PROPERTIES OF OLIVE WASTE ASH MORTAR COMPOSITES

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Introduction

Concrete and mortar are the most widely used constructional material all over the world. Masonry mortar can be defined is a mixture of cement, sand and water. Recently, a number of researchers in civil engineering tend to use mineral admixtures to improve and enhance the mechanical properties of concrete and consequently increase the service life of concrete structures [1].

One of the most important agricultural wastes in the Mediterranean countries such as Jordan is olive waste. Pressing the olive fruits results in the olive oil in addition to solid waste. The solid wastes are dark colored wastes and contain high amounts of organic materials. When dumped, such oil reacts to yield hazardous chemicals such as phenols and other aromatics [2,3]. The olive waste solid is causing an environmental problem and pollution. This study investigates the properties of olive waste ash (OWA) mortar composites.

Experimental

Materials

Portland cement Type I and silica sand were used in preparing the mortar mixtures. The OWA was obtained by incinerating olive waste in an oven at a temperature of 900 °C for a period of 8 hours. The resulting ash was collected from the oven and fine ground for 2 hours. The olive waste contains about 11% OWA. The OWA had a gray color, silica (SiO_2) content of 26%, lime (CaO) content of 43% and Blaine fineness of 420 m^2/kg. Fig. 1 shows a scanning electron micrograph of OWA particles. Most particles of OWA are irregular in shape and some particles are rounded.

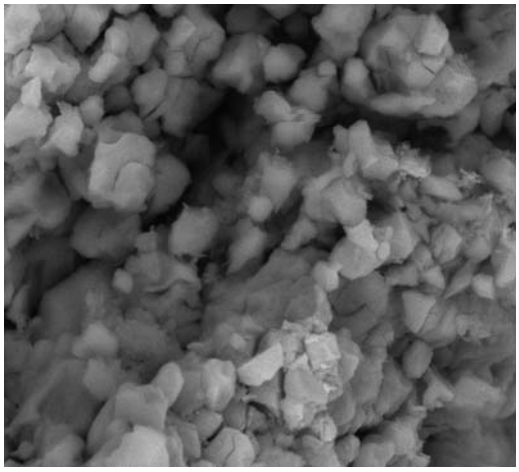

Fig. 1: Scanning electron micrograph of OWA particles.

Specimens and Procedure

The test specimens used in the study were cubes (5 cm) to measure the compressive strength and prisms (4 × 4 × 16 cm) to measure the flexural strength. The OWA was added to mortar mixture as a partial replacement of the cement and silica sand at four levels: 5%, 10%, 15% and 20% by weight. The mortar was mixed in a 4730 cm^3 mixing bowl according to ASTM C305. The mortar mixture proportions were 1:3:0.7 by weight for cement, sand, and water, respectively, for all mortar mixtures used in this study. The workability of the mortar (as measured by flow table test) was conducted according to ASTM C230. Cement paste was prepared to evaluate the setting time using the Vicat apparatus according to the ASTM C 191 [4].

Results and Discussion

The setting times (initial and final) of the control cement pastes were less than that of the OWA paste. As the OWA replacement

increased, the setting time decreased. This is due to the high amounts of Alumina (8.5%) present in OWA, which accelerate the hydration process, leading to fast setting [5].

The effect of OWA content on the mechanical properties (compressive and flexural strength) of mortar using replacement by sand after 7 and 28 days of moist curing is shown in Figs 1 and 2.

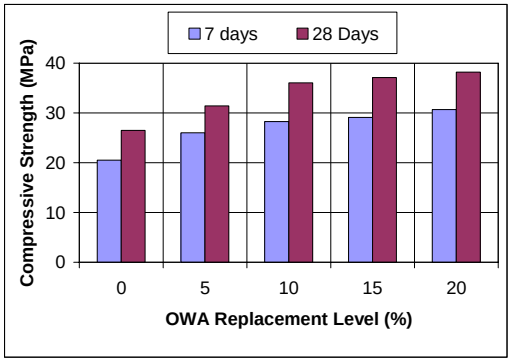

Fig. 1: Effect of OWA replacement on the compressive strength.

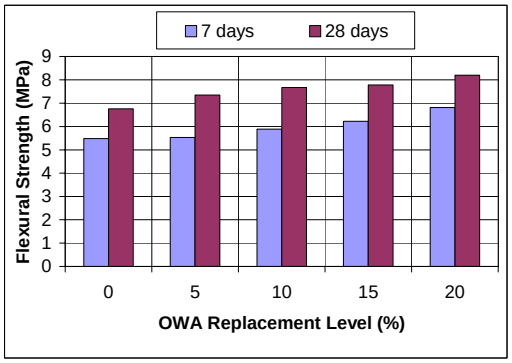

Fig. 2: Effect of OWA replacement on the flexural strength.

It is clear from these figures that there is a significant impact for the effect of OWA content on the mechanical properties of mortar. The compressive and flexural strength increased with increasing the OWA content. The percent increase in the compressive strength was 19, 36, 40 and 44 for OWA replacement of 5%, 10%, 15% and 20%, respectively. The increase in the compressive and flexural strength with the increase of OWA content is attributed to the effect of OWA filler action that increased the compressive and flexural strength.

Conclusions

The properties of OWA mortar composites were investigated in this study. The setting time of OWA cement paste decreased with increasing the OWA content. The workability of OWA mortar as measured by flow test decreased with increasing the OWA content. The compressive and flexural strength of mortar increased with increasing the OWA content as a partial replacement of sand. The compressive and flexural strength of mortar decreased with increasing the OWA as a partial replacement of cement.

References

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