Effect of Foam on the Thermal Conductivity and Fluid Loss Properties of Smart Cement

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Abstract: In this study, the effect of foam on the thermal conductivity and fluid loss properties of smart cement were investigated. The results of thermal conductivity and fluid loss for cement samples with different foam content are presented. Foam contents of 0%, 20% were investigated. Addition of 20% foam reduced the thermal conductivity of smart cement from 0.28W/mK to 0.8W/mK, a 65% reduction. The fluid loss of the smart cement reduced from 134 mL to 13.7mL in 60 minutes, a 90% reduction with the addition of 20% foam.

1. Introduction

Foamed cements are low density systems used in formation unable support the annular hydrostatic pressure conventional cement slurries [1]. Foam cement is a light weight and thermal insulation material consisting of cement matrix with porosity structure created by injecting preformed foam into cement slurry during the mixing process [2]. Fluid loss is the loss of the fluid to the formation. Slurry pumpability and flow properties are affected by fluid loss. Slurries are usually designed to exhibit low fluid loss. Slurries that exhibit excessive fluid loss seem to be most vulnerable to gas migration. Oil well cements are expected to exhibit low thermal conductivity for enhanced zonal isolation.

Some of the typical advantages of foamed cement are as follows [3]:

1. Rheology: The higher viscosities of foamed cement help in the removal and displacement of drilling mud.
2. Fluid Loss Control: Foamed cement has improved fluid loss control ability thus reducing the probability of gas migration.
3. Thermal Conductivity: Reduced thermal conductivity leads to enhanced zonal isolation of the cement.

2. Objective

The main objective was to quantify the changes in thermal conductivity and fluid loss of smart cement by the addition of 20% foam.

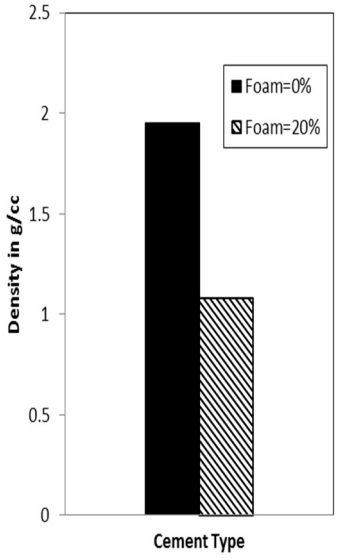
3. Materials and Method

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 0.075% of weight of cement and water were added for the mix to enhance the sensing properties. Preformed foam was used in percentage of total weight of the slurry. API Fluid Press method was used for computing the fluid loss of the cement. A pressure of 100 psi was used for room temperature. Thermal properties meter is used for measuring the thermal conductivity of the cements at room temperature.

4. Results and Discussion

The thermal conductivity of the conventional smart cement was about 0.8W/mK while addition of 20% foam reduced the thermal conductivity drastically to 0.28W/mK close to thermal conductivity of wood pulp. Generally air has thermal conductivity of order of 0.024 W/mk. This low thermal conductivity of air which is present is foam cement is responsible for such low thermal conductivity of foam cement. (Fig.2) The addition of foam also reduced the density of the smart cement from 1.95 g/cc to 1.08 g/cc,(Fig.1)

resulting in formation of light weight cement. The Fluid loss in the smart cement was reduced with the addition of foam. Addition of 20% foam decreased the fluid loss (60 min) from 134mL to 13.7mL (Fig.3). The reduced fluid loss is due to the sealing of surfaces by the foam cement.



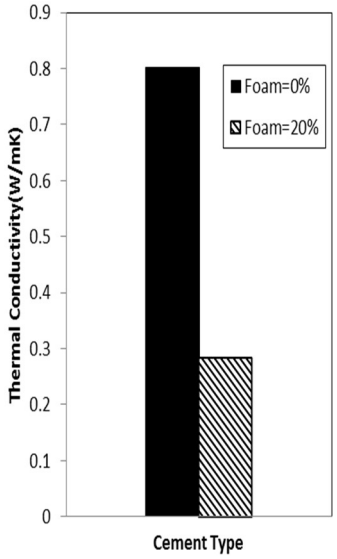


Fig 1, 2. Density and Thermal conductivity in smart cement with

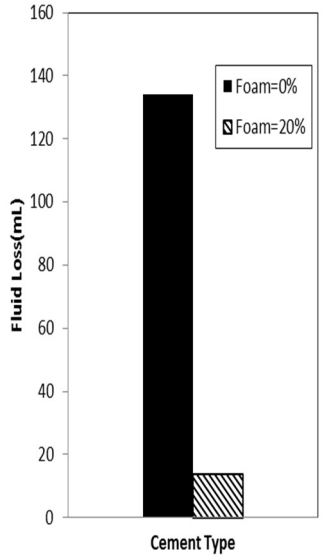


Fig 3- Fluid loss of smart cement with foam addition foam addition

5. Conclusion

Foam cement reduced the thermal conductivity by 65% percentage with the addition of 20% foam. The density of the smart cement was reduced by 50% and the fluid loss was reduced by 90% with just 13.7mL fluid loss.

6. Acknowledgement

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7. References:

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