GEOPOLYMER CAMP 2025

Xatico Performance Minerals

www.xatico.com

ABOUT US

FOUNDED IN 2006

Technical advice on all aspects of minerals
Turnover 6.7 MIO € in 2024

DISTRIBUTOR OF MINERALS FILLERS AND INORGANIC BINDERS

Wide product range carefully selected from the best production sites across five continents

- ~ 8500 MT of fillers sold per year
- 8 warehouses

WIDE PRODUCT RANGE

Our customers come from all industrial sectors, including rubber, plastics, paints and coatings, construction, agriculture, cosmetics, detergents, and adhesives.

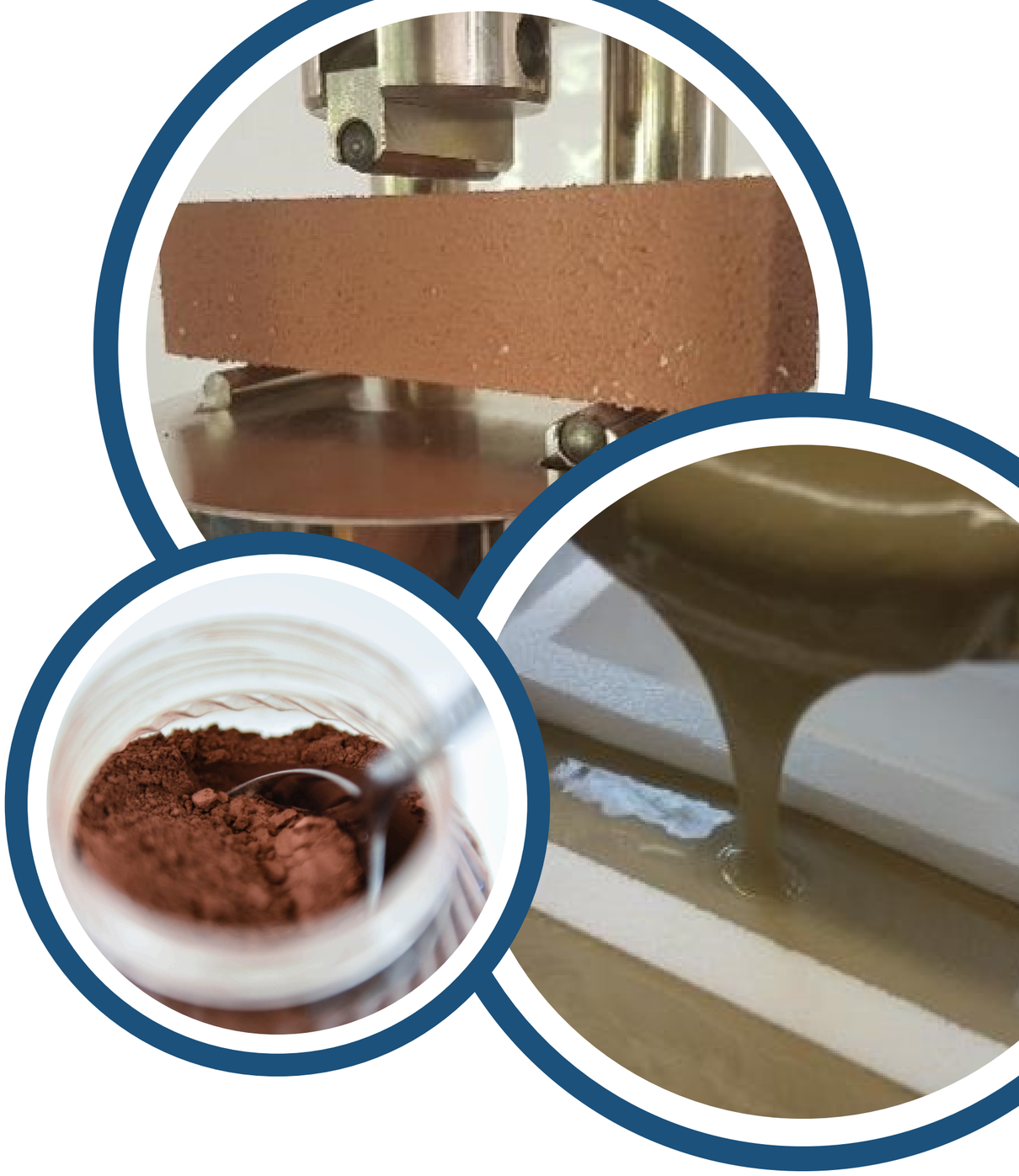
GEOPOLYMER

Close collaboration between
Xatico and Woellner

CONTEXT

The development of sustainable building materials with reduced environmental footprint, in both manufacturing and operational phases of material life cycle, is attracting increasing interest.

→ **New geopolymer-based materials**



Requests of the building industry

- Reproducible raw materials
- Similar aspect and mechanical performance of Portland cement
- Reduce environmental footprint
- Price challenge

ALUMINOSILICATES

Mineral rich in silica and alumina

$SiO_2 + Al_2O_3 > 80\%$

Synthetic ones

Metakaolin, fly-ash, calcinated by-products

Influence of the final properties

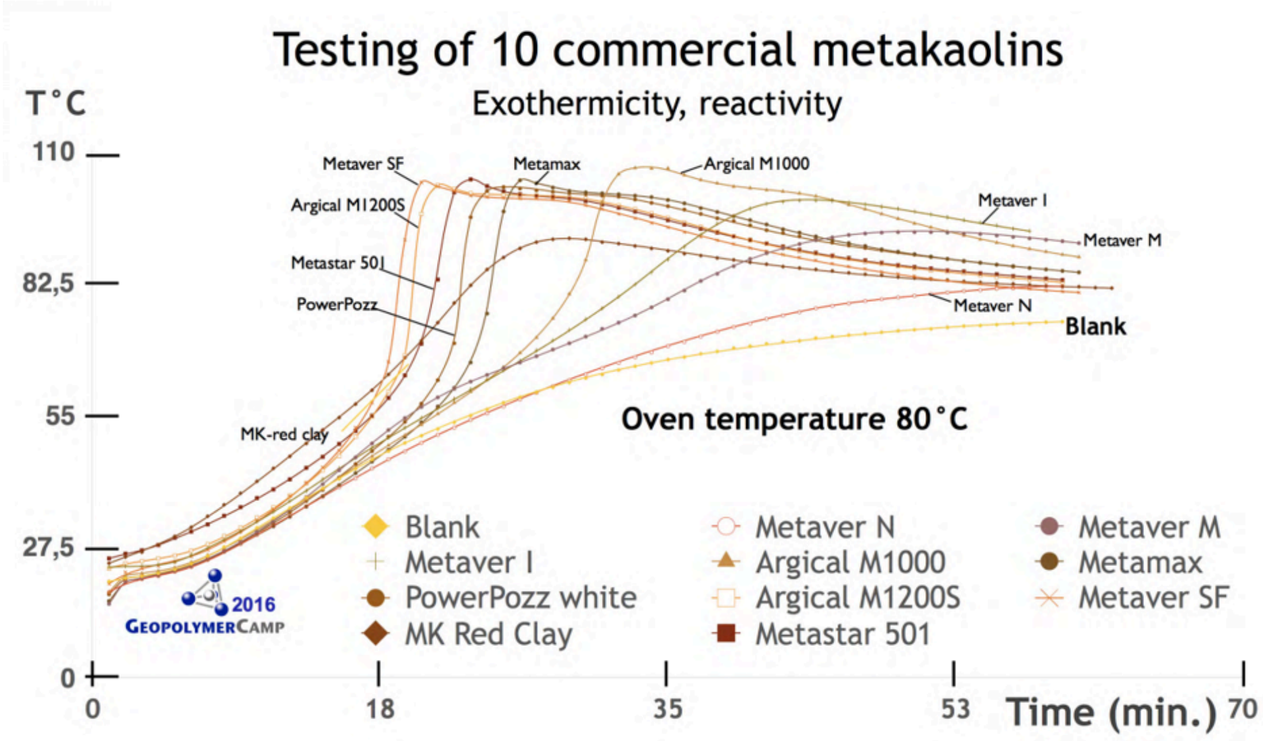
Mining, calcination process, milling

Amorphous content

The more amorphous the material is, the more reactive it will be

KINETIC OF ALUMINOSILICATE

Their reactivities have been tested according to the standard method

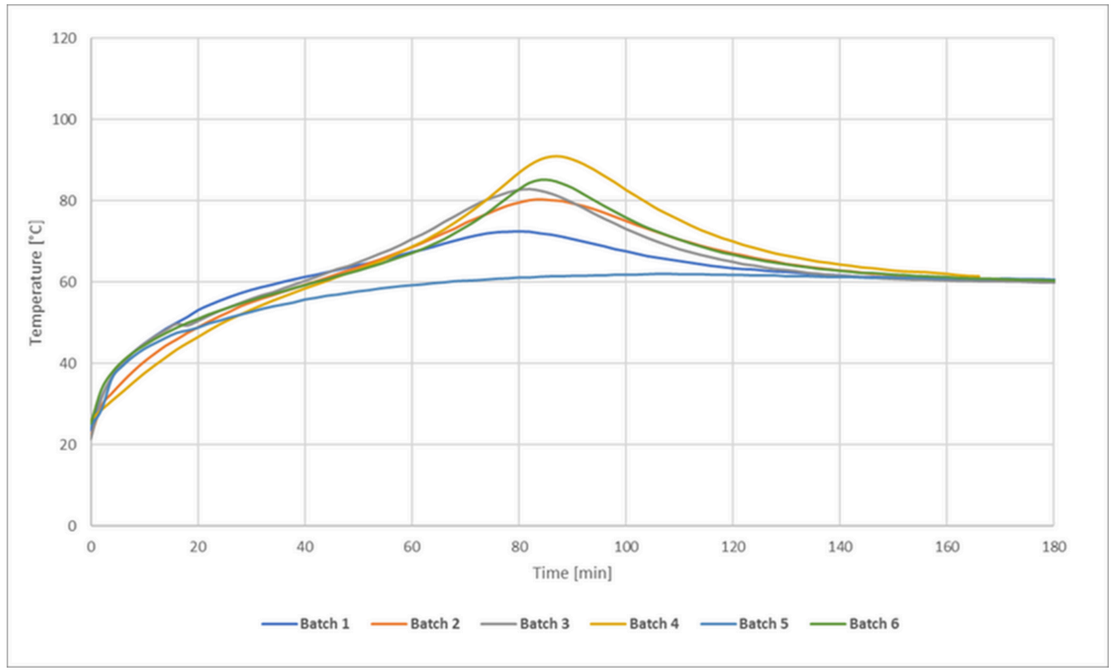


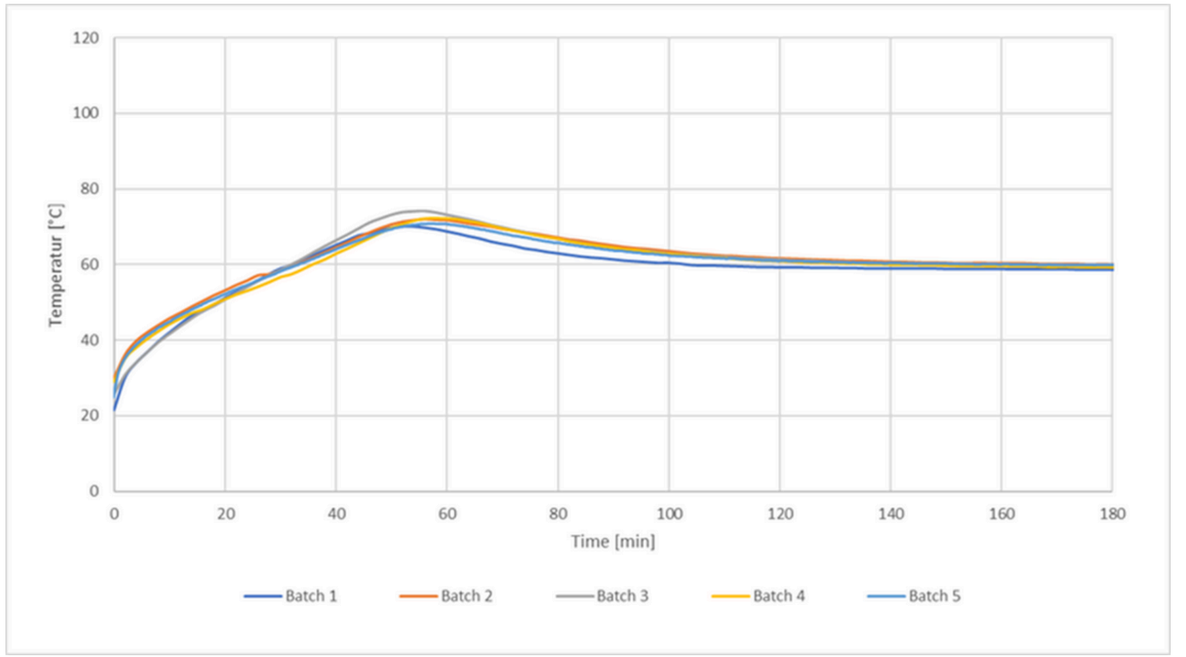
Reactivity test, observing exothermicity

Sample: 100 g of K-silicate MR=1.7, 60 g of metakaolin,
10 min. mixing, 1 hour at 80°C
Blank: 55 g of water, 60 g of metakaolin

VARIATION FROM BATCH TO BATCH

Poor reproducibility



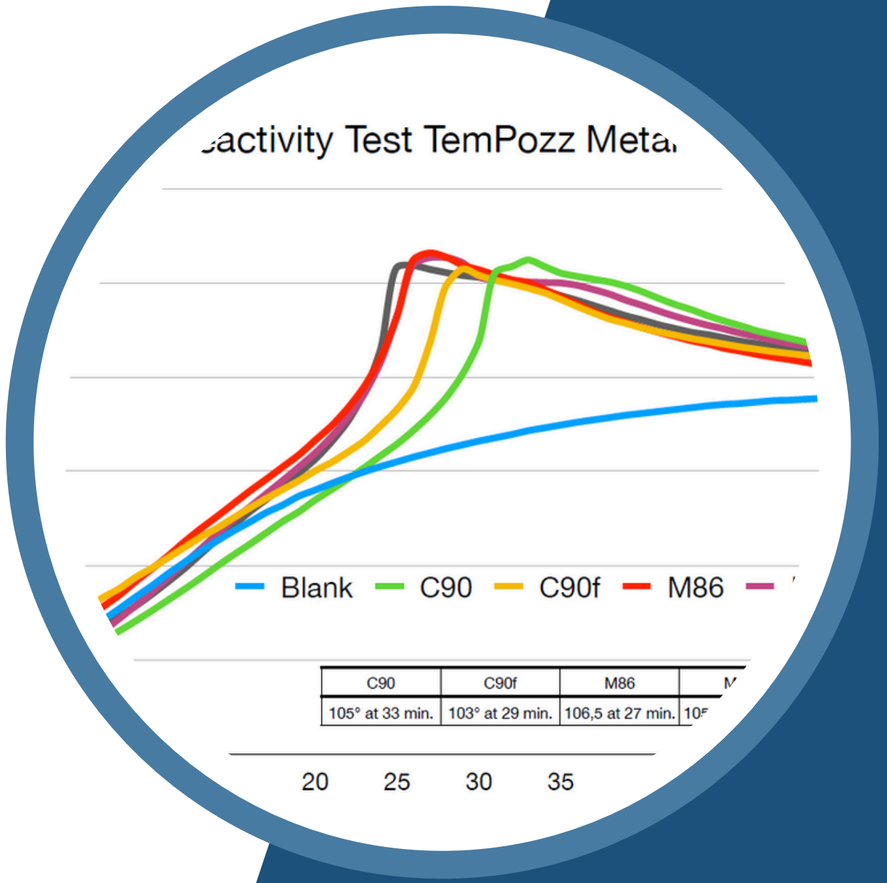


Good reproducibility

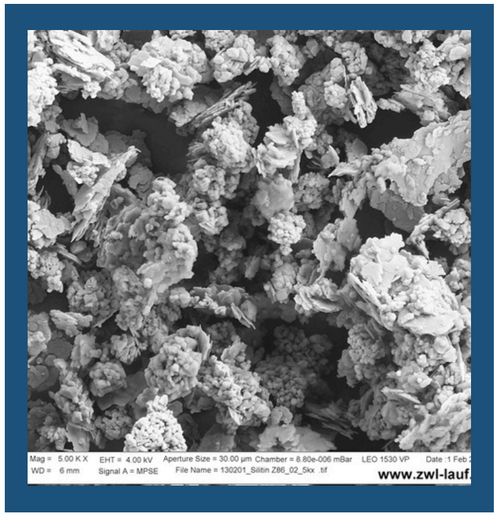
TEMPOZZ

- Super fluid Metakaolin
- Extremely long pot-life
- It is possible to add large amount of fillers.
- Their speed of reactivity, are much slower compared to the other well-known MKs.
- M92 + Geosil K 14517 + Feldspar (d50 63µm). Cured for 100 hours at 80°C

30 MPa flexural - 190 MPa compressive

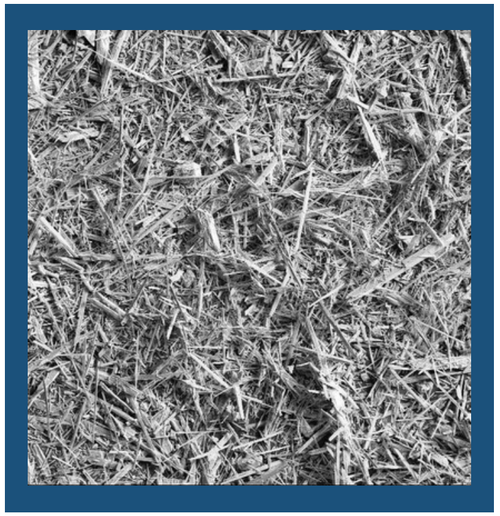


MINERAL FILLERS IN GEOPOLYMER



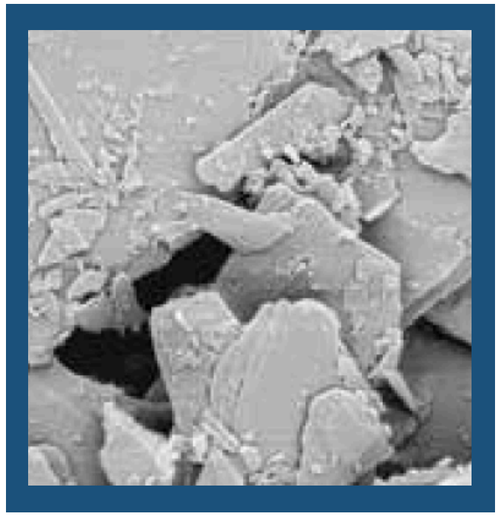
Spherical shape

Silica
Alumine
Diatomaceous earth



Acicular Shape

Wollastonitre



Lamellar shape

Mica

Fibers

Natural ones: basalt fiber
Synthetic ones
Recycled ones

EFFECTS OF MINERALS FILLERS

1. **Mechanical strenght**
   - Fillers such as silica, kaolinite, or fly ash act as reinforcements
   - Improve compressive and flexural strength
2. **Shrinkage**
   - Fillers reduce drying shrinkage
   - Helps prevent cracking and improves long-term durability
3. **Microstructure**
   - Influence pore size and distribution
   - Enhance mechanical properties and resistance to external agents
4. **Workability**
   - Influence the viscosity

A meticulous mixing process is necessary to ensure the uniform distribution of various fillers.

FELSPAR

The addition of feldspar fillers not only alters particle morphology and size but also influences molecular interactions, resulting in a simultaneous rise in viscosity and shear stress.

Tabular/prismatic shape

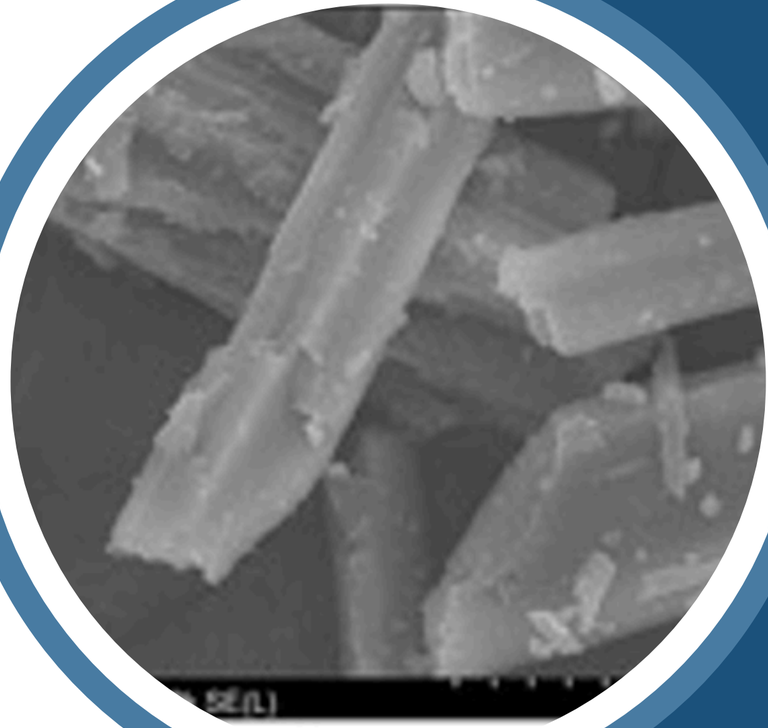
Advanced Refinement of Geopolymer Composites for Enhanced 3D Printing via In-Depth Rheological Insights

Ceramics 2024, 7(4) 1316-1339

WOLLASTONITE

Wollastonite particles interact with binder molecules, via van der Waals forces and hydrogen bonding. These interactions enhancing molecular cohesion.

Wollastonite alter the molecular network structure within the binder by intertwining with binder molecules, resulting in a more complex structure and contributing to increased viscosity.



Acicular shape

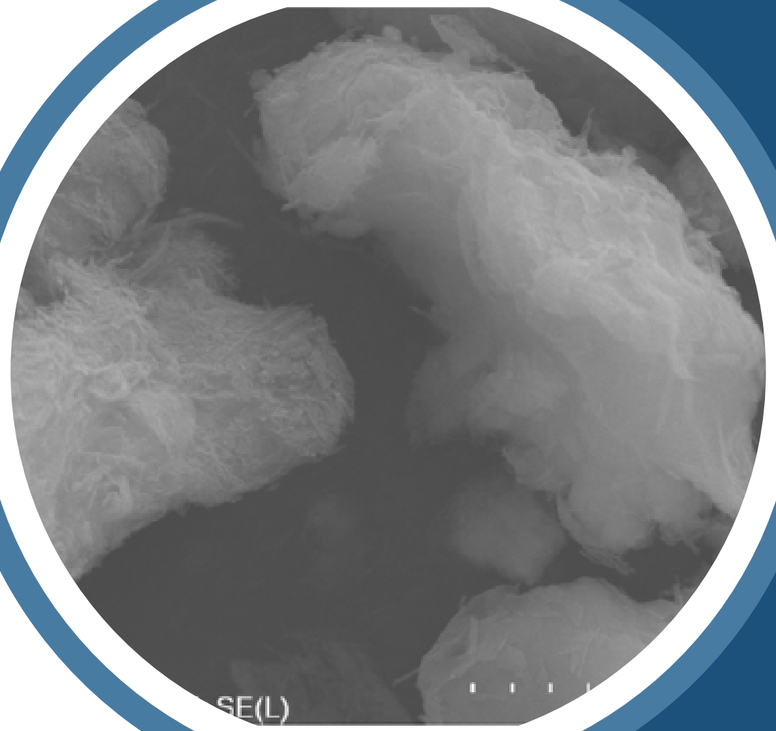
Advanced Refinement of Geopolymer Composites for Enhanced 3D Printing via In-Depth Rheological Insights

Ceramics 2024, 7(4) 1316-1339

SEPIOLITE

The high surface area of Sepiolite enables it to form a three-dimensional network within the geopolymer matrix.

As the shear rate increases, the viscosity decreases due to the breakdown of the sepiolite network, allowing for better flow during extrusion



Fibrous clay mineral

Unveiling additive effects in 3D printed geopolymer composites: A
multi-scale analysis coupling rheological insights and CFD-optimized deposition
Journal of Manufacturing Processes 150 (2025) 445–460

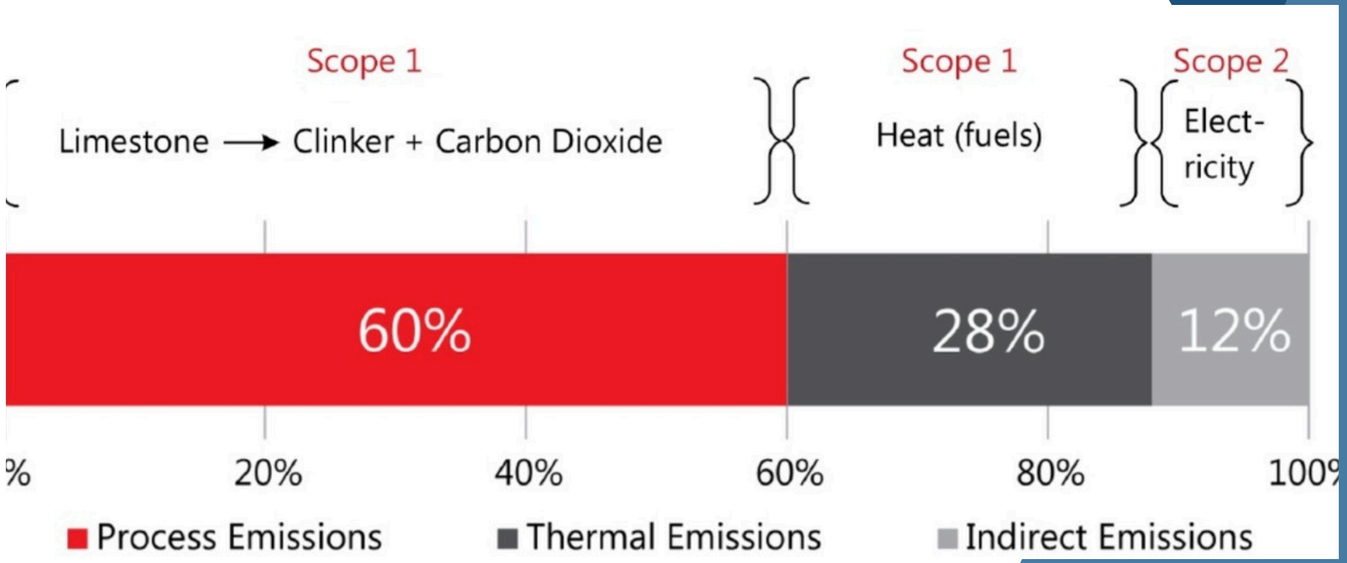
THE CARBON FOOTPRINT OF CONSTRUCTION SECTOR

The building sector is the world's biggest energy consumer, accounting for 40% of final energy consumption and 30% of Greenhouse gas emissions. Most of the sector's environmental impact is linked to the manufacturing phase of materials such as Portland cement.

Producing 1 tonne of Portland cement:

- Required ~ 2 tons of raw material
- Releases ~ 1 ton CO2
- Releases ~ 3kg NOx

There are 3 main sources of CO2 emission associated with cement manufacturing

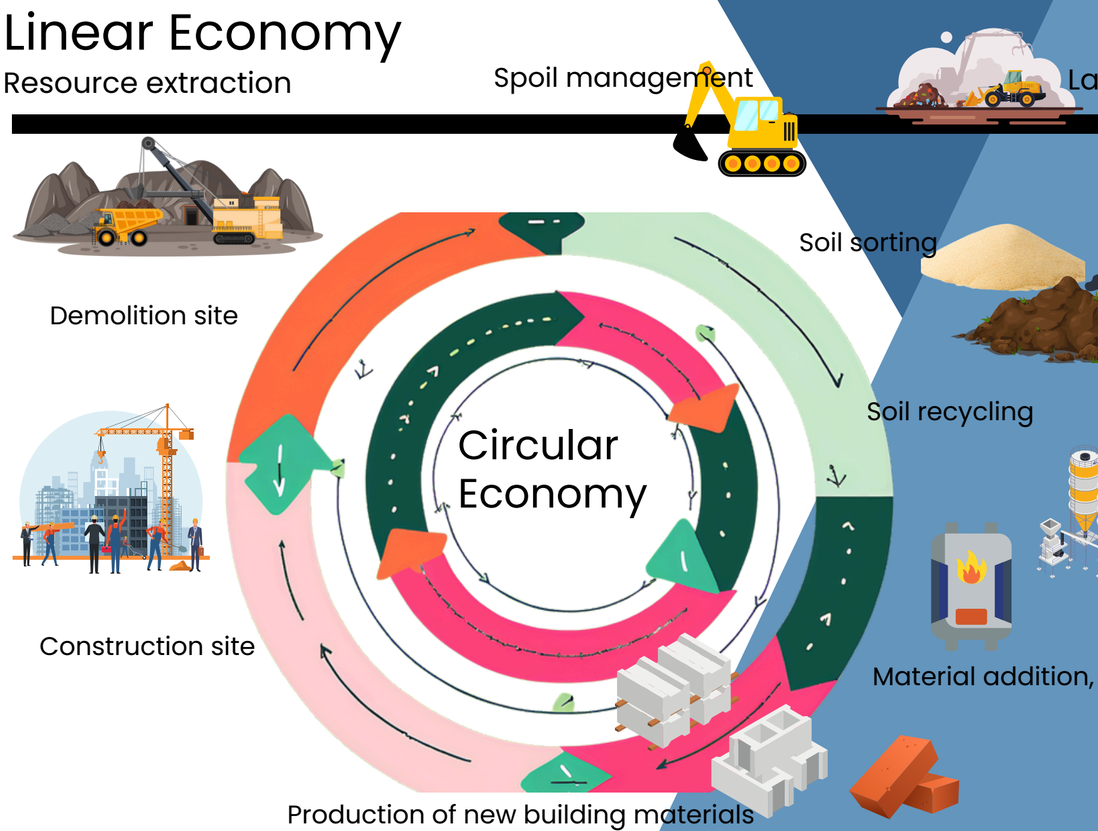


REDUCE THE CARBON FOOT PRINT

CIRCULAR ECONOMY

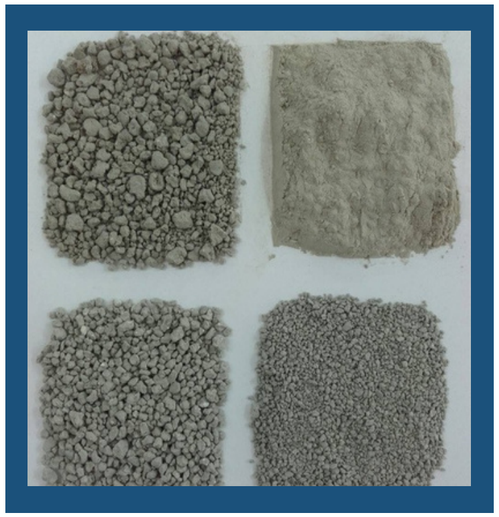
Excavated soil, traditionally regarded as waste on building sites, becomes a valuable resource when a circular approach is adopted.

- 15 million tonnes: the average volume of excavated soil produced each year in the Paris region. Every year, around 37 million tonnes of soil are excavated in Belgium. A lot of initiative are developped everywhere in Europe in the aim to valorizate the excavated soil and marine sediments



METHODOLOGY - APPROACH

Metakaolin available



Additive

Mix

Material with lower carbon foot print

SOLID WASTES INCORPORATED INTO GEOPOLYMERS AS POTENTIAL ALUMINOSILICATE PRECURSORS

Industrial wastes

Fly ash
Industrial slags
Silica fume
Artificial & natural pozzolans
Pumice

Agricultural wastes

Wood ashes
Forest biomass bottom ash
Rise husk ash
Straw ash

Municipal solid wates

Glass powder
Construction waste
Municipal solid waste incinerator fly ash
Waste plastic & rubber
Sludge ashes

METHODOLOGY

IDENTIFICATION POTENTIAL ADDITIVE

Identification of potentially additive.
Physico-Chemical and mineralogical characterization of these materials.
Preparation of selected materials (crumbling, drying, grinding (micronization)).

MIXING PROTOCOL

Study of different blends.
Charactarization of the color and the reactivity

MORTAR FORMULATION AND STRENGTH TESTING

Manufacture of binders and mixes. This step defines whether other SCMs (additions) are to be used. Ex: slag, filler, etc.).
Formulation of mortar specimens to NF EN 196-1 for short- and long-term testing (up to 90 days).

IMT DOUAI
PROFESSOR M. AMAR

- Extensive expertise
- Flash calcination unit
- Laboratory dedicated to the characterization of this type of material and to geopolymers
- Post-doctoral student who did his thesis in the department

XATICO
PERFORMANCE MINERALS

THANK YOU

YOUR CONTACT

+352661100871

c.lefevre@xatico.com

www.xatico.com