XATICO
PERFORMANCE MINERALS

SEMINAR ON GEOPOLYMERS

by Carine LEFEVRE

OUR GROUP

- **Foundation** : 2006
- **Activity** : Benelux, Germany, France, Spain, Portugal, Italy, Switzerland, Austria, Scandinavia, Baltics and the UK
- **Turnover** : 6,1 mio € in 2023
- **6 warehouses**
- **Collaboration** with external **laboratories**

OUR PRODUCTS

- Aluminium Trihydrate (ATH)
- Attapulgite
- Barium Sulphate (Barite)
- Bentonite
- Silicate based inorganic binding agents (Betol®)
- Betolin® - Sapetin® - Sikalon®
- Calcined Neuburg Siliceous Earth
- Calcium Carbonate (Cacite – Marble)
- Calcium Sulphate Anhydrite

- Collosil® – Special Adhesives
- Diatomaceous Earth
- Dolomite
- Geosil®
- Kaolin
- Ligasil® - Stabisil®
- Magnesium Hydroxide
- Metakaolin
- Metal Stearates
- Mica
- Natural Silica
- Nepheline Synite
- Neuburg Siliceous Earth
- Perlite
- Precipitated Silica
- Synthetic Sodium Magnesium Aluminium Silicate
- Talc
- Vermiculite
- Wollastonite
- Zeolite
- Zinc Borate
- Zinc Hydroxy Stannate
- Zinc Stannate

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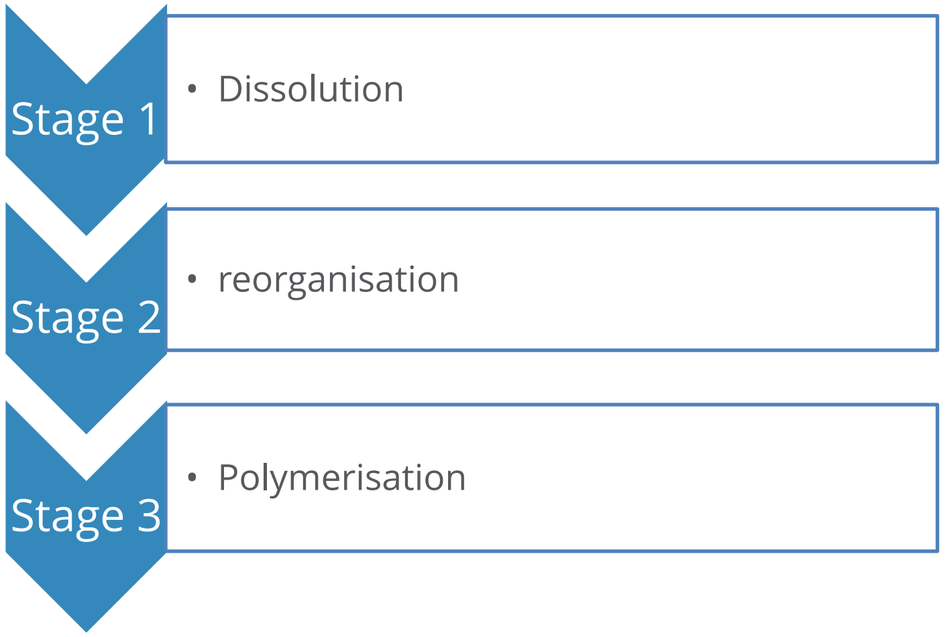
Geopolymer: close collaboration between Xatico and Woellner

FORMATION OF GEOPOLYMER

- The geopolymer is formed by reaction between an alkali silicate and an amorphous aluminosilicate
- The aluminosilicate is the hardener
- Alkali silicate = Geosil®



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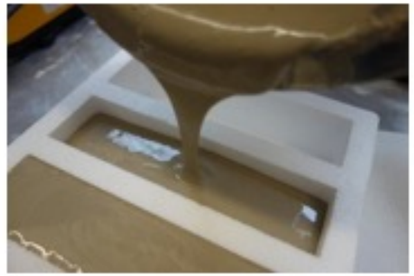
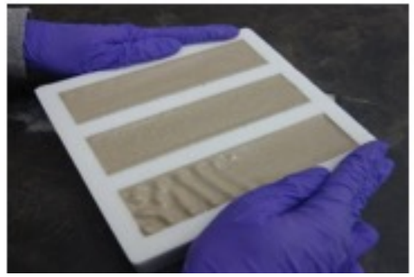
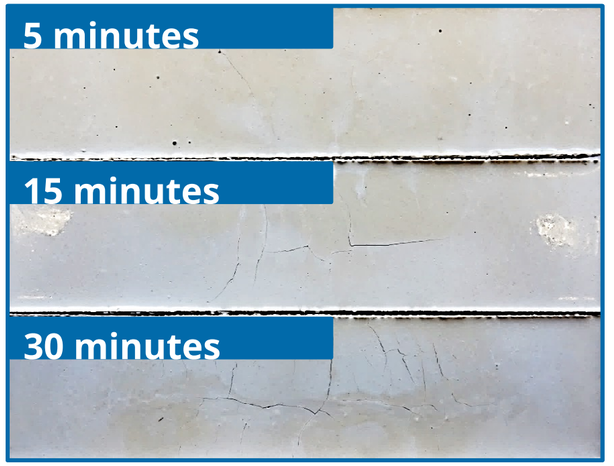
PARAMETERS INFLUENCING GEOPOLYMERISATION





- Composition of the hardener and the various mineral fillers added
  - Particle size
  - Composition in amorphous phase
  - Composition in SiO_2 and Al_2O_3
- Nature and composition of the alkali silicate (molar ratio and nature)
- Solid/liquid ratio
- Cross-linking temperature
- Humidity condition
- Time of mixing



ALUMINOSILICATES

- Materials rich in silica and alumina: $SiO_2 + Al_2O_3 > 80\%$
- Synthetic: metakaolin, fly-ash, calcinated by-products
- Mining, calcination process and milling will influence the final properties
- The more amorphous the material is, the more reactive it will be
- Acts as a hardener in the geopolymer formulation

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METAKAOLIN

- Material delivered from kaolin which is dehydrated by heat treatment
  - With heat, water is released from the crystalline structure
  - This step generates the disappearance of the crystalline structure of kaolinite
  - This disorganisation allows its reactivity

- There are several industrial processes to calcine a kaolin clay
  - Continuous furnaces (rotary kiln): residence time ~ 2h
  - Flash kilns: residence time few second

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Four Flash vertical – FUMEL (47)
(Crédit ARGECO Développement)

COMPARISON of ALUMINOSILICATE

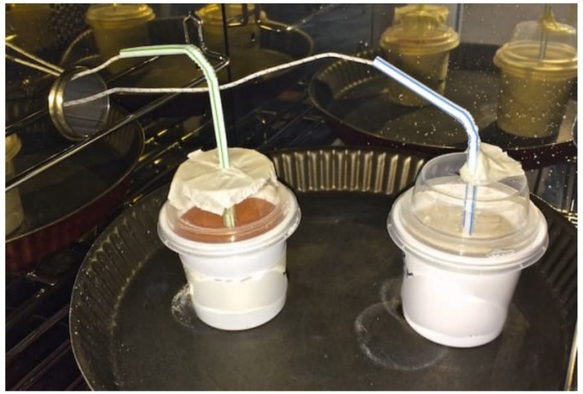
- Determination of ionic solubility (ICP-OES) – (%)
- Determination of the Kinetic reactivity of aluminosilicate
  - Statement about intensity of the exothermic reaction
  - Statement about the reaction rate
- Determination of water demand - (mg/g)
- Determine the maximum ratio between water glass and aluminosilicate

KINETIC OF ALUMINOSILICATE

- Their reactivities have been tested according to the standard method

  https://www.geopolymer.org/news/26-standardized-method-in-testing-commercial-metakaolins-for-geopolymer-formulations/

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

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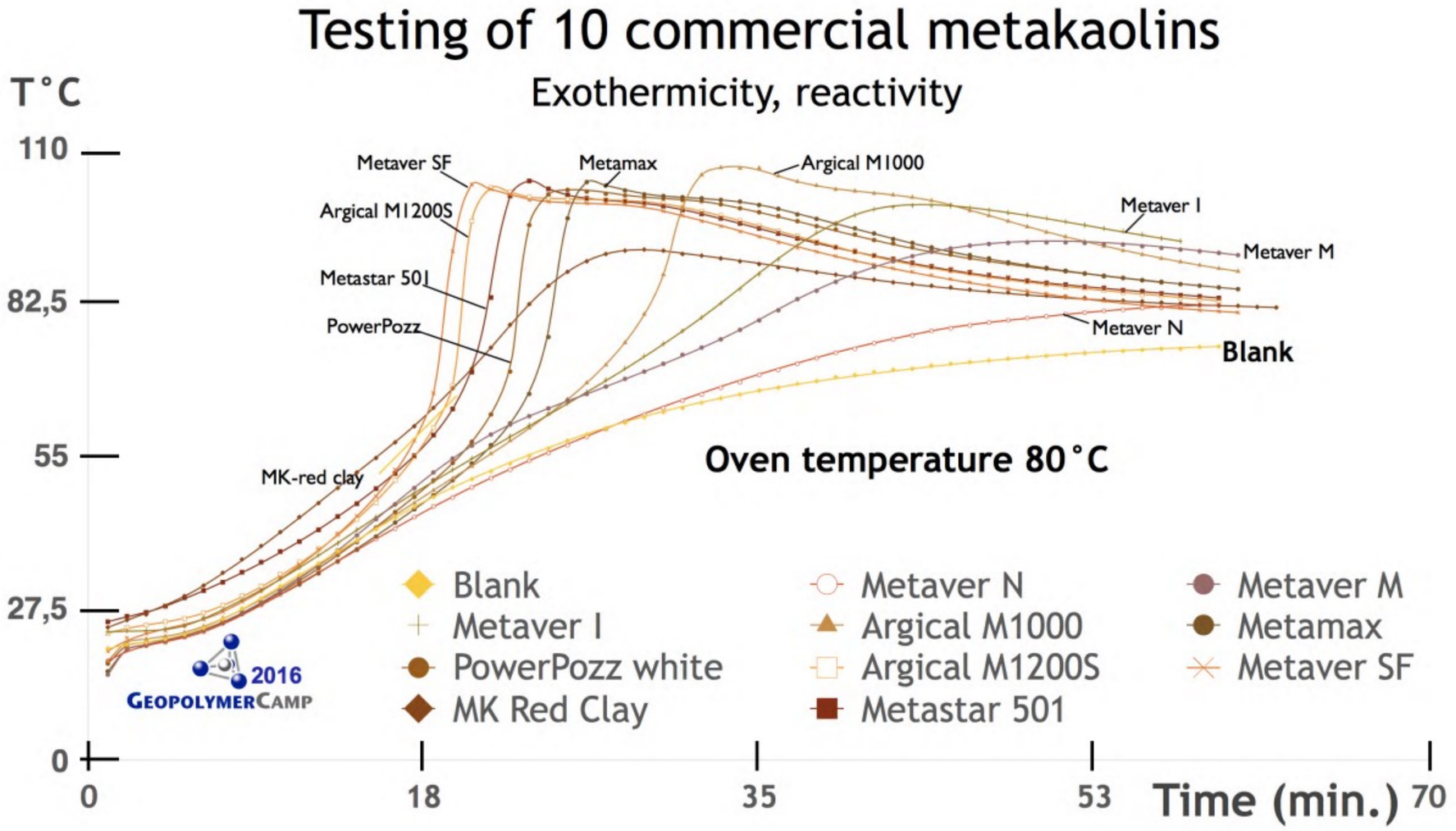
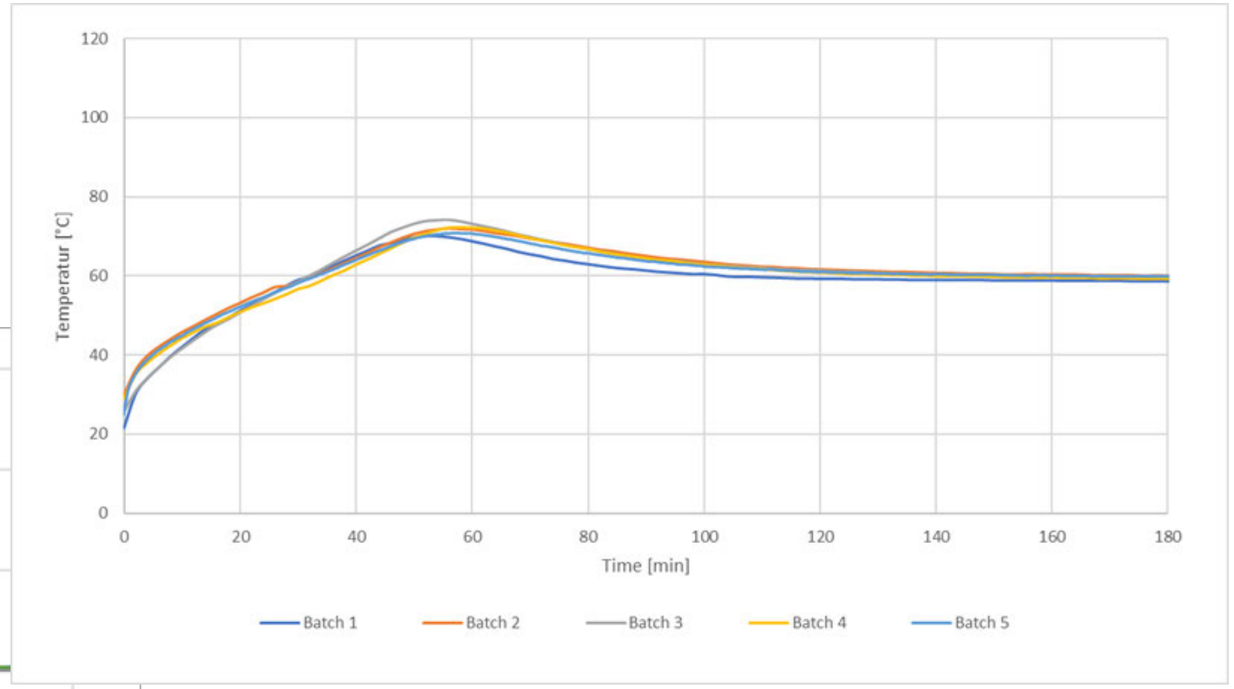
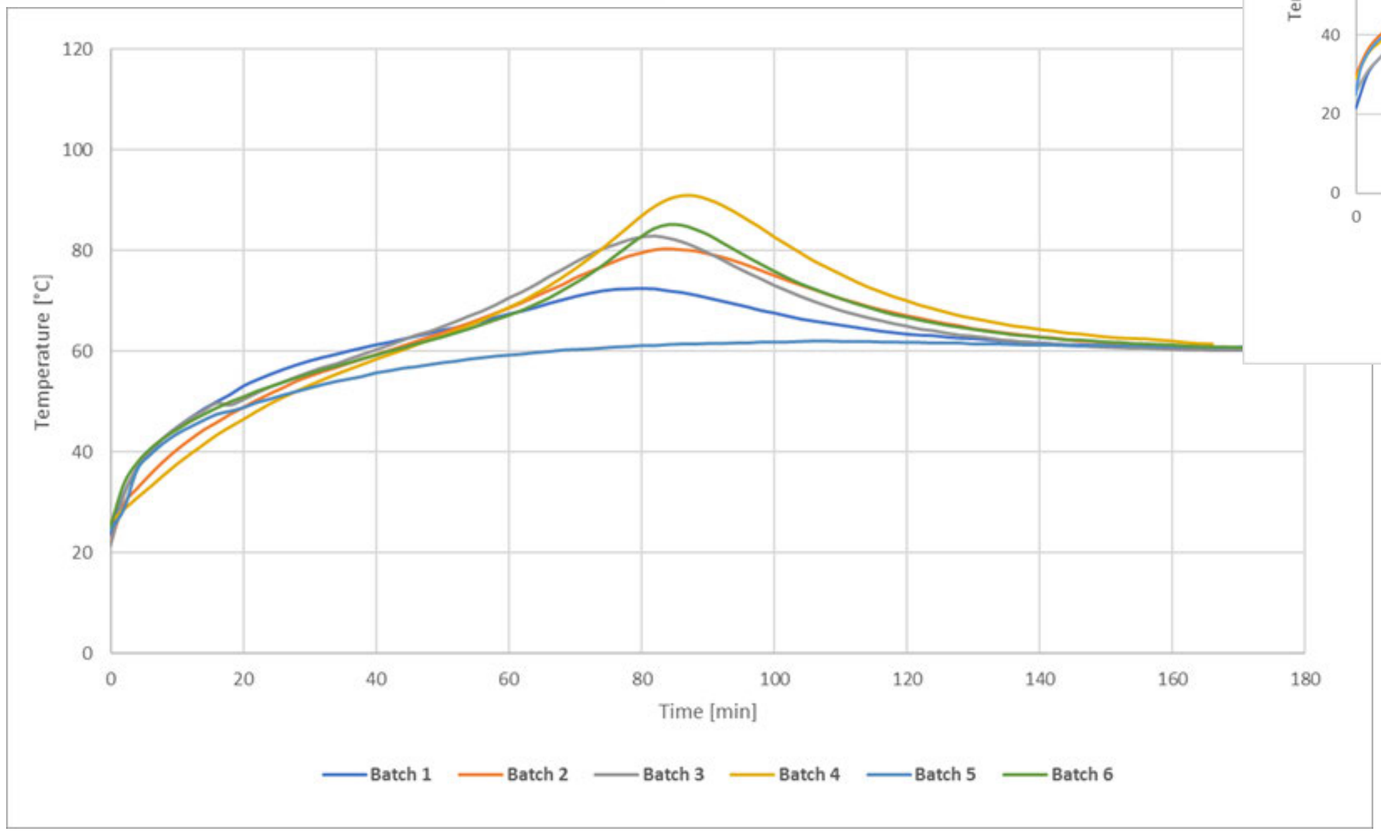
REACTIVITY OF METAKAOLIN



Variation from batch to batch



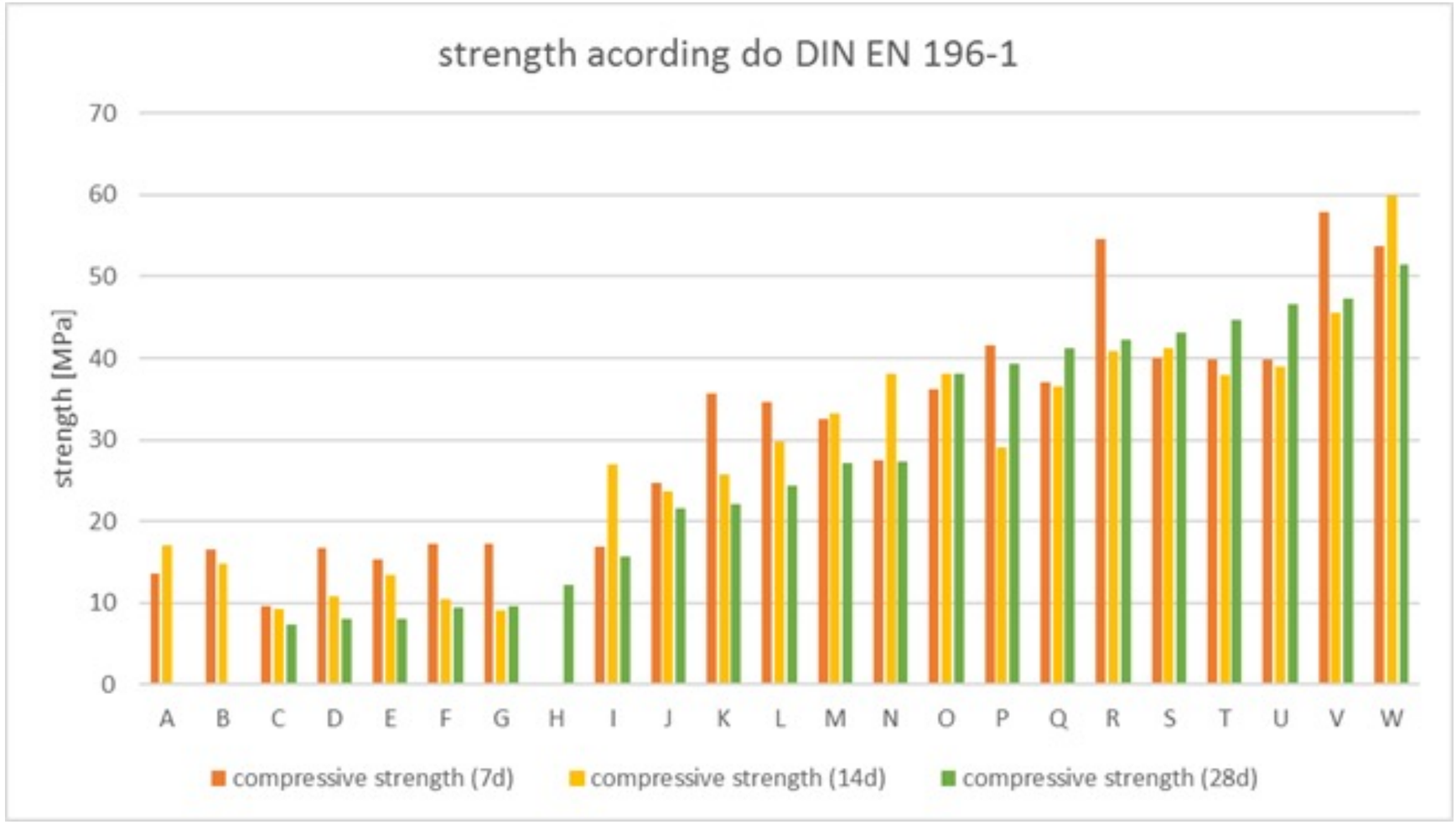
Reproducibility from batch to batch



Poor reproducibility from batch to batch

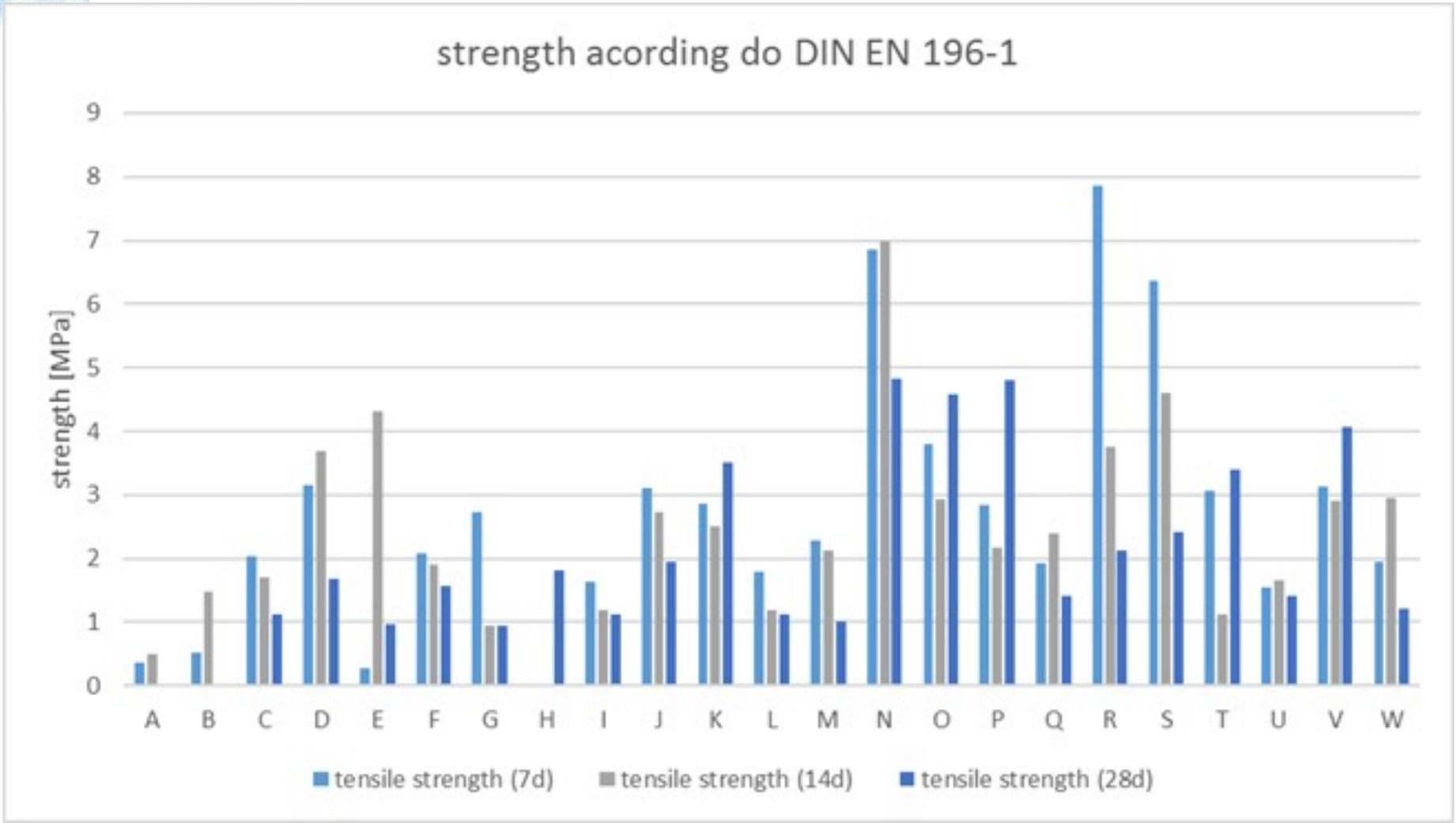
COMPRESSIVE STRENGTH

Compressive strength of 23 different Metakaolins mixed 55/45 with Geosil 14517



TENSILE STRENGTH

Tensile strength of 23 different Metakaolins mixed 55/45 with Geosil 14517.



ENVIRONMENTAL CHALLENGES of geopolymers

- Concrete is the substance used in the larget quantity by humanity, second only after water!!
- The Portland cement needed for its production accounts for roughly 8 % of manmade CO_2 emissions
- Another environmental concern is a large number of waste materials, such as dredged sediments and construction waste.

INORGANIC FILLERS

Mineral fillers and reinforcements used to form a geopolymer composite

Fillers	Morphology	Material	Comment
Mineral fillers	Spherical shape	Silica Alumine	Reinforcement Inert & thermal stability
Mineral fillers	Acicular shape	Wollastonite	Passive anti-corrosion pigment - Reinforcement
Mineral fillers	Lamellar shape	Mica	High lamellarity – Chemically inert – High T° resistance
Mineral Fibers	Various length	Basalte	Reinforcement
Mineral Fillers	Powder Microsphere	Glass Basalt	Corrosion resistant Hydrophil (no surface treatment) – Smoothing cements

TANK YOU FOR YOUR ATTENTION

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