Effect of Metakaolin on the Electrical Resistivity of Modified Oil Well Cement

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Abstract:

The effect of Metakaolin as an additive to modify the oil well cement was investigated at room condition. Based on literature review 10% Metakaolin was added to the cement and change in electrical resistance and weight loss were measured during the curing of the material. Addition of Metakaolin increased the change electrical resistivity during the curing of cement and also reduced the weight loss.

1. Introduction:

Hydration of cementations material is an important process for cement to develop mechanical strength and low permeability. Cement hydration involves chemical reaction between water and the anhydrous compounds present in the cement. As a result, the solid phase becomes highly connected and the material transforms from a viscous suspension of irregular shaped cement and other particles into a porous stiff solid. Cement hydration has been monitored with so many different ways using Vicat needle, strength, scanning electronic microscope (SEM), X-ray diffraction (XRD), (Andrew et al.2012, Cheung et al.2011, Brooks et al.2001). Metakaolin is refined kaolin clay that is fired (calcined) under carefully controlled conditions to create an amorphous aluminosilicate that is reactive (Ambrosia et al.1994). Like other pozzolans (fly ash and silica fume), Metakaolin reacts with the calcium hydroxide (lime) byproducts produced during cement hydration. Metakaolin has been used in concrete to refine the pore structure of the cement paste matrix of concrete, also Metakaolin increased resistance to acids and sulphates, reducing porosity and reduced chloride ion diffusivity. (Ambrosia et al.1994, Khatib et al.1996)

2. Objective:

Effect of Metakaolin on the electrical resistivity and weight change during curing of modified oil well cement at room condition was investigated.

3. Materials and Methods:

The cement was mixed with 10% Metakaolin and then water was added. The water-to-cement ratio (including Metakaolin) was 0.45 for both the Metakaolin and control specimen. The cement mix was then placed in plastic cylinder mold of 2 inches in diameter and 4 inches in height. Each mold had 4 wires installed to measure the electrical resistance.

4. Result and Discussion:

The density of modified cement with or without Metakaolin was 2.009 g/cm^3 and 2.021 g/cm^3 respectively. The change in the electrical resistance ratio for the modified cement increased with curing time. The resistivity ratio change was about 1 after 3 days for curing of the modified oil well cement. Adding of 10% of Metakaolin increased the change in electrical resistivity by about 3 after one day of curing. The resistivity ratio increased to 5 after 3 days of curing. As it can be seen adding Metakaolin lowered the weight loss. The weight loss was about 3.83% for the specimen made with Metakaolin, while for the specimen without Metakaolin weight loss was about 6.71% under curing in room condition.

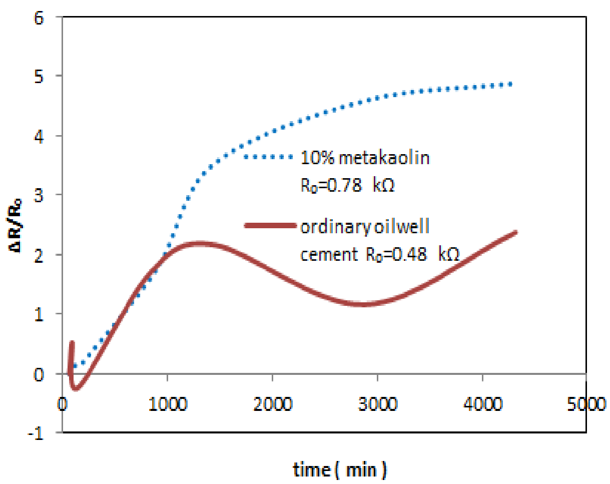

Figure 1. Change in the electrical resistance versus time for the cement with and without Metakaolin.

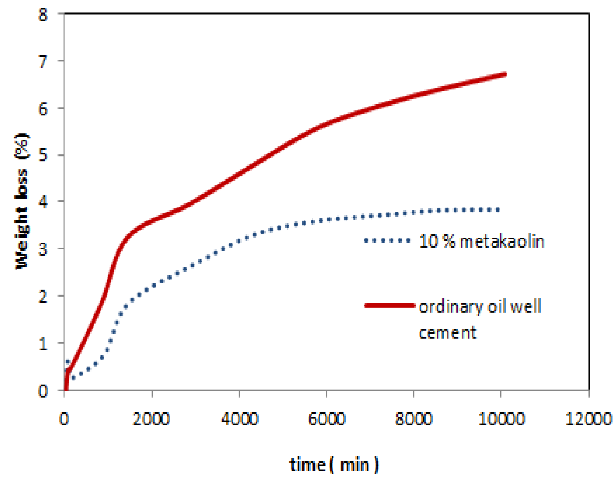

Figure 2. Percentage of weight change for specimens made with and without Metakaolin during curing.

5. Conclusion: Addition of the 10% Metakaolin to the modified oil well cement increased the resistivity ratio by 5 after 3 days of curing which was almost 2 times greater than specimen without Metakaolin. The weight loss decreased from 6.71% to 3.83% with the addition of Metakaolin.

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