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Review

Green concrete: Prospects and challenges

K.M. Liew [a,b,*], A.O. Sojobi [a], L.W. Zhang [c,*]

[a] Department of Architecture and Civil Engineering, City University of Hong Kong, Kowloon, Hong Kong, China
[b] City University of Hong Kong Shenzhen Research Institute, Nanshan District, Shenzhen 518057, Guangdong, China
[c] School of Naval Architecture, Ocean and Civil Engineering, Shanghai Jiao Tong University, Shanghai 200240, China

HIGHLIGHTS

- Green concrete utilizes waste materials as SCM and aggregates in concrete.
- It promotes effective waste management, GHG reduction and resource conservation.
- Benefits: improved strength, workability, durability, pumpability, reduced cracking.
- Benefits: reduction of construction & maintenance costs and increased service life.
- More R & D, standards and large-scale demonstration projects are required.

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ABSTRACT

Utilization of green concrete in construction is increasingly adopted by the construction industry owing to the drawbacks of conventional concrete and the numerous inherent benefits of green concrete. The increasing demand for green concrete has been spurred by demand for high quality concrete products, desire of nations to reduce green-house gas emission, need for conservation of natural resources and limited landfill spaces. Green concrete comes in various forms such as high-volume fly ash concrete, ultra-high performance concrete, geopolymer concrete, lightweight concrete to mention a few. Green concrete offers numerous environmental, technical benefits and economic benefits such as high strength, increased durability, improved workability and pumpability, reduced permeability, controlled bleeding, superior resistance to acid attack, and reduction of plastic shrinkage cracking. These characteristics promotes faster concrete production, reduction of curing waiting time, reduction of construction costs, early project completion, reduction of maintenance costs and increased service life of construction projects. Green concrete promotes sustainable and innovative use of waste materials and unconventional alternative materials in concrete. Suitable standards, more demonstration projects, as well as adequate training, public awareness, cross-disciplinary collaborations and further research and developments are required to promote global adoption of green concrete in large-scale infrastructure projects.

Contents

* Corresponding authors.
E-mail addresses: kmliew@cityu.edu.hk (K.M. Liew), zlvwen@hotmail.com (L.W. Zhang).

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Nomenclature

SCM	Supplementary cementitious material
SF	Silica fume
RHA	Rice husk ash
GGBS & GGBFS	Ground granulated blast-furnace slag
WG	Waste glass
NS	Nano-silica
PPF	Polypropylene fibres
BOFS	Basic oxygen furnace slag
RAC	Recycled aggregate concrete
FFA	Fine fly ash
RHAC	Rice husk ash concrete
FAC	Fly ash concrete
FA-HSC	Fly ash-based high strength concrete
SFC	Silica fume concrete
UHPC	Ultra-high performance concrete
WGC	Waste glass concrete
GF	Glass fume from waste glass
C_3S	(tricalcium silicate)
C_2S	(dicalcium silicate)
RHAC	Rice husk ash concrete
SCC	Self-consolidating concrete
HPC	High-performance concrete
AA	Alternative aggregates
OPC	Ordinary Portland cement
RRHA	Raw rice hush ash
NanoA	Nano-Al_2O_3
CNI	Calcium nitrite-based corrosion inhibitor
FA50L	50%Fly ash content
HVFAC	High-volume fly ash concrete
HPSCC	High performance self-consolidating concrete
FA	Fly ash
CRT	Cathode ray tube waste glass
GFRP	Glass fibre reinforced polymer
CS	Compressive strength
SP	Superplasticizer
w/b	water binder ratio
w/cm	water-cementitious ratio
w/scm	water-supplementary cementitious materials ratio
ASR	Alkali silica reaction
RPC	Reactive powder concrete
MK	Metakaolin
SiO_{2-Eff}	Effective amorphous silica content
S_{eff}	Effective surface area of SCM
CN	Carbon nanotube
HSC	High strength concrete
UHPC	Ultra high strength concrete
LWC	Lightweight concrete
BRAC	Bacterial rice husk ash concrete
CRHA	Rice husk ash from controlled burning