effect of these technologies in predicting liquid loading in gas wells has been continuously improved, which provides important support and guidance for the safe production and operation efficiency of gas wells. At the same time, the challenges faced by the research in terms of data accuracy and method applicability are analyzed. Finally, the summary evaluation of several methods is comprehensively reviewed, and the prospect of future gas well effusion identification and effusion prediction research is discussed.

Keywords: Identification of Fluid Accumulation; Fluid Accumulation Prediction; Fluid Accumulation Prediction Model.

1. Introduction

With the development and utilization of natural gas resources, the problem of wellbore fluid accumulation in gas wells has become increasingly prominent. Wellbore effusion not only affects the normal production of gas wells, but also may lead to wellbore corrosion, blockage and other problems, and even lead to the abandonment of gas wells in serious cases. Therefore, it is of great significance for gas well production to study the law of wellbore fluid accumulation and the establishment of fluid accumulation prediction model. In this paper, the research progress of gas well wellbore fluid accumulation law and prediction model in recent years is reviewed, and the different research methods are analyzed.

2. Background and Significance of Research

Gas well effusion refers to the phenomenon that the liquid accumulates in the wellbore because the gas cannot effectively carry out the liquid in the gas well. In the production process of gas wells, gas-liquid two-phase flows out of the formation and produces the ground through the wellbore. In the early stage of production, the gas production of gas wells is high, and the gas-liquid two-phase flows upward in an annular direction. The liquid is carried in two ways: the droplets entrained in the gas core and the liquid film attached to the pipe wall. As the formation pressure decreases, the gas production of the gas well decreases, resulting in that the liquid flow reversal in the wellbore cannot be taken out of the ground and liquid accumulation occurs, which seriously affects the production efficiency of the gas well.

Therefore, it is of great theoretical and practical

significance to study the law of fluid accumulation in gas well wellbore and its prediction model. Through in-depth understanding and analysis of the formation mechanism of liquid loading and its movement law in the wellbore, it can provide a scientific basis for optimizing production management, reducing operational risks, and improving gas well production efficiency. The establishment of the effusion prediction model not only helps to warn the wellbore effusion in advance, but also provides support for regulating production parameters and formulating reasonable operation plans, thereby improving the overall mining efficiency and economic benefits of oil and gas fields.

3. Research Progress

3.1. Gas Well Wellbore Effusion Identification

In 1992, Li Xiaoping analyzed the causes of gas well wellbore effusion, and put forward the methods of judging gas well bottom hole effusion, including pressure gradient analysis method, empirical formula method and intuitive method.

In 2006, Gou Sanquan developed a method that only needs to calculate the location of the effusion through the pressure difference between the oil jacket, which provides a reasonable scientific basis for predicting the amount of effusion.

In 2011, based on the combination of kinetic energy factor and oil-casing pressure difference method, Zhang Jirong considered the factors such as liquid production change, oil-casing pressure fluctuation, gas production change, etc. Finally, a typical symptom analysis method was proposed, which has certain applicability in various field applications, but the value of the pressure gauge will cause a large error.

In 2012, Ma Hao developed the flow decline curve analysis method, orifice plate pressure peak method, pressure test

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