Fluid Loss Control in Modified Smart Oil Well Cement Using Polycarboxylate Superplasticizer

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Abstract

In this study the effect of polycarboxylate as a water reducing agent on the oil well cement was investigated. Laboratory tests according to API standard were performed to evaluate the mechanical, electrical, rheological and fluid loss properties of cement slurries with different water to cement ratio and various amount of polycarboxylate. Results showed that polycarboxylate reduced the fluid loss and filter cake permeability by up to 97% and 99%, respectively. Also addition of polycarboxylate showed improved rheological and mechanical properties.

1. Introduction

When designing cement mixes for wellbore conditions, it is to include different additives to achieve the desired properties for oil well cement such as fluid loss, mechanical properties and rheological properties. Combining different additives might have negative effect on hardening cement. Hence, reducing the amount of additives is an important task in designing cement slurries. An effective way to achieve this is to use multi-functional additives which can impact different properties of cement. Studies show the multi-functionality of polycarboxylate ($RCOO^-$) on Portland cement, which is used as superplasticizer in the concrete industry (1).

2. Objective

The objective of this study was to investigate the effects of polycarboxylate on the properties of cement slurry during curing and after hardening.

3. Materials and Methods

Cement samples with water-to-cement ratio of 0.33 and 0.38 were prepared by varying the polycarboxylate content from zero to 0.6% BWOC. Tests included rheological, fluid loss, mechanical and electrical properties of specimens. Modified API fluid loss tests were performed at pressures of 100 and 400 psi. Also, the permeability of filter cakes was measured using the fluid loss cell at 100 psi. Rheometer was used for rheological studies at room temperature. Electrical resistivity of samples was measured using a resistivity meter recommended by API. Tests for 24 hour cured cement samples included compressive tests during which the piezoresistivity of modified cement samples was also investigated.

4. Discussion and Results

As shown in Fig.1, adding 0.3% and 0.6% polycarboxylate to cement samples with water-to-cement ratio of 0.33, reduced the calculated API fluid loss by 80% and 99%, respectively. The permeability of the filter cakes for samples with 0.3% and 0.6% polycarboxylate were reduced by 81% and 98%, respectively, as shown in Fig.2. Using 0.6% polycarboxylate resulted in forming a thin layer of cement on the filter paper with very low permeability (0.06 mDarcy) compared to the control sample (24.53 mDarcy). Fig.3 shows the rheological behavior of samples with polycarboxylate. The piezoresistivity behavior and the ultimate 24 hour compressive strength of samples are shown in Fig.4. Addition of 0.3% and 0.6% polycarboxylate increased the compressive strength of samples by 85% and 50%, respectively.

5. Conclusion

The study investigated the effects polycarboxylate of class H oil well cement. Addition of polycarboxylate reduced the fluid loss and enhanced the rheological properties of modified cement. Polycarboxylate also reduced the permeability of the filter cake. Addition of polycarboxylate showed higher compressive strength and lower piezoresistive behavior after 24 hours of curing.

6. Acknowledgement

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7. References

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2. Brandl A. ,Bray W.S. , Magelky C. (2012). Improving well cementing quality with an environmentally preferred multifunctional polymer. SPE 154498 – 1-10.

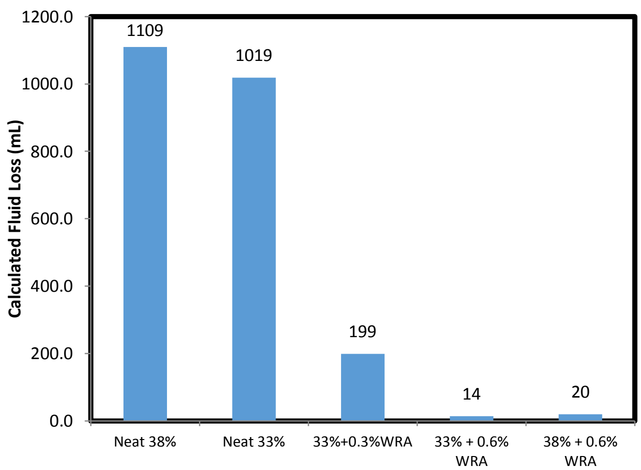

Figure 1. Calculated API Fluid Loss at 400 psi

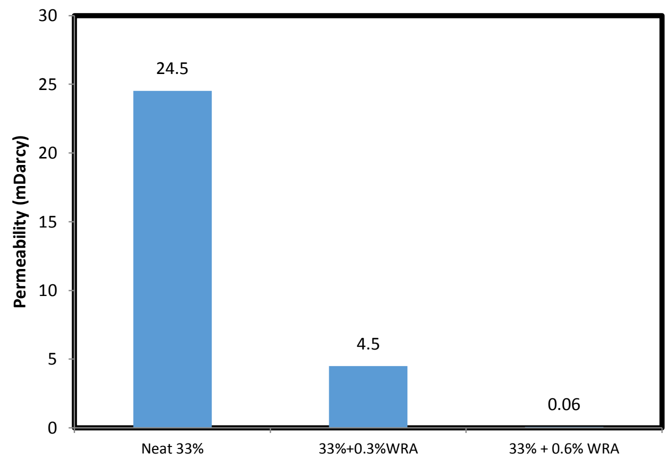

Figure 2. Filter Cake Permeability

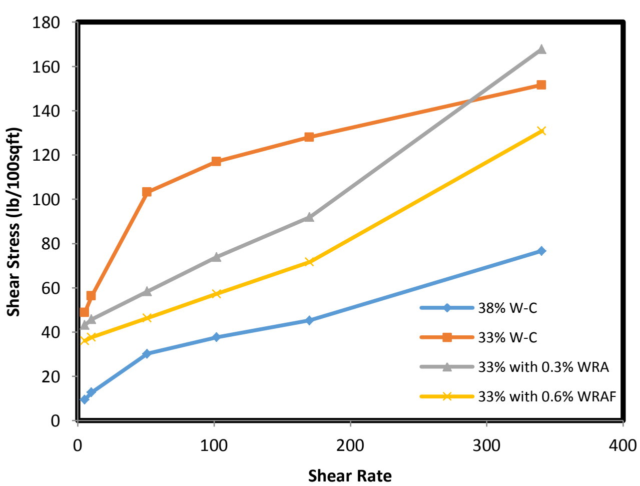

Figure 3. Rheological Behavior of Samples

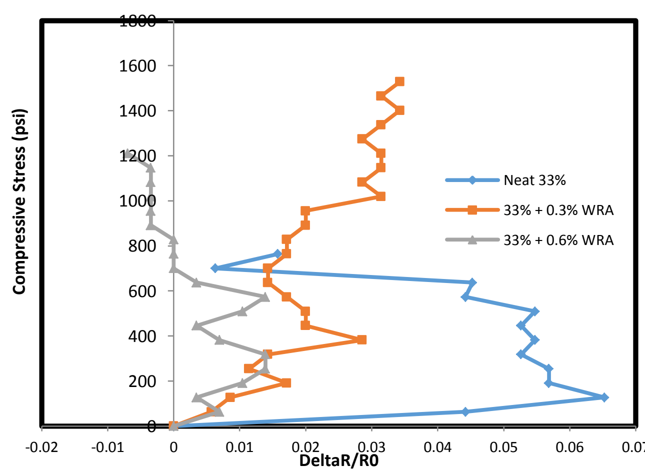

Figure 4. 24 Hour Compressive Strength