Characterizing the Filter Cake of the Modified Oil Well Cement with Nanosilica

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Abstract: The effect of adding one percent nanosilica to modified oil well cement on the fluid loss and filter cake properties were investigated. Adding nanosilica decreased the fluid loss of the cement. Also it increased the density and pulse velocity of the filter cake and decreased the resistivity and moisture in the filter cake. It also decreased the resistivity of the fluid loss water.

1. Introduction

Addition of nanosilica behaves not only as a filler to improve mortar cement microstructures, but also as a promoter of pozzolanic reaction [2]. Fluid loss is the loss of water from the cement slurry into the formation matrix which causes forming of cement filter cake round the well bore. Filter cake affects the performance of cement by changing the water-to-cement ratio. Hence, characterizing the filter cake will give important information about the behavior of the cake.

2. Objective

Effects of adding one percent nanosilica on the fluid loss and the filter cake properties of smart cement were investigated.

3. Materials and Methods

The modified cement was mixed with 1% nanosilica keeping water-to-cement ratio at 0.4 for both the nanosilica and control specimen. The mixing time for all the samples was the same and was about to be 4 minutes. The cement slurry was then placed in the HPHT test cylindrical mold for performing the fluid loss test. Fluid loss was measured at room temperature, under a pressure of 100 psi and after 2.5 min, 5 min, 7.5 min, 10 min, 15 min, 20 min, 25 min and 30 minutes. The filter cake was characterized by measuring its resistivity, pulse velocity, density and moisture of it. Resistivity of the filter cake and fluid loss water were measured by API device. Also the pulse velocity was measured at a frequency of 150 kHz.

4. Result and Discussion

Test results showed that adding 1% of nanosilica reduced the fluid loss from 131 mL to 95 mL, 27% (Fig.1.). Also adding 1% of nanosilica decreased resistivity of the filter cake from 1.4 Ω.m to 0.4 Ω.m, 71% (Fig.2), and density from 2.24 gr/cm^3 to 2.18 gr/cm^3, 3% reduction (Fig.3). It also increased the pulse velocity from 740 m/s to 1355 m/s, 83% (Fig.4) and moisture of the filter cake from 8.7% to 11.6%, a 33% increase (Fig.5). From the result we can concluded that by decreasing the fluid loss, the moisture of the filter cake will be increased which directly effects the pulse velocity; consequently, the less the fluid loss is, the more the moisture and the pulse velocity will be.

5. Conclusion

Adding 1% nanosilica reduced the fluid loss of the cement slurry by 27% and changed the properties of the filter cake.

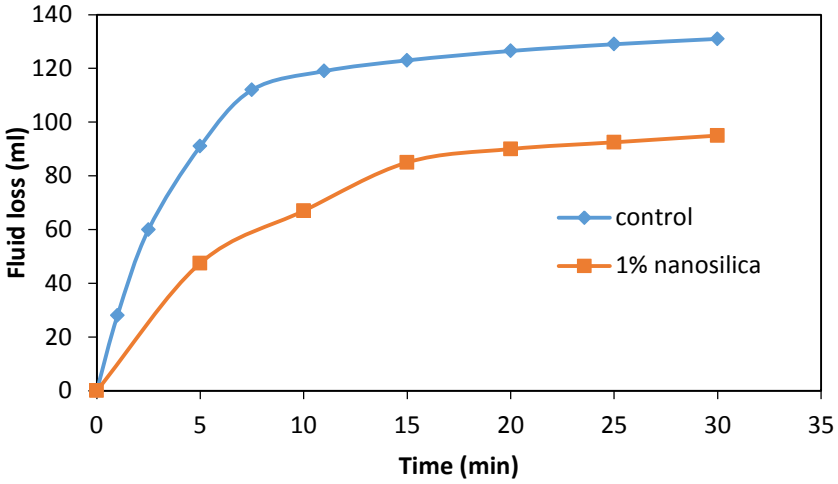

Figure 1. Fluid loss vs. time

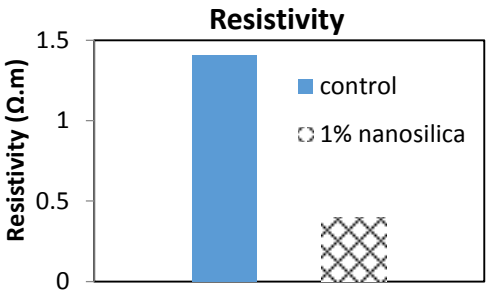

Figure 2. Resistivity of the filter cakes

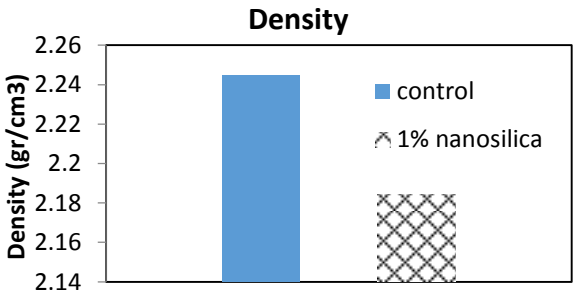

Figure 3. Density of the filter cakes

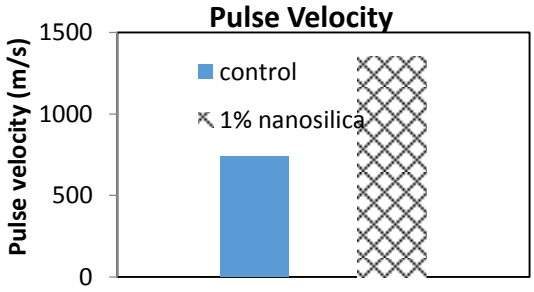

Figure 4. Pulse Velocity of the filter cakes

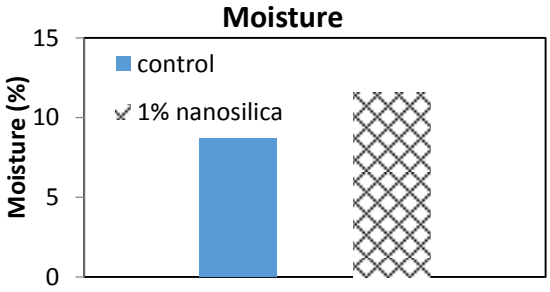

Figure 5. Electrical Capacity

6. Acknowledgements: This study was supported by the Center for Innovative Grouting Materials and Technology (CIGMAT), University of Houston, Houston, Texas with funding from the Ultra Deepwater Program DOE/NETL/RPSEA (Project No. 10121-4501-01).

7. References

1. M. Choolai, A.M. Rashidi, M. Arjmand, A. Yadegari, H. Soltanian (2012). The effect of nanosilica on the physical properties of oil well cement, Material Sience and Engineering A 538 288–294.
2. Singh L.P., Karade S.R., Bhattacharyya S.K., Yousuf M.M., Ahalawat S. (2013). Beneficial role of nanosilica in cement based materials, Construction and Building Materials 471069-1077.