Effect of Curing Conditions on the Electrical Resistivity Development of Smart Foam Cement

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Abstract: In this study, the effects of curing conditions on the electrical resistivity development of smart foam cement were investigated. The results of moisture loss and resistivity change for cement samples with different foam content are presented. Foam contents of 0%, 5% and 20% were investigated. Addition of 20% foam reduced the moisture of smart cement from 6.4 gms to 1.4 gms, a 78% reduction for room cured sample for a curing period of 200 days. The electrical resistivity of smart cement reduced to 14 Ω.m, 12 Ω.m and 3.1 Ω.m for moisture cured, room cured and under water cured samples with the addition of 20% foam, showing a decrease of about 22%, 50% and 85% respectively.

1. Introduction

The term curing stands for procedures devoted to hydration reaction, consisting of control of time, temperature and humidity conditions [1]. Electrical resistivity is a parameter that can be used to monitor the entire hardening process of oil well cement slurries. Foamed cements are low density systems used in formation unable support the annular hydrostatic pressure conventional cement slurries [2].

2. Objective

The main objective was to quantify the changes in electrical resistivity and moisture loss of smart cement by the addition of 20% foam.

3. Materials and Method

Oil well cement of Class H was used for the formulation of the foam cement. A water to cement ratio of 0.38 was employed. Conductive Fillers of about 0.04% of weight of cement and water were added for the mix to enhance the sensing properties. Commercially available foam was used in percentage of total weight of the slurry. The sample were subjected to room curing, moisture controlled curing and underwater curing for period of 200 days.

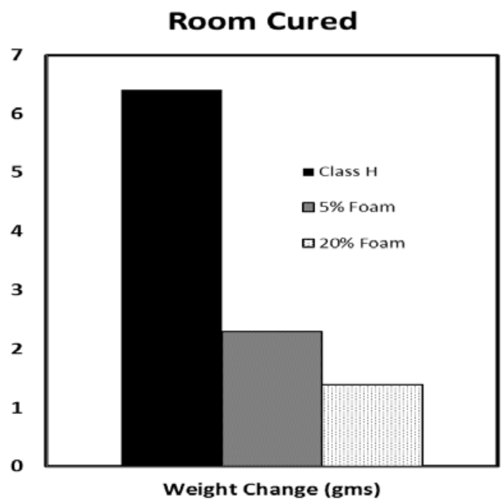
4. Results and Discussion

Addition of 20% foam increased the initial electrical resistivity of smart cement from 1.05Ωm to 2.03Ωm, a 93% increase.

Room Curing: Smart cement without any foam had a weight change of 6.4gms showing maximum moisture loss. With the addition of 5% foam, the moisture loss reduced to 2.3gms. Addition of 20% foam further reduced the moisture loss to 1.4gms (Fig. 1). For Class H, the change resistivity was 22.9% for 200 days with a resistivity of 25 Ω.m. Addition of 5% and 20% foam, the change in resistivity dropped to 9.2% and 4.9% with resistivity of 12.2 Ω.m (Fig. 2).

Moisture Controlled Curing: For Smart cement without any foam, the change resistivity was 16.4% for 200 days of moisture controlled curing with a resistivity of 18.25 Ω.m. With addition of 5% and 20% foam, the change in resistivity dropped to 10.2% and 5.8% with resistivity of 13.2 Ω m and 14.2 Ω.m (Fig.3).

Underwater Curing: The change resistivity was 18.8 % for smart cement without any foam for 200 days of underwater curing with resistivity of 20.7 Ω.m which was due to increased hydration. Addition of 5%, 20% foam dropped the change in resistivity to 4.35%, 0.5% with resistivity of 6.4 Ω m and 3.1 Ω.m (Fig. 4).



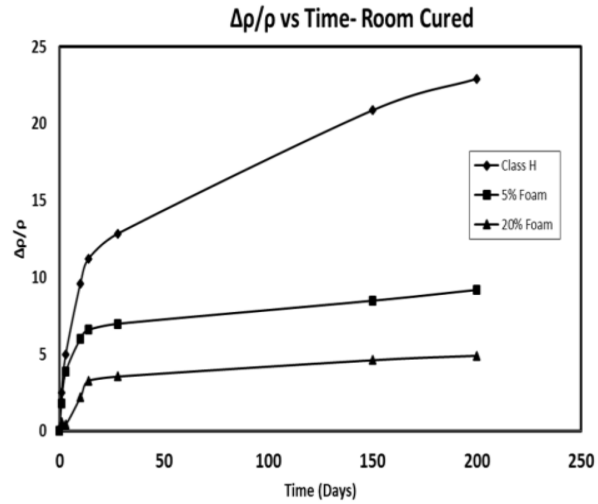
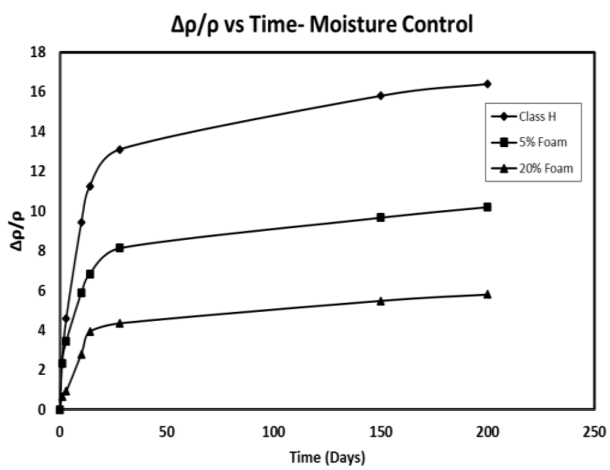


Fig 1,2-Moisture loss and resistivity change for room cured samples for 200 days of curing.



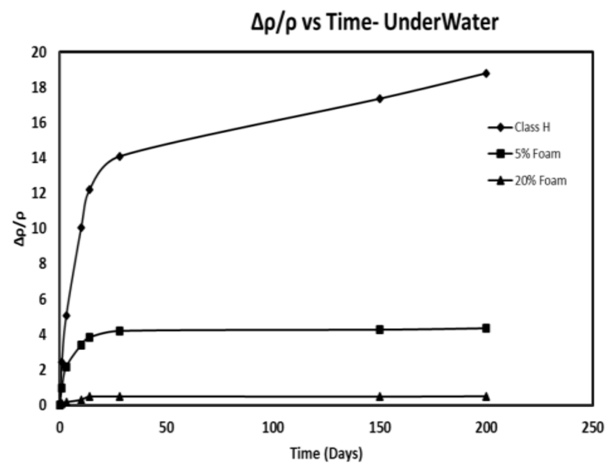


Fig 3, 4-Resistivity change for moisture control and underwater cured samples for 200 days of curing.

5. Conclusion

The room curing of sample showed maximum change in Smart cement samples without foam while moisture curing showed maximum change in foam cement samples. The underwater cured samples showed least change in resistivity for the foam cement samples due to the presence of conductive medium in the pores. Foam cement showed minimum moisture loss for room cured samples. (78% decrease).

6. Acknowledgment

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References

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