Available online at www.sciencedirect.com

ScienceDirect

Procedia Technology 25 (2016) 186 – 193

Procedia Technology

Global Colloquium in Recent Advancement and Effectual Researches in Engineering, Science and Technology (RAEREST 2016)

Feasibility Study of Geopolymer Binder from Terracotta Roof Tile Waste

S Usha[a]*, Deepa G. Nair[b], SubhaVishnudas[b]

[a]*Research Scholar, Division of Civil Engineering, School of Engineering, CUSAT, Kochi, India*
[b]*Associate Professor, Division of Civil Engineering, School of Engineering, CUSAT, Kochi, India*

Abstract

Geopolymers are amorphous to semi crystalline polymeric products formed by the alkali activation of alumino-silicate materials with alkaline silicate solution at ambient or slightly elevated temperatures, which can be used as alternative to ordinary cement. In this paper, the feasibility of geopolymer binder from terracotta roof tile waste was investigated by varying different parameters like concentration of sodium hydroxide, proportion of sodium silicate to sodium hydroxide solution, alkaline activator to binder ratio and elevated temperature curing. Strength characteristics of geopolymer mortars at 7 and 28 days were investigated and SEM analysis was conducted for establishing the feasibility of roof tile powder waste as a potential source of geopolymer.

Peer-review under responsibility of the organizing committee of RAEREST 2016

*Keywords:*geopolymer, sodium silicate to sodium hydroxide ratio, roof tile waste, SEM

1. Introduction

The world is facing the challenges of global warming and climate changes due to the emissions of CO_2, greenhouse gases and other environmental pollutants. Geopolymers are amorphous to semi crystalline polymeric products formed by the alkali activation of alumino-silicate materials with alkaline silicate solution at ambient or

* Corresponding author. Tel.: +0-944-781-9058; fax: +0-000-000-0000 .
*E-mail address:*ushaushus11@rediffmail.com

Peer-review under responsibility of the organizing committee of RAEREST 2016
doi:10.1016/j.protcy.2016.08.096

slightly elevated temperatures, which can be used as alternative to ordinary cement. The sustainable and environmental friendly approaches points towards Geopolymer technology which minimizes energy requirements and CO_2 emissions by using industrial wastes and by products. Generally, materials containing mostly amorphous silica (SiO_2) and alumina (Al_2O_3) are a possible source for geopolymer production. Palomo et al. [1] concluded that the concentration of the alkaline activator plays a crucial role in the polymerization reaction which was confirmed by the studies of other authors also [2, 3]. The addition of sodium silicate solution to the sodium hydroxide solution as the alkaline activator enhanced the reaction between the source material and the solution [4, 5, 6, 7]. Initially the geopolymer research was concentrated on the waste material fly ash only. At ambient temperature, geopolymerization reaction of the raw fly ash is extremely slow [8], which was enhanced by mechanical activation or addition of ground granular blast furnace slag to fly ash [9,10,11,12]. Some other authors reported that increased curing temperature exhibited the best physical and mechanical properties [8,6,13,14]. In recent years many research works has been carried out to investigate the possibility of utilizing industrial waste materials as raw material in the production of geopolymer cements [15, 16, 17]. Terra cotta tile industry is one of the traditional industries of Kerala. Around 20000 tons of damaged / faulty tiles are produced during the manufacture of terracotta roof tile annually. In this paper the feasibility of geopolymer binder from terracotta roof tile waste (TRTW) and the effects of different parameters on the proposed geopolymer binder are presented.

2. Materials and Experimental Details

2.1 Materials

TRTW were collected from a terracotta tile factory (St.Josephs Clay Works, Kalady, Kerala). It was then crushed and powdered to a particle size less than 75µm using ball mill. Fig. 1.shows the particle size distribution curve of TRTW powder determined by hydrometer analysis. Table.1and Fig.2.shows the chemical composition obtained by X-Ray Fluorescence (XRF) analysis and microstructure by Scanning Electron Microscope (SEM) analysis of TRTW respectively.

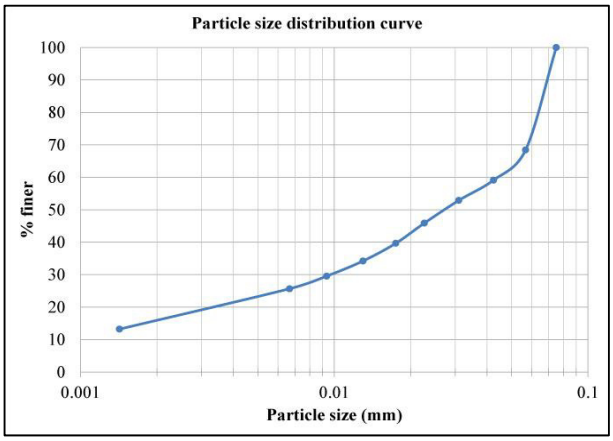

Fig.1. Particle size distribution curve of TRTW powder

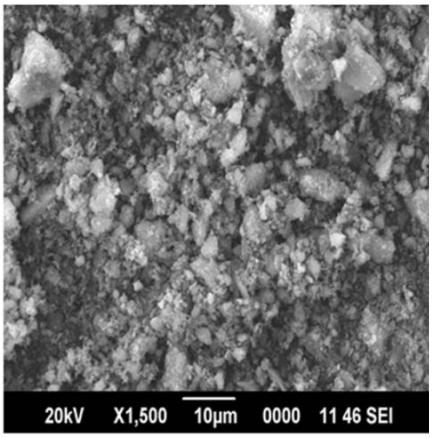

Fig.2. SEM image of TRTW

Table.1.Minerological composition of TRTW

Compound	SiO_2	Al_2O_3	Fe_2O_3	MgO	K_2O	TiO_2	CaO	Na_2O	P_2O_5	MnO
% Weight	54.79	30.66	9.54	0.82	1.49	1.24	0.56	0.30	0.21	0.06