Investigating the use of refineries' FCC spent catalyst as cement or fine aggregates partial replacement in cement mortars

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Abstract:

This research was conducted to characterize FCC spent catalysts produced from two refineries in Oman (i.e. Sohar Refinery and Mina Al-Fahl Refinery) and to investigate the use of these materials as cement or fine aggregates partial replacement in cement mortars.

Spent Catalysts are waste materials generated in the refinery processes during refining of heavy oils. These materials became hazardous to the environment and could be used in other beneficial applications. The results of this work can give a solution for this environmental issue in addition to the saving of the natural resources and monetary saving.

Different mortar mixtures were prepared using spent catalyst. Mortars differ in terms of water-to-cement ratio that ranges between 0.50 and 0.60. The material sources were Sohar refinery and Mina Al-Fahl catalysts. Different replacement ratios were used for cement replacement which vary from 0 to 10% and from 0 to 25% for sand replacement.

The raw spent catalyst materials were studied in terms of their physical and chemical properties. Unconfined compression strength and heavy metal leachates tests were used to analyze the samples.

The results indicated that Sohar Refinery’s spent catalyst can be utilized in mortar mixtures effectively at a high water-to-binder ratios of 0.60 and 0.55. Twenty percent of sand or 8-10% of cement can be replaced by spent catalyst without affecting their compressive strength.

The results also indicated that Mina Al-Fahl spent catalyst can be utilized effectively at water-to-binder ratio of 0.60. When it is used as cement substitute, the crushed material can replace up to 4% of the cement in the mortar mixture, while it can replace 15% of the sand without affecting their compressive strength.

The environmental results showed an environmental compatibility with the standards limitations by which the material can be classified as non-hazardous unlike some other spent catalysts.