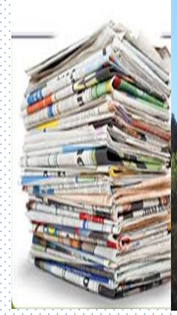
THE APPLICABILITY OF RECYCLED WASTEPAPER AS LIGHTWEIGHT BUILDING MATERIALS: DEVELOPMENT OF CWLB

University of Wolverhampton
Knowledge • Innovation • Enterprise
Faculty of Science and Technology

Oriyomi M Okeyinka

Supervisory team: Dr David A Oloke (Dos) , Prof. Khatib Jamal



Abstract

The various notable environmental impacts associated with the activities of the construction industry gradually constitute threats to the natural ecosystem. As part of efforts to promote sustainability in the construction industry, this study was conducted to determine a suitable mix proportioning process for the production of cement-less wastepaper based lightweight block (CWLB) from mixture of postconsumer wastepaper, sand and a non-hydraulic binder. It proposes the use of waste additives as binder in the place of the more traditional hydraulic binder. The laboratory experimentation carried out involved the processing of wastepaper into an artificial lightweight aggregate, designing and preparing trial mixes, moulding of trial specimen and testing of trial specimen at 28days curing age. It was found that, at optimum mixture composition of constituent materials, alongside appropriate amount of compacting force and water binder ratio, the CWLB specimen exhibited; an average compressive strength of 2.71MPa which maximally satisfies the minimum standard strength requirement for non-load bearing lightweight block, an average density of 901.1kg/m3 which satisfies the requirement for lightweight blocks, a satisfactory dimensional deviation and a minimum thermal conductivity of 0.19W/m.k. Therefore, CWLB can be regarded as a viable eco-friendly non- load bearing wall element considering it's; high level of recycled waste contents which indicates natural resources conservation, low thermal conductivity which suggests energy conservation, lightweight which implies low construction cost and faster construction period. This finding indicates the possibilities of producing environmentally friendly block with less use of natural resources.

Background

Many activities of the construction industry are highly material intensive and this is gradually constituting a threat to the natural eco-system

- The building industry requires about six to seven more tonnes of sand and gravel, for each tonnes of cement used in construction, (USGS,2013)
- Globally, sand and gravel account for 68 to 85% of about 59billion tonnes of material mined every year (UNEP,2014; Seinberger et al,2010)
- The world over 40billion tonnes annual aggregate consumption was estimated to be about 100% more than its yearly aggregate renewal by all rivers of the world (UNEP,2014)

Objective

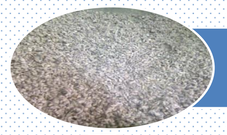
To develop an eco-friendly lightweight, non load bearing block, from recycled wastepaper without the use of hydraulic binder

Methodology

Collection of wastepaper

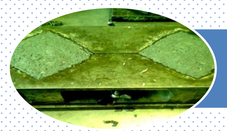
Collection of waste additive (binder)

Processing of wastepaper



Processed wastepaper

Design and Preparation of trial mixes



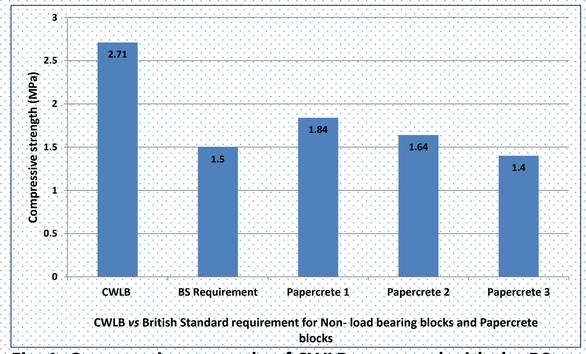
Moulding of trial specimen

Curing of trial specimen

Compression strength test

Results and Findings

The compressive strength of CWLB is 81% higher than the BS requirement and 47% higher than the compressive strength of cement based wastepaper blocks



CWLB *vs* British Standard requirement for Non- load bearing blocks and Papercrete blocks

Legend :

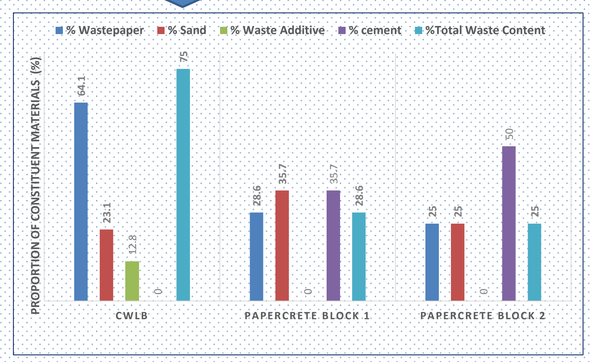
- ❖ *CWLB→ Cement-less Wastepaper-based Lightweight Block*
- ❖ *BS requirement→ British standard specification for non-load bearing blocks (BS 771-4:2011)*
- ❖ *Papercrete→ Cement based wastepaper blocks (Modry, 2001; Chandarana et al, 2014; Akinwumi et al,2014)*

Fig. 1: Compressive strength of CWLB compared with the BS standard specification and papercrete blocks available in the literature

Eco-Friendliness of CWLB in terms of constituent materials:

- ❖ 75% waste content indicate natural resources conservation and reduced environmental pollution
- ❖ 0% cement content indicate reduction in greenhouse gas emission(GHG) such as CO2, and indirect reduction in energy consumption
- ❖ Use of Waste by-product as waste additive implies the practice of industrial ecology

CWLB has excellent energy performance characteristic as it exhibit a thermal conductivity of 0.19W/m.k which indicate excellent insulation property



CWLB is a lightweight block as it exhibits an average density of 901.1kg/m3 which implies faster and low construction cost

Fig. 2: Constituent Materials of CWLB Compared to Constituent Materials Papercrete Blocks

Future work in Progress

Simulation and modelling of the load carrying capacity of CWLB in real life application

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