Effect of Polypropylene Fiber on Oil well Cement Behavior

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Abstract: In this study, the effect of adding polypropylene fiber up to 0.2% on smart oil well cement was studied. Significant increase in compressive strength reduced volumetric shrinkage and linear shrinkage, changes in electrochemical impedance is observed.

1. Introduction

Cement modified by polymers possesses higher compressive strength, flexural strength, ductility, impermeability and adhesion with steel than with normal cements[1]. Additionally, polymer modified cement has better shrinkage properties. The composites made by using fiber with smart cement are referred as polymer modified smart cement (PMSC). The enhanced properties of PMSC make them suitable for making various precast and structural products.

In Oil well cement, polymer modified cement can be effectively used to control shrinkage, micro cracks and improve cement casing adhesion. These can be used in various forms like: liquid resins, latexes and dispersible fibers. Further, the polymer systems can also be modified by the use additives like surfactants, stabilizers, antifoaming agents and colors.

Concrete strengthened by fibers has high strength against cracks, increased formability, strength against moisture and thermal expansion, enhanced strength against impulse and abrasion[2] .Additionally, the polypropylene fiber augments the concrete resistance to abrasive erosion[3].Further, addition of fibers have reduced the drying shrinkage of concrete[4]. In this research, the effect of polypropylene fiber on oil well smart cement mix is investigated. To measure it, four tests were done: Compressive strength, to determine the effect of fiber on cement matrix: shrinkage test, to study the long term exposure; Electrochemical impedance, to study the electrical behavior of specimens.

2. Objective. The overall objective is to investigate the effectiveness of polypropylene fiber added smart oil well cement.

3. Materials and Methods-

Three different set of mixes were produced with different volume fraction of polypropylene fibers added into the smart cement. Using the LCR meter, the piezo-resistive behavior of the test specimen were measured simultaneously with the compression test. Due low density of the polypropylene fibers, low percentage of fibers is added to smart cement matrix.

The test specimen was prepared following API standards. Class H cement was used with water cement ratio of 0.4. Drying mixing of conductive filler, polypropylene fiber and cement was done.

4. Results and Discussion.

Compressive Test: Compression test of the specimen were competed using Tinius Olsen compression Testing Machine. Three specimens were prepared and polypropylene fiber content was changed. Adding polypropylene fiber enhanced the compressive strength of smart oil well cement. The increase in compressive strength is around 15 percent.

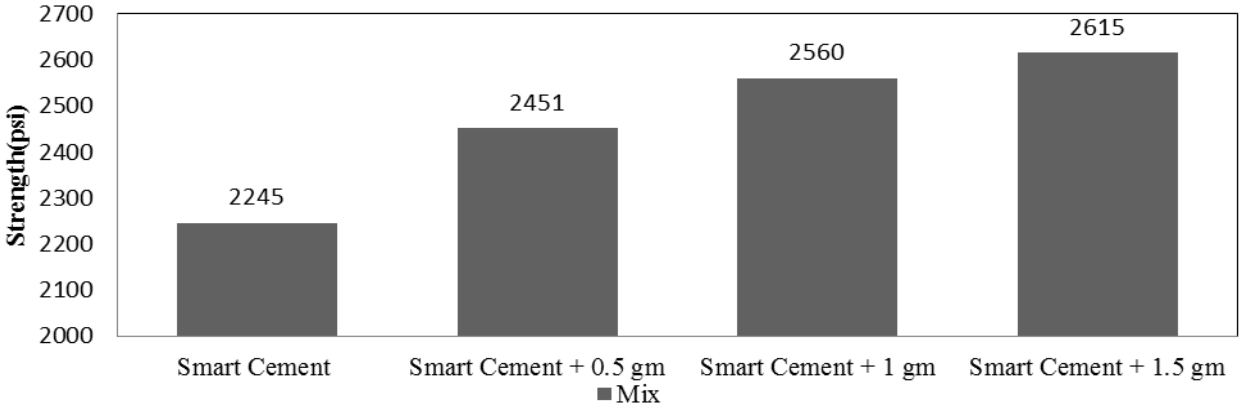

Figure 1: Compressive strength of the specimens after 21 days.

Adding polypropylene fiber enhanced the strength and durability of cement specimen. From the results it is found that adding .5gm, 1gm and 1.5 gm of fiber increased the strength by 9,14 and 16 percent respectively.

Shrinkage Test:Linear shrinkage of the fiber reinforced cement sample were measured for a period of 48 hours. Although, moisture loss happened in the specimen but substantial reduction in volumetric and linear shrinkage is observed.

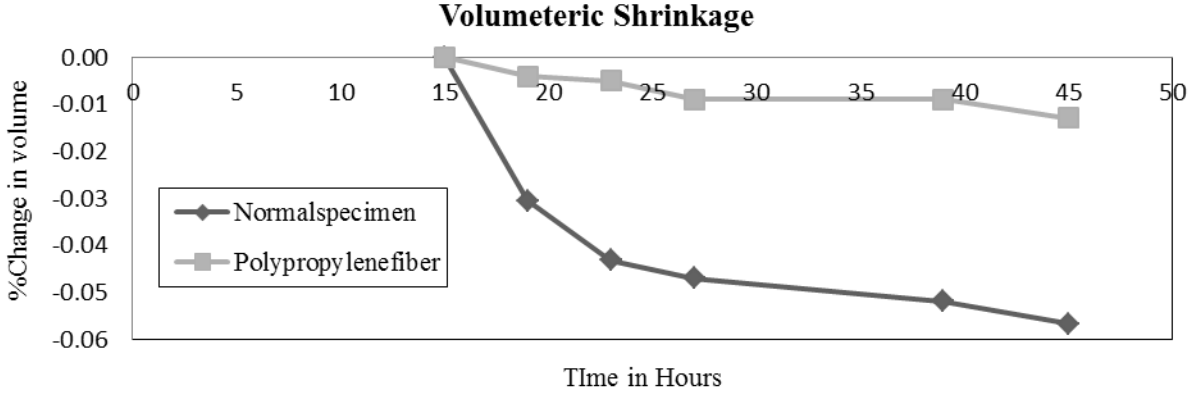

Figure 2: Volumetric Shrinkage of specimens.

In order to simulate the long term shrinkage beahaviour,oven curing of the samples was done at 50 degree centigrade. Also, the linear shrinkage behavior of the specimens are provided..

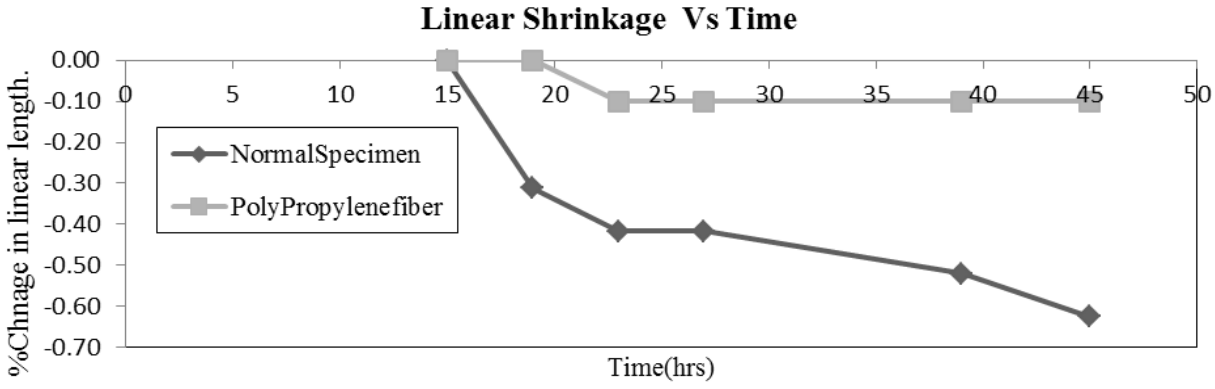

Fig 3: Linear Shrinkage of specimens.

From the aforementioned experimental plots, it is clear that the addition of polypropylene fiber into smart cement reduces the linear and volumetric shrinkage of oil well cement. However, to get desired results proper mixture and dispersion of polypropylene fiber is needed.

Electrochemical Impedance PMSC: The electrochemical impedance of the PMSC is plotted.

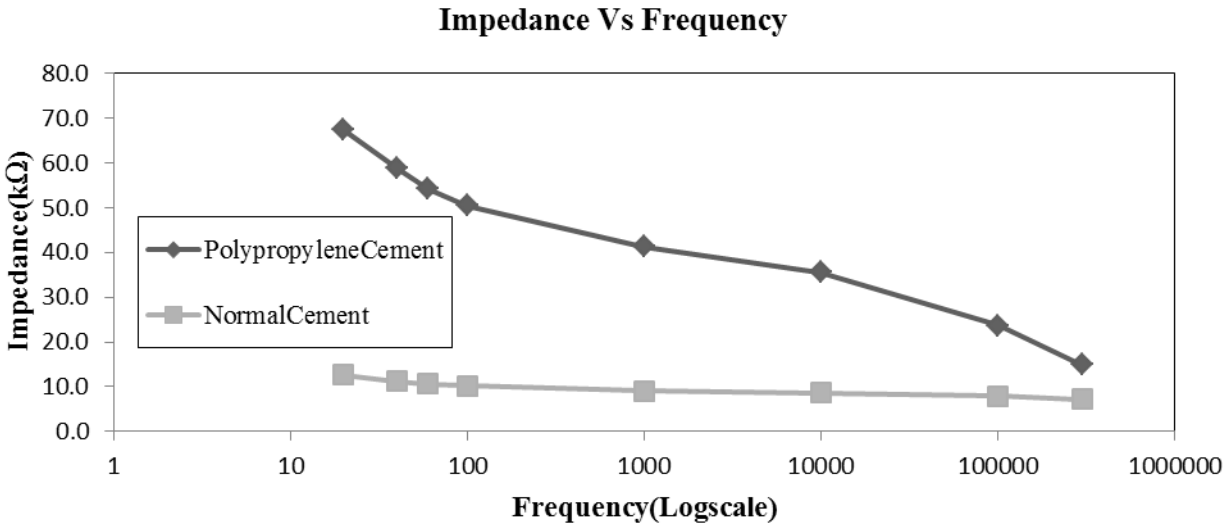

Fig 4: Impedance Vs Frequency plot of smart cement and Polymer Modified smart Cement.

The impedance curves of the specimen follow Case II and higher impedance curve is observed in case of polypropylene fiber. This indicates the PMSC is more resistant to corrosion as it has high resistivity.

5. Conclusion: Polypropylene modified cement has higher compressive strength, excellent in controlling shrinkage compared to Class H Oil well cement. PMSC show higher resistivity and is more resistant to corrosion occurring in deep oil wells.

6. Acknowledgements:

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7. References:

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