Research paper

Stabilised unfired clay bricks for environmental and sustainable use

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Abstract

Currently there is a growing pressure on energy efficiency for new buildings in the UK and worldwide. This has arisen partly due to the increasing awareness of the public for sustainable building construction. In addition, there is pressure on building materials manufacturers, due to new government regulations and legislations that are targeting energy usage and carbon dioxide emissions in new buildings. This

dioxide emissions in new buildings. This paper reports on unfired clay bricks for environmental and sustainable use. Lime or Portland cement was used as an activator to an industrial by-product (Ground Granulated Blastfurnace Slag) to stabilise Lower Oxford Clay for unfired clay brick production. Portland cement was used in the formulation of the unfired clay brick test specimens predominantly as a control. Industrial scale brick specimens were produced during two separate industrial trials. The first trial was at Hanson Brick Company Ltd, Bedfordshire, UK, while the second was carried out at PD Edenhall Ltd, Bridgend, South Wales, UK. From the environmental and sustainability analysis results, the unfired clay material has shown energy-efficiency and suggests a formidable economical alternative to the firing of clay building components. This study is one of the earliest attempts to compare fired and unfired clay technologies, and also to combine energy use and CO_2 emission for the evaluation of unfired clay bricks relative to those bricks used in mainstream construction. This is an attempt to come up with one parameter rating. The overall results suggest that the spinoff from this technology is an invaluable resource for civil

technology is an invaluable resource for civil engineers and other built environment professionals who need quick access to up-to-date and accurate information about the qualities of various building and construction materials.

Highlights

► Industrial scale brick specimens were produced during two separate trials. ► Unfired clay material showed better energy-efficiency than fired clay. ► This study is one of the earliest attempts to compare fired and unfired clay. ► The earliest attempts to combine energy use and CO_2 emission for unfired clay brick. ► Valuable resource to professionals on various non-traditional materials.

Introduction

Clay building material plays a major role in improving the environmental efficiency and sustainability of buildings and contributes to economic prosperity and infrastructural development in the UK and worldwide. On the other hand, the production processes of a construction material have a considerable

impact on the environment. Edwards and Bennett (2003) reviewed the lifecycle concepts and considered recent developments. Works on the use of some secondary materials and waste types, as partial substitute for primary clay in the manufacture of fired bricks, in order to reduce the energy and firing cost of the clay brick production process was conducted by Boardman (2004), Kjarstad and Johnsson (2007), Rajgor (2007) and Carter (2008). Other workers, Demir (2006) studied the potential for utilising processed tea waste in the production of unfired clay brick. Heath et al. (2009), Morel et al. (2007), Walker (1995) and Walker et al. (2008) worked on Portland Cement (PC) stabilised clay bricks and stress on the environmental benefits. Previous research studies (Heathcote, 1991, Walker, 2004 and Jayasinghe and Kamaladasa, 2007 among others) reported on compressive strength and erosion characteristics of unfired clay bricks. Venkatarama Reddy et al. (2007) reported on enhancing bond strength and characteristics of unfired clay bricks made from PC-clay mixture. Temimi et al. (1995) studied the possibility of producing low-cost unfired clay building bricks utilising PFA/lime-clay mixture. The Brick