Universität Hamburg
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UNIVERSITEIT STELLENBOSCH UNIVERSITY

ADDIS ABABA UNIVERSITY

THÜNEN

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DAAD

DLR Projektträger

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MK/FA based geopolymer bamboo wood composites light weight Concrete In Ethiopia

GEOPOLYMER CAMP 2019

Fikru Bedada

July 2019, Saint Quentin France

Background (cont…)

- The BioHome project at the University of Hamburg aims to develope bio-based composite materials for affordable housing compartments with Sub-Saharan partner universities (AAiT & Stellenbosch University) in a trilateral research and education program.
- The combination of bio-composite materials, life cycle assessment and research-driven postgraduate education shall yield valuable socioeconomic and technological advantages in Ethiopia, South Africa and Germany.
- BioHome aims to combine secondary resources with lignocellulosic feed-stocks, such as invasive plants, agricultural residues and burnt plantation wood.

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BioHome Team

Background (cont…)

- Geopolymer is produced by the reaction of aluminosilicate-rich sources such as kaolin clay, fly ash etc. at room or controlled temperatures.
- The utilization of coal combustion products and calcined kaolinite clay as a cement replacement results in economic and environmental benefits like saving of energy and reduction in carbon dioxide emissions (5).
- In the search of green geopolymer composites, some researchers used natural Particles.

Background (cont…)

- The use of regional and local materials in the production of geopolymeric composites reduce environmental impacts and broaden their applications.
  - Kaolins hosted by sedimentary rocks are reported in Blue Nile river basin, Ogaden basin and Mekele Outlier which can be easily extracted within the top 5 meters of earths crest(Geological survey of Ethiopia) .
  - Ethiopia has over 370 million tons of coal resources with large proportion of sub bituminous coal.
  - Ethiopia has one of the largest bamboo stocks in Africa (It is estimated to be about 849.000 ha in total from which only some parts were mapped until today) (LUSO Consult 1997)

Objective of the research

General objective

- To develop sustainable Geopolymer concrete by using MK / fly ash/OPC based geopolymer cement activated by sodium water glass and bamboo particle as a partial sand replacement.

Objective of the research

Specific objectives

1. To investigate the physico-chemical, microstructure, mechanical and time dependent volumetric properties of calcined kaolinite clay and coal fly ash based geopolymer cement activated by sodium water glass.
2. To investigate the possibility of producing calcined kaolinite clay and coal fly ash based geopolymer cement at lower temperature using cementicious material as a tertiary base.
3. To develop, a light weight non-structural masonry unit using bamboo particles as a partial replacement for sand and consequently investigate the time dependent volumetric change properties under various environmental conditions.

Research questions

1. Can Geopolymer cement sustainably replace conventional cement, for use in non structural elements of affordable housing?
2. Is it possible to produce geopolymer cement through low temperature curing?
3. Can the consumption of water glass be reduced in the production of geopolymer cement?
4. Can bamboo wood particles provide beneficial attributes to the short and long-term performances of geopolymer mortar?

Source Material

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1. Complete silicate analysis have been conducted on kaolinite clay and coal fly ash collected from bishoftu area.

	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Na_2O	K_2O	MnO
Kaolin	29.24	36.24	2.30	1.32	0.16	0.86	1.30	0.04
Fly ash	31.04	13.38	7.76	2.92	0.84	0.72	0.44	0.20


THANK
YOU