Encuentro Internacional de Doctorandos en Ingeniería Civil - EIDEIC 2021

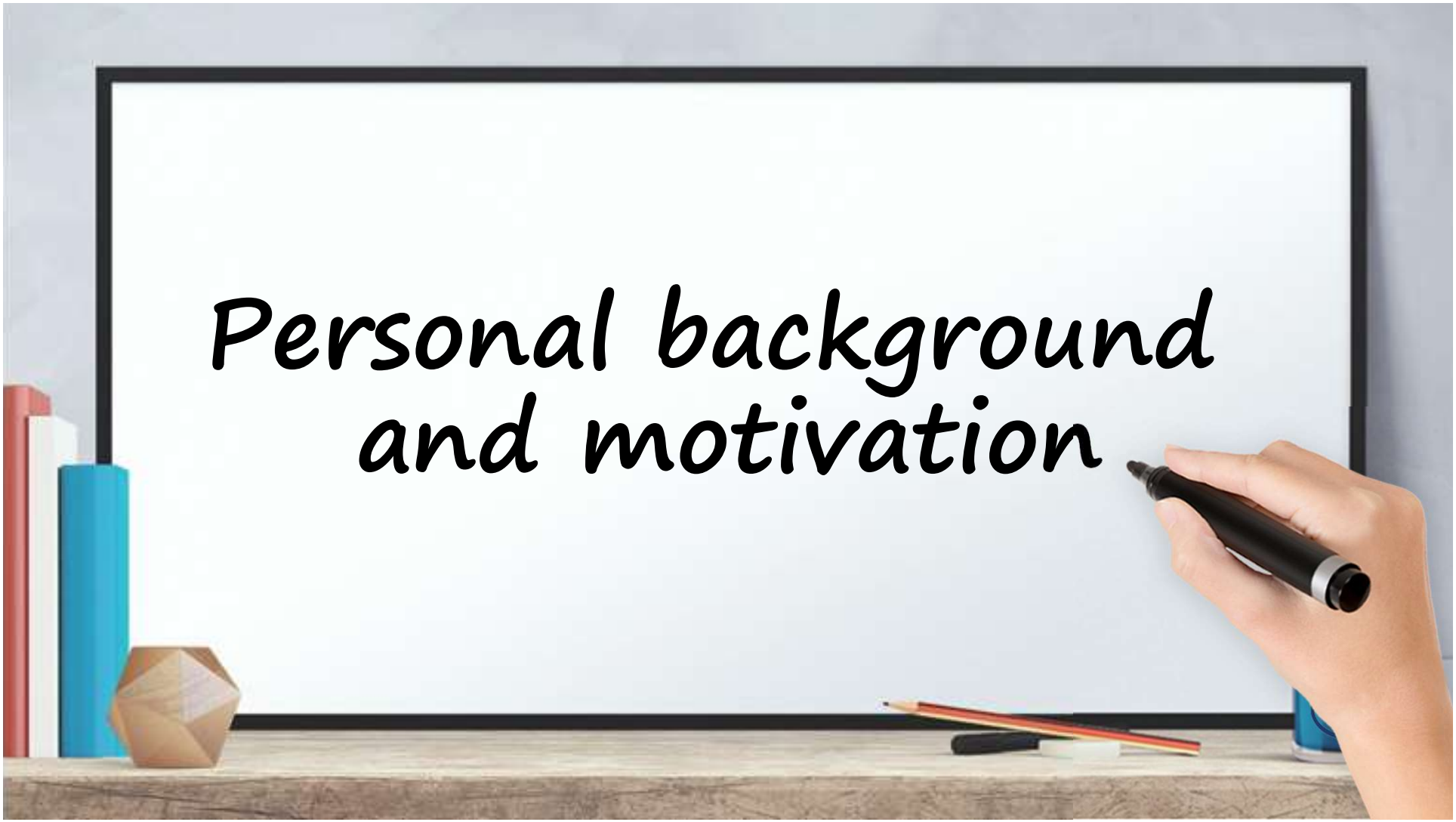
Feasibility of steel slag as binder and aggregate in alkali-activated concrete

PhD candidate: VITOR ALENCAR NUNES

Supervisors: Prof. PhD. Carlos Thomas (UC)
Prof. PhD. Paulo Borges (CEFET-MG)

Agenda

1. Personal background and motivation
2. Thesis theme
3. Objectives
4. Expectations


Personal background
and motivation

Personal background and motivation

2010

Civil Production Eng.
Undergrad Course

2011-2012

Scientific research
scholarship

2012-2013

International Stay
Research project

2013-2015

Construction sector
experience

Personal background and motivation

2015
Undergrad degree

2016-2017
Master degree
Civil Engineering

2018
Visiting researcher

2018
PhD candidate
Civil Engineering

Personal background and motivation

JASMMIN

2019

Co-foundation
Startup company

2020

Convention for thesis co-tutelage

CEFET-MG UC UNIVERSIDAD DE CANTABRIA

UC UNIVERSIDAD DE CANTABRIA

2021

PhD candidate
Civil Engineering


Thesis theme

Thesis theme

1.8 billion tons of crude steel in 2019

(WSA, 2019)

Main solid waste (90%) -> steel slag

(THOMAS et al., 2019)

World - 270 millions tons in 2019 (WSA, 2019)

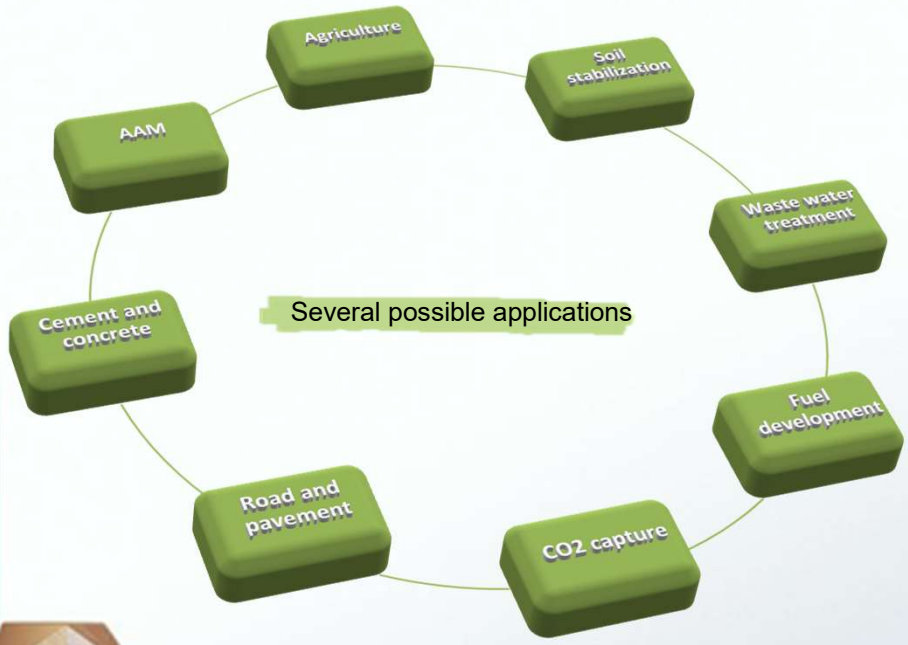
Brazil - 4.5 millions tons every year (IAB, 2019)

SS is stockpiled on open field (GUO et al., 2018)

The excessive stockpiling causes environmental harm and financial liability

Promotion of reutilization of steel slag is the main effort to reduce amount

Thesis theme



Japan: 98% (NSA, 2017)

Europe: 86% (EA, 2016)

US: 84% (Guo et al. 2018)

China: 29.5% (Guo et al. 2018)

Brazil: 22% (IAB, 2018)

Base and subbase

Land levelling

30% destined as donation (IAB, 2018)

Thesis theme

Potential consumer of steel slag as supplementary cementitious material and as aggregate for concretes

Japan employs 30.9% of the generated in civil engineering works (NSA, 2017).

ATTENTION!

- ✓ Volumetric expansion of steel slag may cause deteriorations and negatively affect the durability of building materials (WANG, 2016)
- ✓ Portland cement industry is responsible for 8% of the global greenhouse gas emissions (MOUMIN et al., 2020)

Alkali-activated materials (AAM) have been promoted in the recent years as alternative greener building materials

- ✓ Better mechanical and durability properties (BERNAL et al., 2011; NUNES et al., 2019; PACHECO-TORGAL et al., 2008)
- ✓ Potentially lower environmental impact (BERNAL et al., 2014; PROVIS; BERNAL, 2014a, 2014b)


Objectives

Objectives

- Determine the feasibility of steel slag (SS) as raw material in the development of a low environment impact construction material (alkali-activated material - AAM):

  i. Make a thorough state-of-art review mainly comprising the recent developments in the possible re-utilization of SS and highlight the potential and research needs; ✓

  ii. Evaluate the feasibility of SS … influence of activation parameters on the mechanical and microstructu… , comparing to conventional BFS-based AAM;

  iii. Evaluate the feasibility of SS a… influence of activation parameters on the mechanical and microstructu… S-based mortars, comparing to natural aggregates;


Construction and Building Materials

journal homepage: www.elsevier.com/locate/conbuildmat

Review

Recent advances in the reuse of steel slags and future perspectives as binder and aggregate for alkali-activated materials

Vitor A. Nunes *, Paulo H.R. Borges

HIGHLIGHTS

ARTICLE INFO

ABSTRACT

Objectives

- Determine the feasibility of steel slag (SS) as raw material in the development of a low environment impact construction material (alkali-activated material - AAM):

    iv. Develop a properly designed high-performance SS-based AAM by using the Andreasen particle packing method;

    v. Assess the physical (consistency, viscosity), mechanical (compressive and flexural strength, modulus of elasticity) and microstructural (water absorption, density, pore distribution, capillarity, interface transition zone - ITZ) properties of SS-based AAM developed;

    vi. Assess the durability properties of SS-based AAM by ultrasonic pulse velocity test (concrete quality), electric resistivity (risk of corrosion), unrestrained shrinkage and accelerated tests such as accelerated carbonation and sulfate attack;


Expectations

Expectations

- An international doctorate co-supervision with double title is very rewarding, personally and professionally;
- A doctorate program can offer me the opportunity to continue learning, which is essential for professors, researchers, and specialists;
- As an entrepreneur, I can use the knowledge acquired to develop better solutions for my company.
- As a researcher, I can enhance even more my scientific knowledge to pursue an academic career in the future.

Any questions?

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Acknowledgments