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High-performance self compacting Geopolymer mortar based on flash-calcined materials

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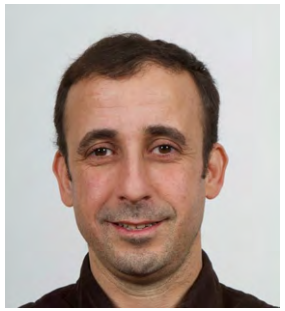
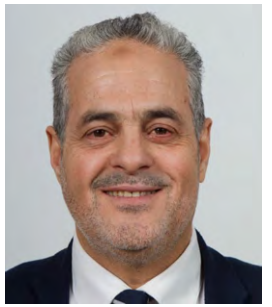

Geopolymer Camp
Saint-Quentin, 06/07/2022

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Outline

- Materials and Flash Calcination
- Geopolymer cement design
- Verifying the design
- Mixing Procedure
- Results
- Upcoming results

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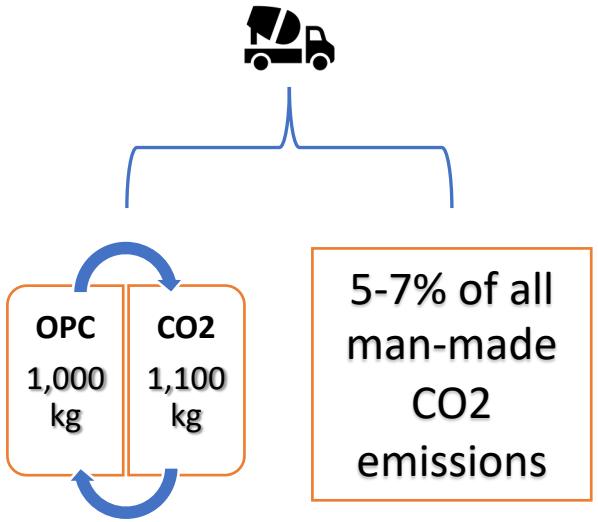
Cement industry



5-7% of all man-made CO2 emissions

Excavated Materials

Dredged Sediments

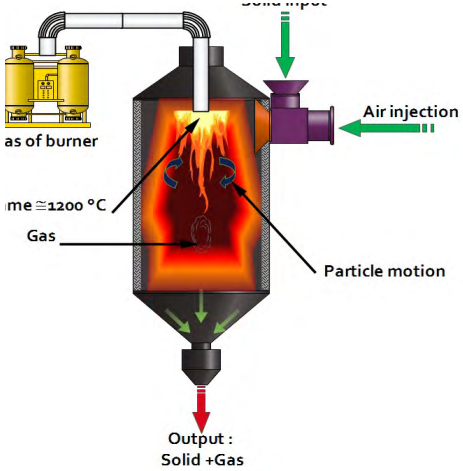
56 million m^3 **per year**

Excavated soils

130 million tons **per year**

Waste Materials

Treating Materials



Flash Calcination

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Flash-calcined-based geopolymer cement with **room temperature setting**

Flash-Calcined sediments

1. Flash Calcined Sediments **(FCS)** = %
2. Metakaolin **(MK*)** = %
3. Slag **(GBFS) =** %

?

MK → Stabilization

GBFS → Hardening

Flash-calcined excavated clays

1. Flash Calcined excavated clay **(FCC) =** %
2. Metakaolin **(MK)** =%
3. Slag **(GBFS)** = %

?

***MK= Argeco Commercial Product**

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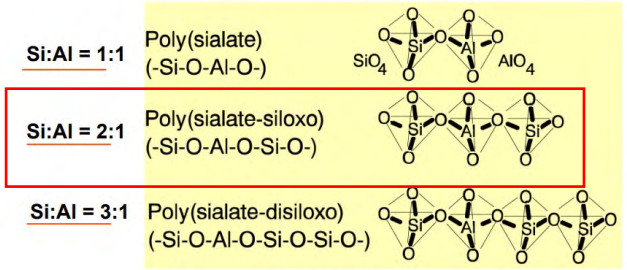
Geopolymer Design

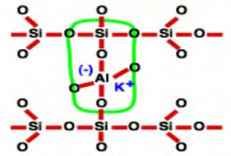
Mineralogical char.

Elements	MK	GBFS	FCS	FCMC
Si	27,4	14,9	20,8	28,8
Al	16,5	6,8	6,7	9,8
SiO2	58,6	31,8	44,4	61,6
Al2O3	31,1	12,84	12,6	18,5

Si/Al=?

Geopolymer Terminology





Rigid 3D Macromolecular structure

% chosen according to design

✓ **Note: In geopolymers the % of materials used is important to have a good precursor**

IMPORTANT

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Geosil / Binder

This ratio is dependent on

- Total % of Al_2O_3 reacting
- Na,K: Al =? = nK_2O: Al_2O_3 =? = 1

Total % of Al_2O_3 reacting ?

- MK = 100%
- GBFS = 50%
- FCS OR FCC = 20%, 40%, 60%....100% ?

TESTS AND RESULTS

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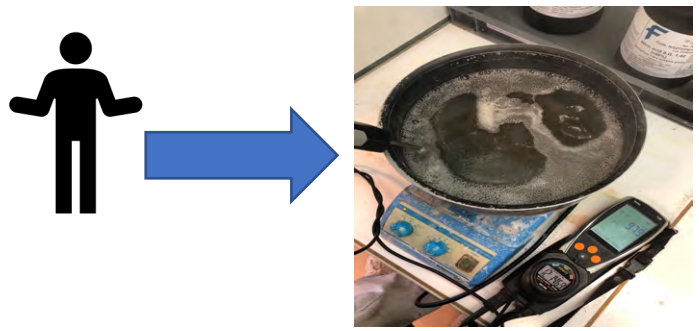
$Si:Al=2$ + $nK_2O:nAl_2O_3=1$ + $T(Al_2O_3)_{reacting}$ ✓

Geopolymer → 3D network → Geopolymerization of silicates and alumino-silicates in alkaline or acidic medium

Verifying the correct design



Chemical formula ✓

Boiling water at 100 C for 10 mins+ still solid

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To ensure Geopolymerization when experimenting

Mixing Design Procedure

Least reactive material + reagent for 10 mins

Add MK for 5 mins

Add Slag which is most reactive so we add it at last for 3 mins

Add sand for 5 mins

Curing

Note: *At room temp*

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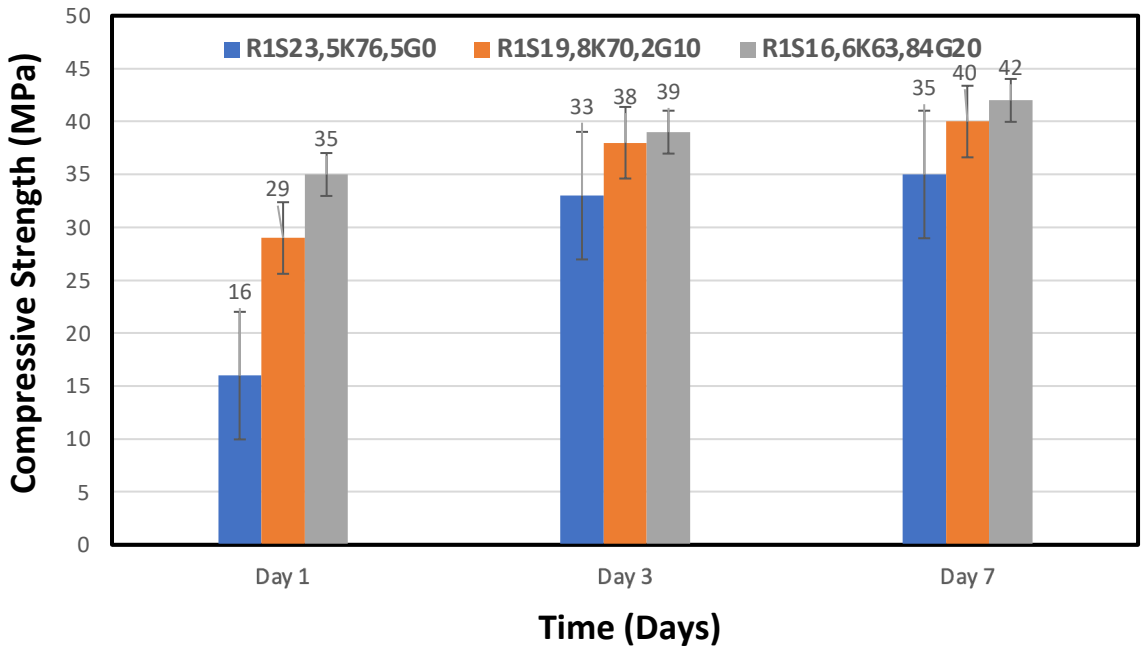
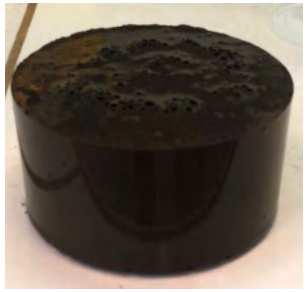
Results

$Si:Al=2 + nK_2O:nAl_2O_3=1 + T(Al_2O_3)_{reacting}$

- MK = 100%
- GBFS = 50%
- FCS = 100%





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Up-Coming Results

$Si:Al=2$ + $nK_2O:nAl_2O_3=1$ + $T\%(Al_2O_3)_{reacting}$

- MK = 100%
- GBFS = 50%
- FCS = 20%, 40%, 60%, 80%

As

$T\%(Al_2O_3)_{reacting}$  → Mass Binder  → Alkaline/ Binder 

Coming Soon ← MPa  ? ←

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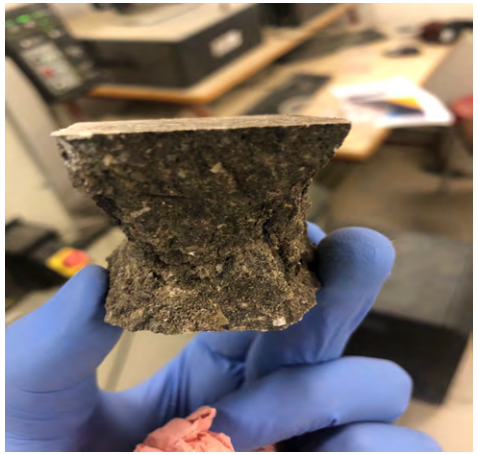

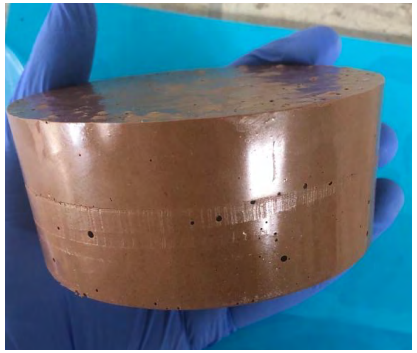

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Thank you !