Potential use of spent catalyst generated by Sohar and Mina Al-Fahl Refineries in concrete

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Abstract

Solid wastes like spent catalyst can be utilized as valuable materials in concrete applications. Two types of spent catalyst, zeolite and equilibrium, are generated in Oman at Sohar and Mina Al-Fahl Refinery from the oil cracker. These materials were characterized chemically, physically and environmentally and it show high potential to be used in the concrete applications. The pozzolan composition of the spent catalyst is about 77.4% and 67% at Sohar and Mina Al-Fahl Refineries, respectively. Spent catalyst from Mina Al-Fahl contains high amounts of alkalis which affect the corrosion results adversely. The specific gravity of the spent catalyst varies between 2.6 and 2.79.

Several tests were conducted on concrete to study the effect of replacing cement or sand by spent catalyst from both refineries. The replacement proportions were 2%, 4%, 6%, 8% and 10% for cement and 5%, 10%, 15%, 20% and 25% for sands in addition to the control mixtures with no spent catalyst replacement by considering w/b ratios of 0.5 and 0.7. Results show that the compressive strength increased by using spent catalyst from Sohar Refinery as sand replacement and it yielded comparable compressive strength to control mixture when it was used as cement replacement. At 25% sand replacement, the increase in the cubes compressive strength with respect to the control mixture was 73% at w/b ratio of 0.7 and it was 21.6% at w/b ratio of 0.5. The tensile and the flexural strength results follow the same behavior as in the compressive strength. Using spent catalyst from Mina Al-Fahl Refinery as cement replacement with small percentages resulted in a comparable compressive strength to the control mixture. However, using 25% spent catalyst from Mina Al-Fahl Refinery as sand replacement yielded 46% reduction in the compressive strength at w/b ratio of 0.7. Total absorption test, accelerated corrosion test and setting time test were conducted for some selected mixture; 6% and 10% of cement replacement and 15% and 25% of sand replacement in addition to the control mixture. Total absorption was increased by increasing the cement replacement and it was approximately constant by increasing the sand replacement. Applications made of the spent catalyst from Mina Al-Fahl Refinery absorbs higher amount of water than the applications made of spent catalyst from Sohar Refinery. Corrosion test results showed that the spent catalyst from Sohar Refinery has good resistivity to the steel corrosion and concrete cracks. The setting time of the concrete made with spent catalyst from both refineries became lesser by replacing more amounts the cement or the sand.