Research on a Reinforcement Material for Low-Cost and Low-Density Cement Slurry
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ABSTRACT
In order to effectively solve the problem of cementing the long sealing section of low-pressure volatile formations, and at the same time to adapt to the current low-cost strategy for oil and gas exploration, a lightening and strengthening material was developed. The material has the characteristics of good stability, high activity, high water storage, etc., and has a wide range of sources and low price. It is supplemeted with appropriate admixtures to form a low-density cement slurry of 1.20 ~ 1.60 g / cm³. While expanding the liquid-solid ratio and reducing the density, it has excellent performance and greatly reduced costs. 60 °C/24 h compressive strength is greater than 8 MPa, 72 h compressive strength is above 10 MPa; slurry stability and pressure resistance are good; water loss is controllable and thickening time is adjustable to meet construction requirements. It has good prospects for promotion and application.

KEY WORDS: Well cementing; loss; cement slurry; low cost; low density

INTRODUCTION
Low-pressure and easily leaking complex oil and gas wells are commonly found in Changqing Oilfield, Tarim Oilfield, Jilin Oilfield, Qinghai Oilfield and offshore oilfields in China. Under the new safe production and environmental protection policies, each oilfield strictly requires the cementing of all well sections must be sealed and the cement slurry must return to the ground. This will undoubtedly result in high cementing costs due to the high consumption of low-density cement slurries. At the same time, the exploration and development costs of the “low oil price” market environment have been greatly reduced, so the contradiction between “high performance” and “low cost” of low-density cement slurry becomes more profound.

Low-density cement slurry currently has two mature technologies: One is to expand the liquid-solid ratio (LSR) by adding superabsorbent materials and lightweight fillers such as bentonite, diatomaceous earth, expanded perlite, etc. Another technology is to add glass micro beads, hollow beads, and so on. They can replace some of the cement to reduce the density of the slurry. Generally, the density of low-density systems has a minimum limit. For example, the minimum densities of bentonite, diatomaceous earth, fly ash, and floating bead cement are 1.60, 1.50, 1.55, and 1.38 g/cm³ (Liu, 2001), Below the above values, the performance of the cement slurry is poor, especially the compressive strength. According to the requirements of Cementing Technical Specifications of CNPC: The non-target layer cement stone of the production casing shall have a compressive strength of not less than 7 MPa at 24~48 hours. In the low pressure and easily lost formation, the above system is difficult to meet the requirements. The cement slurry with artificial hollow microbeads has better performance and lower density, but the cost is higher, and it is difficult to promote and apply (Zhou, 2004). In summary, combining the two methods, with the goal of reducing cost and maintaining performance, a composite reinforcing material BCE-600S was developed using high water absorption, high activity and ultrafine materials. Its role is to expand the liquid-solid ratio, significantly reduce the cost of cement slurry and improve the performance of cement slurry. BCE-600S is used as a mitigating agent, and at the same time, it is used as an auxiliary material and an admixture to form an Low-density cement slurry with a low cost and excellent performance of 1.20~1.30 g/cm³, in order to cope with the current severe environmental protection requirement and low-cost development strategy.

EXPERIMENTAL INSTRUMENTS AND METHODS

Experimental Instruments

8240 High Pressure/High Temperature (HPHT) Consistometers, 7204 Compressive Strength Tester, HTD 7169 Fluid Loss Tester, Fanns (ZNN-D6B) Six Speed Rotary Viscometer, 5265 Static Gel Strength Analyzer.

Experimental Method


STUDY OF THE REINFORCEMENT MATERIAL

Design Principle