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Well type and pattern optimization technology for large scale tight sand gas, Sulige gas field, Northwest China

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Sulige gas field is a typical tight sand gas field in China. Well type and pattern optimization is the key technology to improve single well estimated reserves and recovery factor and to achieve effective field development. In view of the large area, low abundance and high heterogeneity of Sulige gas field, a series of techniques have been developed including hierarchical description for the reservoir architecture of large composite sand bodies and well spacing optimization, well pattern optimization, design and optimization for horizontal trajectory and deliverability evaluation for different types of gas wells. These technologies provide most important technical supports for the increases of class 1 and 2 wells proportion to 75%-80% with recovery factor enhanced by more than 35% and for the industrial application of horizontal drilling. To further improve individual well production and recovery factor attempts and pilot tests in various well types including side tracking of deficient wells, multilateral horizontal wells and directional wells and horizontal well pattern and combined well pattern of various well types should be carried out throughout the development.

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Current development and application of chemical combination flooding technique

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With the rapid development of chemical flooding technologies during recent decades, great success has been achieved in the fundamental studies and field tests of chemical combination flooding in recent years. In China, a low concentration ASP formula was employed to achieve ultralow interfacial tension by the synergistic effect of alkali and surfactant. The viscosity of polymer solution prepared from produced water could meet the technological requirements when salt tolerance polymer was applied. ASP or SP flooding could increase both oil displacement efficiency and sweep volume. ASP pilot tests and industrial field tests in Daqing Oilfield have resulted in an oil recovery increase of 18.5%-26.5%. The chemical combination flooding has entered into the industrial promotion and application stage with a series of supporting techniques formed in the field tests. Chemical combination flooding has become a cost effective EOR technology in recent years. The overall tendency of chemical combination flooding is turning from strong alkali ASP flooding to weak alkali ASP or even alkali free SP flooding. The conditions and types of applicable reservoirs are also broaden from high permeability to low permeability reservoirs from sandstone to conglomerate, carbonate and complex fault block reservoirs from low temperature low salinity to high temperature high salinity reservoirs. The main challenges in this technique include short pump-checking period and difficulty in produced liquid handling and high cost. Micelle-polymer flooding as the major chemical combination flooding technique was applied abroad in the early stage of chemical flooding tests. However, the micelle-polymer flooding has not been applied widely due to its high cost. Thus low concentration chemical combination flooding has drawn more attention. Because of high temperature and high salinity in most reservoirs abroad where chemical combination flooding is going to be used, the temperature resistance and salt tolerance oil displacement agents are the bottleneck for application of chemical combination flooding. There are some major technological problems need to be solved in future application of chemical combination flooding. Firstly, high-performance, low-cost surfactants for chemical combination flooding should be developed. Secondly, new salt-tolerance, temperature-resistance polymers and surfactants should be developed. Thirdly, chemical combination flooding supporting technology in field tests and application should be improved. Fourthly, monitoring, tracking adjustment and optimizing technology in chemical combination flooding field tests should be improved.

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