

Effects of fibre reinforcements on properties of extruded alkali activated earthen building materials

Emeso B. Ojo^{a,b,*}, Kabirat O. Bello^{a,b}, Kabiru Mustapha^c, Ronaldo S. Teixeira^d, Sérgio F. Santos^e, Holmer Savastano Jr.^d

^a African University of Science & Technology (AUST) Materials Science & Engineering Department, Abuja, Nigeria

^b Nigerian Building & Road Research Institute (NBRRI), Building Research Department, Abuja, Nigeria

^c Kwara State University (KWASU) Materials Science & Engineering Department, Malete, Nigeria

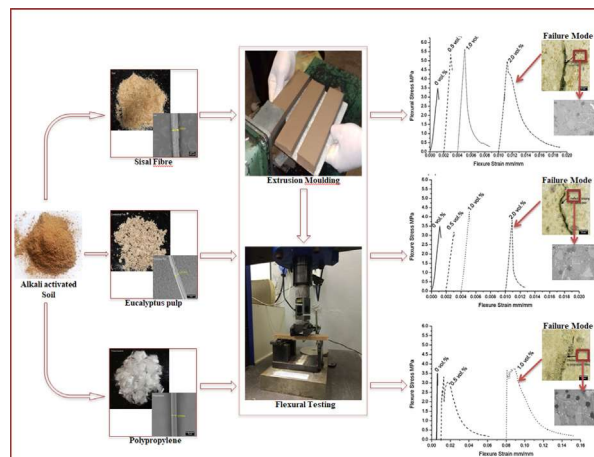
^d University of São Paulo (USP), Biosystems Engineering Department, São Paulo, Brazil

^e São Paulo State University (UNESP), Materials & Technology Department, São Paulo, Brazil

HIGHLIGHTS

- Fibres and alkali activators significantly improve properties of earth-based composites.
- Physical and chemical fibre-matrix interactions control composite performance.
- Sisal fibres increase flexural strength/density and reduce water absorption.
- Sisal fibre presents superior reinforcing potential relative to E. pulp microfibres.
- Polypropylene fibres impart deflection-hardening behaviour to composites.

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:

Received 2 March 2019

Received in revised form 24 July 2019

Accepted 20 August 2019

Available online 30 August 2019

Keywords:

Earthen building materials

Lignocellulosic fibres

Fibre reinforced soils

Modulus of rupture

ABSTRACT

The reaction between clay minerals present in soil and an alkaline solution has the potential to develop in situ binders, which can be harnessed in the development of earth based construction materials. To ascertain the efficacy of this stabilisation mechanism in conjunction with fibres which are commonly used in earthen construction, this study presents a comparative analysis of the reinforcing effect of different fibre types (sisal, Eucalyptus pulp microfibres and polypropylene) in an alkali activated stabilised soil produced using extrusion technique. An evaluation of flexural properties in oven-dry and saturated conditions was conducted to simulate mechanical response in ideal and extreme conditions to evaluate effect of fibre type and content (0–2 vol%). Physical properties were also studied and optimum fibre contents evaluated. Results show that with respect to lignocellulosic fibres, sisal fibre reinforcements yielded the most remarkable result with the highest statistically significant improvement in flexural strength (79% relative to the unreinforced matrix) compared to composites reinforced with Eucalyptus pulp micro-fibres. Improved packing density and attendant reduction in water absorption associated with sisal fibre reinforced composites was attributed to synergistic interactions between sisal fibres and alkali activated matrix. On the other hand, synthetic fibre reinforcement (polypropylene), which had no

* Corresponding author.

E-mail address: ejojo@aust.edu.ng (E.B. Ojo).