

Research on Shale Gas - based Mud System

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Abstract. Oil-based mud horizontal wells drilled with fractured development strata, prone to well leaks, and a large loss of oil-based mud not only increases drilling costs and destroys the environment. In order to solve the problem of oil-based mud leakage effectively, a set of cement slurry system which can be used for horizontal oil-based mud plugging is developed through the optimization of additive materials. The results show that the thickening time of the cement slurry is adjustable, the temperature is not sensitive, the early strength is developing rapidly, the oil-based mud pollution is good, the cement slurry is 40% by volume Oil-based mud pollution, 24-hour conservation strength of up to 1.9 MPa. The cement slurry technology has been successfully applied to the coke rock shale gas horizontal well plugging operation, the site effect is good.

Introduction

Shale gas is a natural gas resource that is mined from shale or mud shale and is partially present in fractures, pores and other reservoirs with a free phase, and a portion of which is adsorbed. It exists on kerogens, clay particles and pore surfaces, A very small amount of dissolved state in the kerogen, Zhejiang green and oil. Shale gas is an important field and objective of industrial exploration of natural gas under the current economic and technical conditions. The exploration and development of shale gas in the United States is at the forefront of the world and the only country in which shale gas has been successful in large-scale commercial development. Followed by Canada, in recent years has also carried out shale gas exploration and experimental research. China's shale is widely distributed, with great development potential.

At the beginning of the twentieth century, crude oil was used as a drilling fluid to avoid and reduce the complexities that occurred in drilling. At that time played a role in anti-collapse, anti-card and the protection of oil and gas layer, but there is also a small force, it is difficult to suspend barite, large loss of filtration, rheology is not easy to control and volatile oil, easy fire and other shortcomings. As a result, the gradual development of diesel as a continuous phase of the whole oil-based mud and water-in-oil emulsion drilling fluid stage. These drilling completion fluids have good rheological properties, filtration control performance and lubricity. From the development of oil-based mud equipment, it is moving towards high temperatures, improve drilling speed, reduce costs and prevent pollution and other direction. In recent years, oil-based mud and water-based mud equipment has made great progress, such as in the new environmentally friendly oil-based drilling fluid development, oil-based drilling fluid performance in-depth study and other aspects of greater progress. Shale horizontal wellhead wall instability has been the problem of drilling engineering, so drilling more oil-based drilling fluid. The effect of oil-based drilling fluid on cementing quality is mainly reflected in the efficiency of replacement, the strength of cement stone and the degree of cementing of the second interface. Oil-based drilling fluids are more difficult to flood than water-based drilling fluids, especially in shallow wells with low underground temperatures, which will directly affect the reservoir protection effect during perforation operations. In addition, in order to prevent the wall instability, to ensure efficient rock carrying efficiency, drilling fluid density, viscosity is generally high, poor mobility, cementing seriously affect the efficiency of replacement. Shale gas horizontal wells have higher performance requirements for cement installations, shale gas horizontal well cementing, and high performance requirements for rheological properties, settling stability, water loss, and free flow of cement. Cement stability is not good, under the action of gravity will occur subsidence, will be left in the horizontal section of the

channeling channel.

Shale based Mud Prize Development Status

As early as the 1970s, people had added crude oil to the drilling fluid to increase the lubricity of the drilling fluid to avoid and reduce the occurrence of various complex conditions in the drilling. But also played a role in anti-collapse, anti-card and the protection of oil and gas layer, but there are also small cut force, it is difficult to suspend barite, large loss of filtration, rheology is not easy to control and volatile components of crude oil easy to fire and other shortcomings , Only for 1000 meters or less shallow wells.

At present, the domestic whole oil-based drilling fluid is still in the research, testing, improvement stage, the whole oil-based drilling fluid technology research has just started in the country, some of the domestic oil field for the whole drilling fluid field test, the end of 2009 in Liaohe Oilfield Shen 307 well Wells were field tested, the first use, and achieved success. The effect of oil-based drilling fluid is shown to show the characteristics of high-temperature stability, excellent lubrication and drag reduction, and improve the shear efficiency. The drilling speed increases obviously, Collapsed to a strong inhibitory effect, and its preparation process, maintenance and processing technology to explore a set of successful experience, which filled the domestic oil-based drilling fluid blank, for the future expansion of overseas oil business and domestic complex deep wells The smooth drilling has important guiding significance.

Performance Evaluation of Cement Slurry

Ordinary cement slurry system and oil-based mud mixture will appear after the increase in the consistency of the phenomenon, in particular, will make the cement slurry strong thixotropy, loss of liquidity. Indoor compatibility of slurry and oil-based mud was tested. Cement slurry formula: G grade cement 800 g + FLO-L glue liquid 48 g + fresh water 330 g + DISP-2 dispersant 10 g + DS stabilizer 24 g + RET-M retarder 4 g. The oil-based mud is a 51-5HF oil-based mud with a diesel 1: 1 mixture. It can be seen that the mixing of cement slurry and oil-based mud does not show obvious thickening, delamination and flocculation, and the cement-based 24-hour curing strength can reach 1.9 MPa when the oil-based mud volume ratio is 40%. With the increase of the proportion of oil-based mud, the mixed slurry showed obvious dilution phenomenon, and the slurry was stable. The evaluation data showed that the compatibility between the slurry and the oil-based mud was good.

In the oil-based mud level for cement plugging operations, cement slurry and oil-based mud mixed contact with each other is inevitable. Indoor focus on the different proportions of oil-based mud into the cement slurry, the thickening performance of cement paste.

After the oil-based mud penetrates the oil-based cement slurry, the thickening time of the cement slurry is prolonged, and the initial consistency of the cement slurry decreases first and then increases. With the oil-based mud into the cement slurry ratio increased, the mixed liquid thickening time increased significantly. When the amount of oil-based mud intrusion reached 40%, the mixing thickening time of up to 492 minutes. The thickening time of cement paste is prolonged with the increase of mud intrusion to ensure the safety performance.

The basic performance of the cement slurry system was tested experimentally, including the thickening time of cement paste, water loss, free liquid, stability and compressive strength. Focus 51-4HF well during the three drilling a total of 17 missed, including loss of return missed 2 times. Drilling to 4 746.62 m Loss of return occurs, try to plug the plugging plug. The first note plugging slurry 19.2 m³, for pulp 48.3 m³, wellhead did not return. The second exchange drill pipe, note plugging pulp 25.5 m³, for the pulp 44.7 m³, wellhead did not return. The third drill from 3 858 m, note the plug pulp 22.6 m³, for the pulp 36.16 m³, the wellhead has not yet returned. In view of the use of plugging slurry plugging the way the effect is not good, decided to use oil-based mud drilling horizontal wells plugging mud slurry system plugging. Taking into account the oil-based mud in the mud to play a certain degree of risk, so the site construction to take the necessary technical

measures to avoid the emergence of security risks:

- 1) Preparation of dilute oil - based mud with solid content of 18% as precursor slurry;
- 2) the site into the well cement to be a detailed indoor safety performance evaluation;
- 3) into the cement slurry before the first into the 1.5 side diesel as a pre-liquid, fill in the cement slurry and then continue to inject 1.5 diesel as a post-liquid;
- 4) Calculate the amount of pulp to ensure that the cement slurry near the leak layer.

Replaced in place, began to drill, drill 29 columns with 70 minutes, the drilling process is more smooth, no significant increase in the phenomenon of friction;

Waiting for 24 hours, began drilling, drilling with 6 hours in the end, there is a cement plug formation, site plugging success, cement plug length of 380 meters.

Effect of Oil - based Mud on Horizontal Wells of Horizontal Wells

First make sure that drilling can produce gas. There is no doubt that in this particular case, since adjacent wells are produced in the same reservoir, the logs show that the area is a gas zone and a gas surge is found in the reservoir section The signs. Barehole filter cake cleaning may be a problem that could greatly weaken the production capacity of gas wells. And others cited the formation of drilling horizontal wells in the process of damage mechanism, the other examples of damage is divided into three types:

Shale gas horizontal well oil-based mud equipment includes damage caused by high mobility in the wellbore. The rest of the shale gas horizontal wells oil base mud of the filter cake damage: and mentioned that the recent production of horizontal wells in the North Sea showed that some horizontal wells production section is not the entire horizontal well drain channel. Due to near well damage caused by wetting of near wellbore. Which is caused by the shale gas horizontal well oil-based mud intrusion into the near-wellbore; shale gas horizontal well oil-based mud may be invaded into near-wellbore and left with residual shale gas horizontal well The strong wetting of the will cause this zone to be wet, which will greatly reduce the relative permeability of the gas phase, resulting in damage to the production capacity. And so on with this example of the study used in similar mud population for the core displacement test study. Experiments show that nearly 4 times the pore volume of mud-aggregate can penetrate into the reservoir before forming a good filter cake.

Brown also simulated formation damage resulting in reduced permeability of near-wellbore and only partial horizontal well drain in both production conditions. It was concluded that horizontal wells contribute to flow and maximize production capacity , The role it plays is more important than the effect of reducing the permeability around the well, unless serious damage occurs. Based on this research, the focus is on eliminating the first two possible damage, then evaluating the productivity of the well, and finally dealing with the critical matrix area to eliminate the third possible damage, with the aim of ensuring that most of the horizontal effect. The key objective of dealing with critical substrates is to restore the permeability of the original near wellbores that may be invaded by the particles and to ensure that the rocks are wet to improve the gas phase relative permeability.

With the diameter of 1.75in equipped with high pressure rotary ejector coiled tubing to ensure the best results of the construction work, high pressure jet rotary nozzle can improve the injection of liquid and filter cake contact probability. In the process of entering the well, the well is filled with nitrogen and there is no natural gas in the well. The first step of the treatment: from the bottom of the reservoir to the root of the bottom to enhance the coiled tubing process, with the surfactant solution in the bare hole jet wells, which requires 90bbl solution, 1bbl solution with nitrogen into the 700ft³ line nitration treatment, The processing is performed under underbalanced conditions throughout the processing period. At the end of the jet well, the coiled tubing is reintroduced to the bottom of the reservoir section, cutting off the nitrogen and evaluating the effect of damaging and removing the sludge from the production section. After the productivity evaluation, it was found that there was no satisfactory results, the hydrochloric acid jet was well washed and the first stage of the treatment was about the same. The wells are closed again to evaluate capacity. This stage with 80bbl hydrochloric acid solution.

The results of the pressure recovery test were then analyzed and analyzed, although the infiltration rate distribution range of 0.3-0.7 mD was determined, although the final stability and the radial flow on the horizontal surface were not observed for the final stability uncertainty. The best combination was obtained with an average permeability of 0.3 mD and a production channel with a total length of 1155 ft. The minimum production length required to achieve the combination is 650 ft corresponds to an average permeability of 0.77 mD. The corresponding examples show that the geometric skin factor is negative and the mechanical epidermis factor is around zero. Even if production logging is not carried out to evaluate the length of the output section, the pressure recovery analysis shows that at least half of the production section is successful.

Conclusion

The results show that the cement slurry has good anti-pollution ability and 40% of the oil-based mud pollution sludge slurry still has a strength of 1.9 MPa. The experimental results show that the cement slurry The system has no obvious sensitivity to the experimental temperature, and the cement slurry has good stability at the bottom of the well, and it is effective to ensure the safety and efficiency of the site construction. The oil-based cement slurry as a new plugging technology still needs to be improved in the field Technology and formula, the system in the oil-based mud drilling section of the plugging operations in the application of a wider space.

References

- [1] Shan Gaojun, Cui Maorong, Ma Yong. Study on performance and cementing quality of oil-based drilling fluid [J]. Natural Gas Industry, 2005,25 (6): 70-71.
- [2] Du Chengwei, Lu Guangming. Laboratory study of oil-based cement slurry plugging [J]. Petroleum Drilling & Production Technology, 1999,21 (3): 69-74.
- [3] B.R.R. Reddy, Larry S. Eoff. Design Considerations for Oil-Based, Squeeze Cement Slurries to Prevent Unwanted Fluid Production: Methods of Slurry Performance Evaluation and Potential Formulation Improvements [J]. SPE-158065, 2012.
- [4] Li Zao yuan, Gu Tao, Guo Xiaoyang. The influence of oil-based drilling fluid on the performance of cement slurry and its mechanism [J]. Natural Gas Industry, 2015,35 (8): 63-68.
- [5] Du Weichen. Application of Oil-based Cement Slurry in Oil Drilling Engineering [J]. Petroleum Drilling & Production Technology, 1998,20 (2): 46-50.
- [6] Ma Yong, Guo Xiaoyang, Yao Kunquan, et al. Preliminary study on the incompatibility of drilling fluid with cement slurry [J]. Drilling fluid and completion fluid, 2010,27 (6): 46-48.