

Effect of Sodium lignosulphonate-based Cement Retarder on the Free Fluid Property of Cement Slurry

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Abstract— This study was carried out using API recommended practice 13B-2 in a cement laboratory, and the essence was to establish the effect of sodium lignosulphonate-based retarder on the free fluid of cement slurry. The test was carried out at different temperatures of 80°F and 100°F and retarder concentrations of 0.01 gal/sk, 0.03gal/sk, 0.05 gal/sk, 0.07 gal/sk, 0.09 gal/sk and 0.10 gal/sk. The test results obtained showed the free fluid of sodium lignosulphonate-based retarder at concentrations of 0.01gal/sk, 0.03gal/sk, 0.05gal/sk, 0.07gal/sk, 0.09gal/sk and 0.10gal/sk were 0.8%, 1.2%, 1.46%, 1.75%, 1.92% and 2.12% at 80°F respectively; similarly at 100°F the free fluid were 0.79%, 1.21%, 1.56%, 1.72%, 1.91% and 2.22%. The results it meant that concentration play a major role in adjusting the free fluid property of cement slurry while temperature has no significant effect on it.

Keywords— Free Fluid, sodium lignosulphonate cement retarder, Temperature.

I. INTRODUCTION

Cementing operation involve the cement slurry placement in the oil well annulus and casing to provide proper zonal isolation. The main aim is to completely prevent fluids in the well from interacting from one part to another, provide support or point of attachment for the casing, prevent corrosion of the Casing, prevent shock loads during drilling, prevent blowouts, plug off vugular zones and for abandonment. A key and essential part of the wellbore construction process is cementing (Lootens, 2004). The integrity of the oil well construction depends, to a large extent, on the quality of cement formulation and slurry (Ridha et al., 2010) and this is to ensure the safety of the well and durability (Pourafshary et al., 2009; Ershadi et al., 2011). The incomplete isolation of the zone has been linked to the alteration of the production capacity and efficiency of the oil well operation. If it is ineffective cementing, production below optimum is bound to occur (Calvert, 2006). Poor cement slurry design and poor cementing operations are key factors that can affect the performance of the well efficiency and could result in a reduction in oil production. Environmental damage from oil spillage is the side effect of poor cementing and poor slurry design (Lootens, 2004) that

causes death to aquatic lives and land pollution, causing low production of agricultural produce, making the environment inhabitable to human and animal life as it causes some respiratory diseases. The spills also result in the loss of oil that is a part of the useful global oil reserve. Temperatures are a key factor of cement slurry formulation. Oil well cement experience different pressure ranges downhole from pressures within atmospheric pressure to higher pressures of about 1360 kPa, in wells over 10000 ft (Joel, 2009). Apart from high temperature and pressure encountered in wells, the slurries are formulated to take care of the weak or vugular formations and reactive fluids. Successes achieved in the formulation of slurry have been linked to researches, discoveries and findings from additives account for various conditions experienced during cementation operations. Additives are introduced for the adjustment of the slurry system, making it more efficient for obtaining the objective of successfully separating the formation from the casing in order to ensure proper zonal isolation during production. To achieve high-quality slurry for a good cementation operation, an additive known as retarder is usually added in the slurry system to delay the time the cement sets so as to allow adequate time for the operation to come to an end.

Cementing operations are carried out at high-temperatures and high pressures (HTHP) in oil well bores and this can be quite challenging. This requires cement formulations that are good technically. Free fluid is the amount of fluid that separates from the cement slurry at the top of the cement column after placement but before setting. This study is to evaluate the effect of sodium lignosulphonate-based retarder concentration on the free fluid property of cement slurry.

II. MATERIALS AND METHODOLOGY

A series of experiments were performed at different concentrations and temperatures to evaluate the effect of sodium lignosulphonate-based retarder concentration on the free fluid property of cement slurry. All tests were conducted in line with the specification for materials and testing for oil well cements (Anon, 1997 and 2013).

(a) Slurry preparation

The slurries were prepared according to the API specification 10A standard using a class G Dyckerhoff grade cement, and the free fluid test was carried out at the various concentrations and Temperature of 80°F and 100°F.

b) Free Fluid Test

After blending, the slurry was conditioned using atmospheric Consistometer which has 190°F as the highest temperature see Plate 1. The slurry was exposed to 80°F and 100°F, for conditioning, after the conditioning, the slurry was then transferred into a 250ml cylinder and was left on standing for 2 hours. The slurry was then checked for any free fluid above the cement column. This free fluid was poured out using a

syringe to determine the percentage of free fluid, considering the 250ml volume as a basis. The test was repeated for sodium lignosulphonate concentrations of 0.01 gal/sk, 0.03gal/sk, 0.05gal/sk, 0.07gal/sk, 0.09 gal/sk and 0.1gal/sk and the results were recorded. The free fluid was estimated using the formula:

$$free\ fluid = \frac{vol\ of\ free\ fluid\ measured(ml) * 100}{250(ml)}\%$$



Plate 1: Ofite Atmospheric Consistometer for slurry conditioning

III. RESULTS AND DISCUSSION

The graph below shows the relationship between the sodium lignosulphonate-based retarder concentration and the free fluid.

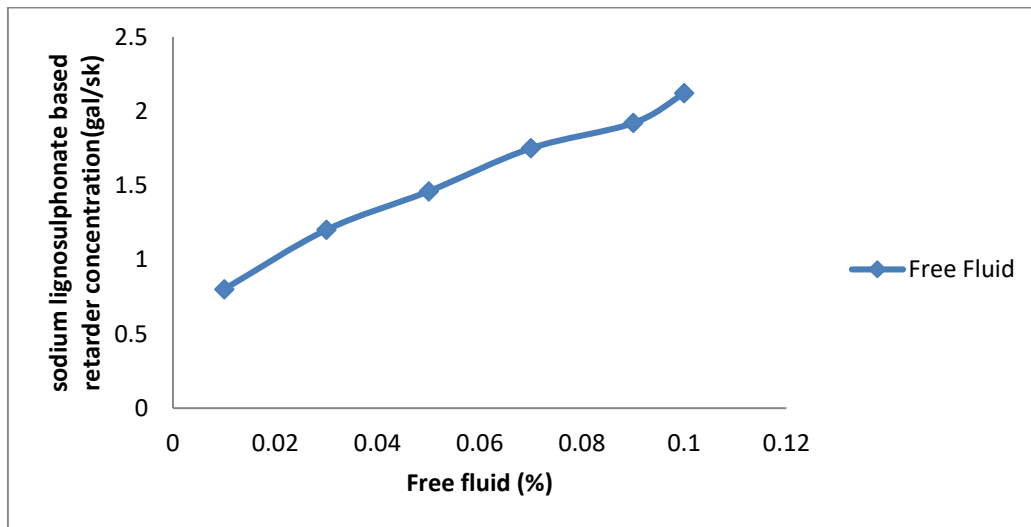


Fig.1: Effect of concentration of sodium lignosulphonate-based retarder on free fluid at 80°F

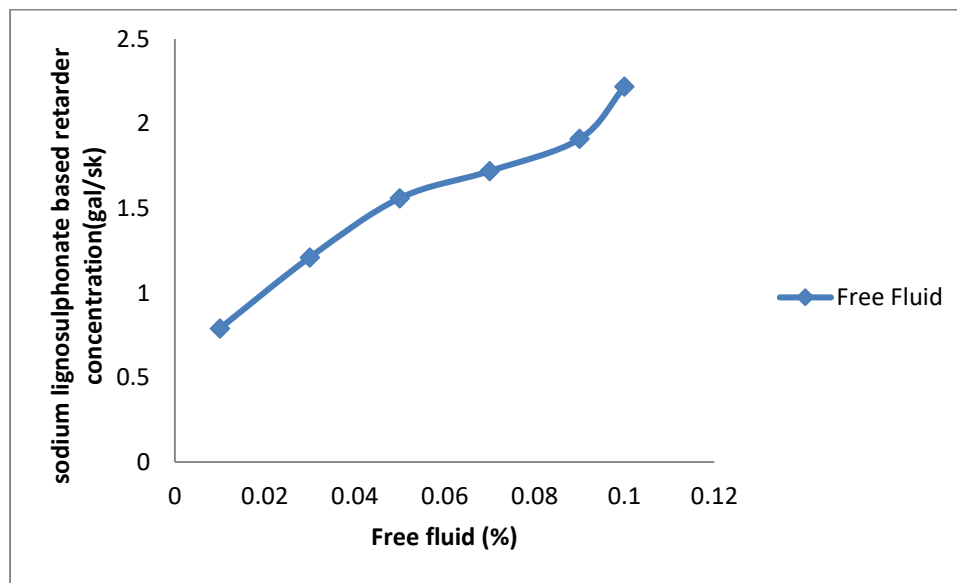


Fig.2: Effect of concentration of sodium lignosulphonate-based retarder on free fluid at 100°F

IV. DISCUSSION

It is observed as shown in figures 1 to 2 that as the sodium lignosulphonate-based retarder concentration increases, there is a corresponding increase in the free fluid which is in agreement with the findings of Joel(2009).The free fluid at sodium lignosulphonate based retarder at concentration of 0.01gal/sk, 0.03gal/sk, 0.05gal/sk, 0.07gal/sk, 0.09gal/sk and 0.10gal/sk are 0.8%, 1.2%, 1.46%, 1.75%, 1.92% and 2.12% at 80°F respectively, similarly at 100°F the free fluid are 0.79%, 1.21%, 1.56%, 1.72%, 1.91% and 2.22%.This increase in free fluid may be due to the dispersing ability which the sodium lignosulphonate-based retarder has shown to have according to Anaele*et al.*, (2019). Also, the resultshad shown that temperature may not be a significant factor to consider when free fluid property of cement slurry is to be adjusted as there is no clear difference in the free fluid at 80°F and 100°F as shown in figures 1 and 2 respectively.

V. CONCLUSION

The study revealed that:

- (1) Increase in sodium lignosulphonate-based retarder concentration leads to increase in the free fluid property of the cement slurry.
- (2) Temperature does not have a significant effect on the free fluid property of cement slurry.

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