XATICO PERFORMANCE MINERALS

Performance Minerals
for Innovative Solutions

Geopolymer Camp September 2021

OUR GROUP

- Foundation : 2006
- Countries : Benelux, Germany, France, Spain and Portugal
- Turnover : 4,3 millions € per year
- 8.300 MT sold per year
- + than 700 active customers
- 6 warehouses
- Collaboration with external laboratories

Our Partners

HOFFMANN MINERAL

argeco DEVELOPPEMENT

woellner

OUR PRODUCTS

Aluminium Trihydrate (ATH)
Attapulgite
Barium Sulphate (Barite)
Bentonite
Silicate-based inorganic binding agents (Betol®)
Betolin® – Sapetin® – Sikalon®
Calcinated Neuburg Siliceous Earth
Calcium Carbonate (calcite – marble)
Calcium Sulfate Anhydrite
Collosil® – Inorganic adhesive
Diatomaceous Earth
Dolomite
Geosil®
Kaolin
Ligasil® – Stabisil®
Magnesium Hydroxyde
Metakaolin
Metal Stearates
Mica
Natural Silica
Nepheline Synite
Neuburg Siliceous Earth
Perlite
Precipitated Silica
Synthetic Sodium Magnesium Aluminum Silicate
Talc
Vermiculite
Wollastonite
Zeolite
Zinc Borate
Zinc Hydroxy Stannate
Zinc Stannate

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ALUMINOSILICATES

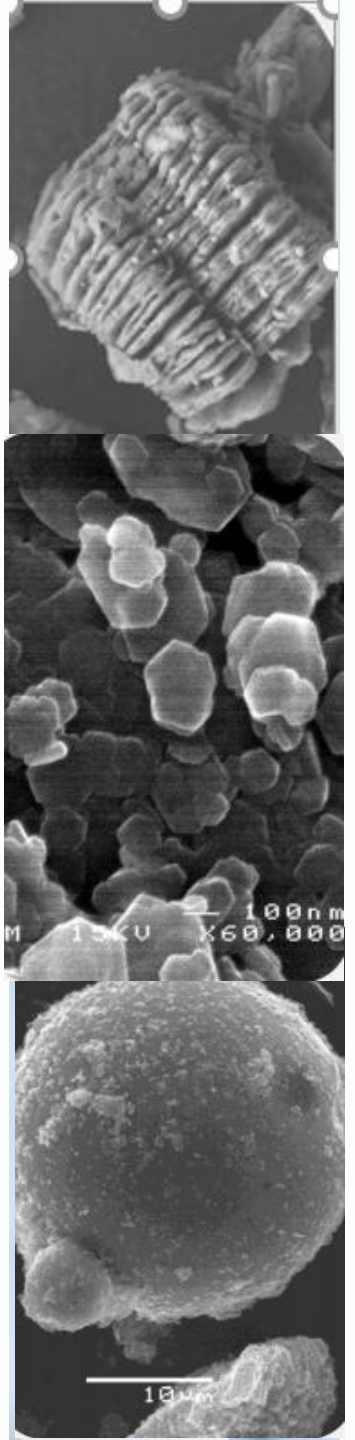
- Materials rich in silica and alumina: $SiO_2 + Al_2O_3 > 80\%$
- Synthetic: metakaolin, fly ash, calcinated by-products
- Mining, calcination process and milling will influence the final properties
- The more amorphous the material is, the more reactive it will be

Acts as a hardener in the geopolymer formulation

METAKAOLINS

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

- There are several industrial processes to calcine a kaolin clay
  - Continuous furnaces: residence time ~ 4 hours
  - Flash kilns: residence time less than 1 second



GEOPOLYMERIZATION

- Composition of the hardener and the different mineral fillers added
  - Granulometry
  - Composition of the amorphous phase
  - Composition in SiO_2 and Al_2O_3
  - Nature and composition of the silicate (molar ratio and nature)
  - Solid/liquid ratio
  - Cross-linking temperature
  - Humidity condition
  - Composition of each ingredient

- The preparation conditions (mixing)

Physical and mechanical properties

Le métakaolin

Carrière du brétou

Argeco développement

Deposit

The quantity of the deposit of Fumel is estimated at 5 10^6 tons distributed as follows:

- South slagheap 200 ktons
- East slagheap 700ktons
- West salgheap 4300ktons

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Process de production

Extraction du matériau brut en carrière

Réduction du brut (0/300 mm) par un émotteur pour obtenir un 0/50 mm

Séchage et broyage du 0/50 mm

Sélection du 0/0,5 mm pour obtenir un cru 0/0,1 mm

Calcination du cru pour obtenir le métakaolin

Mélange de produits pulvérulents

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GEOFLASH S & P – METAKAOLINs for GEOPOLYMERS

	Geoflash P	Geoflash S
Teneur en SiO_2	62,4 %	69,8 %
Teneur en Al_2O_3	30,5 %	21,6 %
Teneur en Fe_2O_3	1,4 %	2,2 %
Teneur en TiO_2	1,5 %	1,0 %
Teneur en CaO	1,8 %	0,3 %
Teneur en K_2O	0,1 %	0,3 %
Teneur en MgO	0,5 %	0,2 %
Teneur en Na_2O	0,05 %	0,1 %
Teneur en sulfates	0,3 %	0,13 %
Teneur en soufre	0,5 %	0,12 %
Teneur en chlorures	< 0,01 %	< 0,01 %
Masse volumique réelle	2400 à 2600 kgs/m^3	2400 à 2600 kgs/m^3
Usages principaux	Utilisation dans les produits géopolymères	Utilisation dans les produits géopolymères

Rapports molaires principaux	Geoflash-S	Geoflash-P
Rapport SiO_2/Al_2O_3	2,7	2,04
Rapport SiO_2/CaO	108,9	34,7
Rapport SiO_2/Fe_2O_3	42,1	44,6

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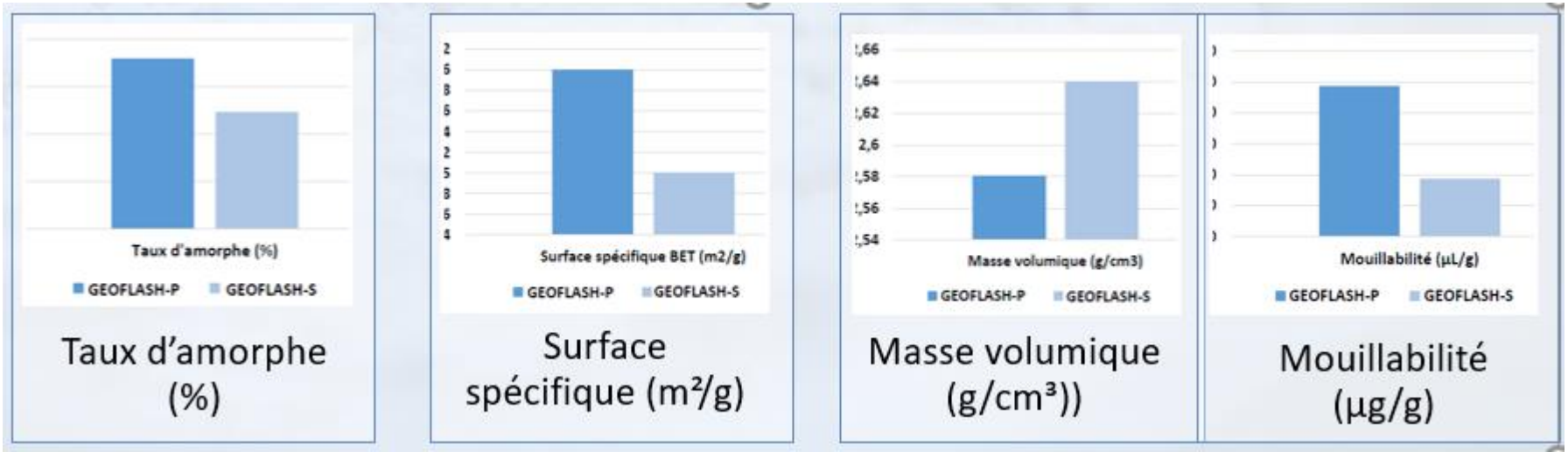
GEOFLASH S versus P

- Limit the precursor's water demand
- Have a maximum and optimal ratio between reactive amorphous phases, non-dehydroxylated kaolinite and over-calcined (mullite).
- Contains few Calcium oxides → Used alone or in combination with other precursors that do not contain CaO, it therefore does not contribute to the formation of CSH.



GEOFLASH S versus P

- 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/

The results show a good reactivity, in the right average → both are well suited to be used as geopolymer binders. The values are:

- GEOFLASH-S: 32 minutes, 96° C
- GEOFLASH-P: 30 minutes, 103° C

Silicate	Molar ratio	Formula	MK	Formula	Curing 4 hours – 80°C Bending test (3 pts)
Geosil 14517 (K)	1,7	100g	Geoflash P	107,64g	7,3 MPa
Geosil 14517 (K)	1,7	100g	Geoflash S	76,23g	3,7 Mpa (powder at the surface – silica)
Geosil 34417 (Na)	1,7	100g	Geoflash P	128,71g	9,3 MPa
Geosil 34417 (Na)	1,7	100g	Geoflash S	91,15g	5 Mpa (powder at the surface – silica)

INORGANIC ADDITIVES

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	Corrosion resistant Hydrophil (no surface treatment) – Smoothing cements

Inorganic Additives

Silica SiO_2

It exists in the free state in different crystalline, amorphous or combined forms. In silicates, SiO_2 groups are linked to other elements: Al, Fe, Mg, Ca, Na and K.

Amorphous silica can be used as an additive

Siliceous earth of Neubourg - Sillitin V85

SIO_2	AL_2O_3	Fe_20_3	Phase amorphe
87%	8%	<1%	8%

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Inorganic Additives

- Alumine is found in nature in the form of various minerals

Albit 45 – Alumino silicate

SiO_2	Al_2O_3	Fe_2O_3	CaO	d50	d98	Blancheur*
69-71%	17,5-18,5%	0,02-0,04%	0,50%	7µm	35µm	92%

* Datacolor 200M, D65, 10°

Corindon

α-Al_20_3 pure form obtained by calcination of Y-Al_20_3 at high température (>1500C).
Highly crystalline form, thermodynamically stable and poorly soluble in concentrated alkaline solution

SiO_2	Al_2O_3	Fe_2O_3	CaO	$Na_2O + K_20$
Max. 0,1%	99,50%	Max. 0,03%	0,10%	Max. 0,3%

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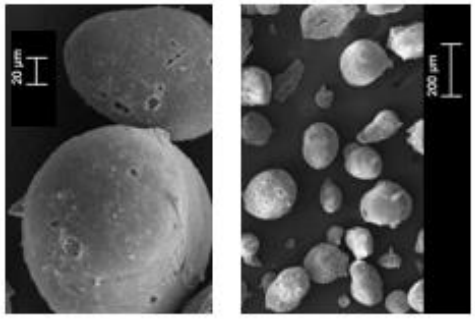
Inorganic Additives

- Hollow mineral spheres of the aluminosilicate group

  various granulometry
  - 50-180µm
  - 50-300µm
  - 250-500µm
  - 500-1000µm

SIO_2	AL_2O_3	Fe_2O_3	CaO	K_2O	Na_2O
74%	13%	2%	2%	4%	4%



Inorganic Additives

- Feldspar : is produced from naturally occuring combination of alumina and silicate having mix oxides and no free crystalline silica. This material is hard and has angular particles that create a rigid reinforcing network.
  Few particle size available

Inorganic Additives

- Wollastonite : natural calcium silicate that can form needle shape during its genesis (acicular structure)

SiO_2	Al_2O_3	Fe_2O_3	CaO	d50	d98	Blancheur*
> 44%		< 0,3%	> 49%	21 µm 33 µm 18 µm 8 µm	189 µm 136 µm 78 µm 37 µm	75% 87% 91% 86%

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Inorganic Additives

- Mica : Muscovite – High lamellarity – Powder & Flakes

SiO_2	Al_2O_3	Fe_2O_3	K_20	Na_2O	MgO
46%%	32%	< 5%	11%	0,30%	0,20%

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Inorganic Additives

Basalte fibers

SiO_2	Al_2O_3	Fe_2O_3	CaO + MgO
70-80%			18-25%

Perlite

Microspheres: volcanic origin

SiO_2	Al_2O_3	Fe_2O_3	CaO
74,28%	12,80%	0,90%	0,90%

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Inorganic Additives

Glass

Boruvit : powder of glass

SIO_2	AL_2O_3	Na_20	K_2O	CaO	Fe_20_3
69-71%	17,5-18,5%	10-11%	0,2-0,4%	0,50%	0,02-0,04%

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Thank you for your attention

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