

Application of sugarcane bagasse ash in the production of low cost soil-cement brick

Mateus C. Amaral^{1a} and José N. F. Holanda^{*2}

¹Department of Engineering, Fluminense Federal University, Rua Recife, s/n,
Rio das Ostras-RJ 28895-532, Brazil

²Laboratory of Advanced Materials, State University of Northern Fluminense, Av. Alberto Lamego 2000,
Campos dos Goytacazes-RJ 28013-602, Brazil

(Received April 6, 2017, Revised June 23, 2017, Accepted January 4, 2018)

Abstract. This work investigated the use of sugarcane bagasse ash (SCBA) generated by an energy co-generation process in sugarcane mill as an alternative raw material in soil-cement brick. The SCBA obtained from a sugarcane mill located in southeastern Brazil was characterized with respect to its chemical composition, organic matter content, X-ray diffraction, plasticity, and pozzolonic activity. Soil-cement bricks were prepared by pressing and curing. Later, they were tested to determine technical properties (e.g., volumetric shrinkage, apparent density, water absorption, and compressive strength), present crystalline phases, and microstructural evolution. It was found that the SCBA contains appreciable amounts of silica (SiO₂) and organic matter. The results showed that the SCBA could be used in soil-cement bricks, in the range up to 30 wt. %, as a partial replacement for Portland cement. These results suggest that the SCBA could be valorized for manufacturing low-cost soil-cement bricks.

Keywords: sugarcane bagasse ash; soil-cement brick; building material; recycling

1. Introduction

The sugarcane industry produces high amount of waste materials, including bagasse (Balakrishnan and Batra 2011). The sugarcane bagasse is a fibrous material essentially composed of cellulose (14-25%), hemicellulose (22-30%), and lignin (14-25%) (Shanmukharadhya and Ramachandran 2009, Balakrishnan and Batra 2011). This waste material has a high calorific value of about 8000 kJ/kg (Batra *et al.* 2013). For this reason, the sugarcane bagasse is very attractive to be used as renewable biomass fuel at the sugarcane mills for electrical energy co-generation (Shanmukharadhya and Ramachandran 2009, Stanmore 2010, Le Blonde *et al.* 2010). In Brazil, sugarcane bagasse biomass represents about 8 % of the total electrical energy consumed (Novacana 2016). However, as a result of this process a solid waste material known as sugarcane bagasse ash (SCBA) is produced in high amount in several countries. Brazil is the world's largest

*Corresponding author, Professor, E-mail: holanda@uenf.br

^aProfessor, E-mail: mateus.amaral2008@hotmail.com

- NPK in calcareous soil”, *Sangklanakian J. Sci. Technol.*, **30**(3), 281-289.
- Le Blonde, J.S., Horwell, C.J., Williamson, B.J. and Oppenheimer, C. (2010), “Generation of crystalline silica from sugarcane bagasse burning”, *J. Environ. Monit.*, **12**(7), 1459-1470.
- Lima, S.A., Varum, H., Sales A. and Neto, U.F. (2012), “Analysis of the mechanical properties of compressed earth block masonry using the sugarcane bagasse ash”, *Constr. Build. Mater.*, **35**, 829-837.
- Luxán, M.P., Madunga, F. and Saavedna, J. (1989), “Rapid evaluation of pozzolonic activity of natural products by conductivity measurement”, *Cement Concrete Res.*, **19**(1), 63-69.
- Novacana. (2016), Cogeração de Energia, <<http://www.novacana.com/n/cogeracao>>.
- Payá, J., Monzó, J., Borrachero, M.V., Díaz-Pinzón, L. and Ordonéz, L.M. (2002), “Sugar-cane bagasse ash (SCBA): studies on its properties for reusing in concrete production”, *J. Chem. Technol. Biotechnol.*, **77**(3), 321-325.
- Ramírez, R.A., García, P.M., Reyes, J.M., Juárez, D.C.A. and Ponce, Y.G. (2012), “The use of sugarcane bagasse ash and lime to improve the durability and mechanical properties of compacted soil blocks”, *Constr. Build. Mater.*, **34**, 296-305.
- Shanmukharadhya, K.S. and Ramachandran, K. (2009), “Thermal degradation behavior of bagasse particles”, *J. Energy Inst.*, **82**(2), 120-122.
- Souza, M.I.B., Segantini, A.A.S. and Pereira, J.A. (2008), “Soil-cement pressed bricks made with concrete wastes”, *Rev. Bras. Eng. Agrí. Amb.*, **12**(2), 205-212.
- Stanmore, B.R. (2010), “Generation of energy from sugarcane bagasse by thermal treatment”, *Waste Biomass Valor.*, **1**(1), 77-89.
- Ú NICA. (2016), Safra 2014/2015, <<http://www.unica.com.br/unicadata>>.
- Valenciano, M.D.C.M. and Freire, W.J. (2004), “Physical and mechanical characteristics of soil-cement-bagasse ash mixtures”, *Eng. Agrí.*, **24**(3), 484-492.