Alkaline Activation of Rammed Earth Material – “New Generation of Adobes”

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Abstract. Adobe is an extremely simple form of earth construction and with this technique the shrinkage associated with the construction of large structures is avoided. In Portugal, earthen materials have been used in load-bearing walls in the form of adobe or rammed earth for the construction of buildings especially in the southern and central coast. Most conventional consolidation treatments used in the past have not succeeded in providing a long-term solution because they did not tackle the main cause of degradation, the expansion and contraction of constituent clay minerals in response to humidity changes. Clay swelling could be reduced significantly by transforming clay minerals into non-expandable binding materials with cementing capacity using alkaline activation. In this study it was being developed adobes with water, and alkaline activated with NaOH and KOH. The obtained results allowed to conclude that the adobes with NaOH and KOH have an increase of its properties.

Keywords: Rammed-earth · Adobe construction · Alkaline activation · “New generation of adobes”

1 Introduction

The use of adobe construction in the Aveiro district reflected the properties of the existing raw materials available to be applied, namely sand, clay sediments and soils and lime (Silveira et al. 2012), and there is an evident heterogeneity of the adobes linked to the geographic distribution of the available resources. In Aveiro there was a semi-industrial production of adobe, some small companies employing ‘adobeiros’, for the manufacture of blocks of adobe, along with a domestic self-production (Costa et al. 2016). Most conventional consolidation treatments used in the past have not succeeded in providing a long-term solution because they did not tackle the main cause of degradation, the expansion and contraction of constituent clay minerals in response to humidity changes. Clay swelling could be reduced significantly by transforming clay minerals into non-expandable binding materials with cementing capacity using alkaline activation.

2 Methods and Approaches

The chemical composition of diatomite samples was assessed by X-ray fluorescence (XRF), qualitative mineralogical analyses were carried out by X-ray diffraction (XRD). Compressive strength tests use a universal mechanical compression testing machine (Shimadzu Autograph AG 25 TA).

3 Results and Conclusions

Mineralogically, samples are composed by quartz, feldspars and phyllosilicates, however, there is an evidence of the presence of amorphous alumino-silicate phases. Samples with higher mechanical strength are associated with higher specific surface areas, namely, those with NaOH. The alkaline activation promotes the increase of mechanical resistance. With the exception of one sample, all the samples present promising mechanical resistances for their application in rehabilitation works on adobe buildings, since these do not require high resistance, even for the sake of compatibility.

References

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