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Mechanical performance of alkali-activated mortar containing porcelain waste as fine aggregate

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Introduction

Sustainable practices used in civil construction are the reduction of waste generated and the choice of materials that promote the replacement of natural resources, including waste generated in industrial, commercial and agricultural activities (Nimwinya et al., 2016). In this context, alkali-activated binders represent cleaner production by allowing the use of waste in its composition and incorporating different components to Portland cement (Provis and Van Deventer, 2009; Provis, 2014).

Objetives

The present research studied the mechanical performance when using Porcelain Electric Insulator waste (PW) to replace the natural sand in alkali-activated mortars.

Materials and methods

Materials: natural sand (NS), porcelain waste (PW) from electrical insulators, NaOH in flakes, metakaolin (MK) “HP ultra” from Metacaulim do Brasil Indústria e Comércio Ltd., rice husk ash (RHA) “Silcca Nobre” from Sílica Verde do Arroz Ltd., and water from municipal supply.

NaOH and rice husk ash were used to make an alternative sodium silicate which was used as alkali activator, and metakaolin was the aluminosilicate source.

Porcelain waste as ground to make the porcelains sand (SPW). Mortars were made with NS and it was replaced by SPW.

Methods: compressive strength and flexural strength were evaluated in mortars (NS and SPW) cured at room temperature.

Results and Discussion

Figures 1 and 2 show the flexural strength and compressive strength, respectively. Flexural strength increased with time for both mortars and SPW has lower values, but they were good enough to produce building components.

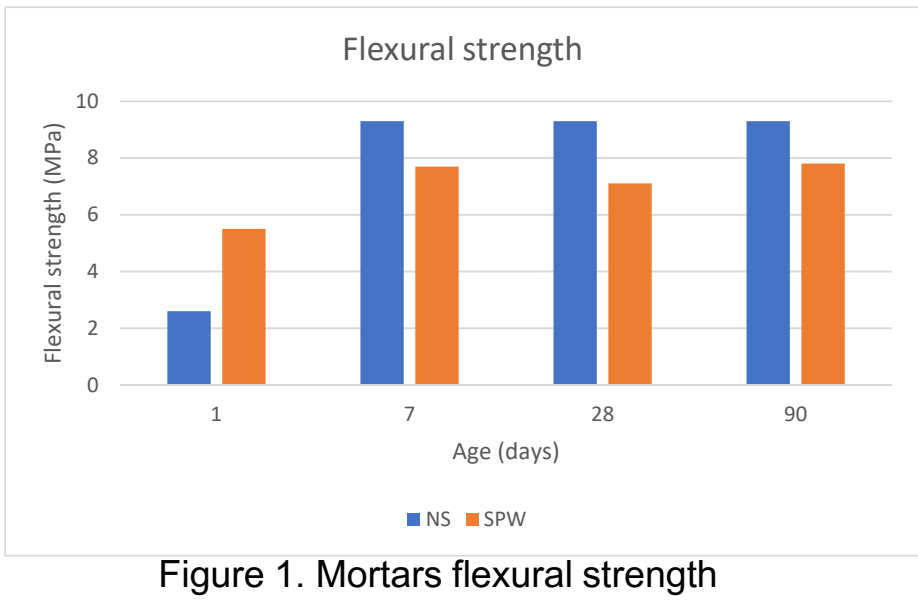


Figure 1. Mortars flexural strength

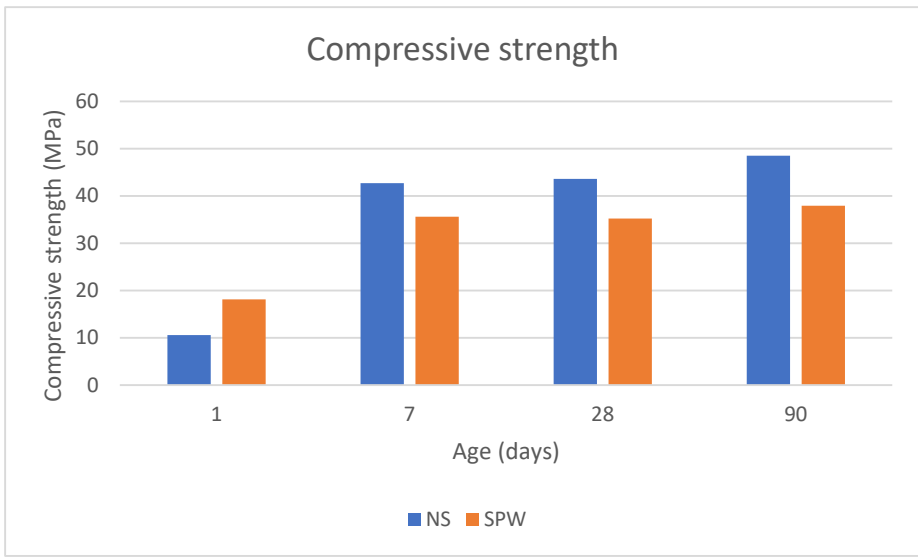


Figure 2. Mortars compressive strength

Compressive results of SPW mortar were 18.1 MPa at 1 day and 37.9 MPa at 90 days. They are higher than the structural ceramic bricks used in building construction which vary from 4 to 14 MPa (ABNT NBR 15270-1).

Conclusion

The results show that porcelain waste can be used as fine aggregate in the production of alkali-activated mortars. Structural components to building construction can be made with porcelain waste.

The alkali-activated mortars with porcelain waste achieved good strength values and promoted energy savings and reduced CO_2 emission.

Acknowledgement

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