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RIGA TECHNICAL UNIVERSITY

GEOPOLYMERCAMP

Porous Geopolymer Materials for Different Applications

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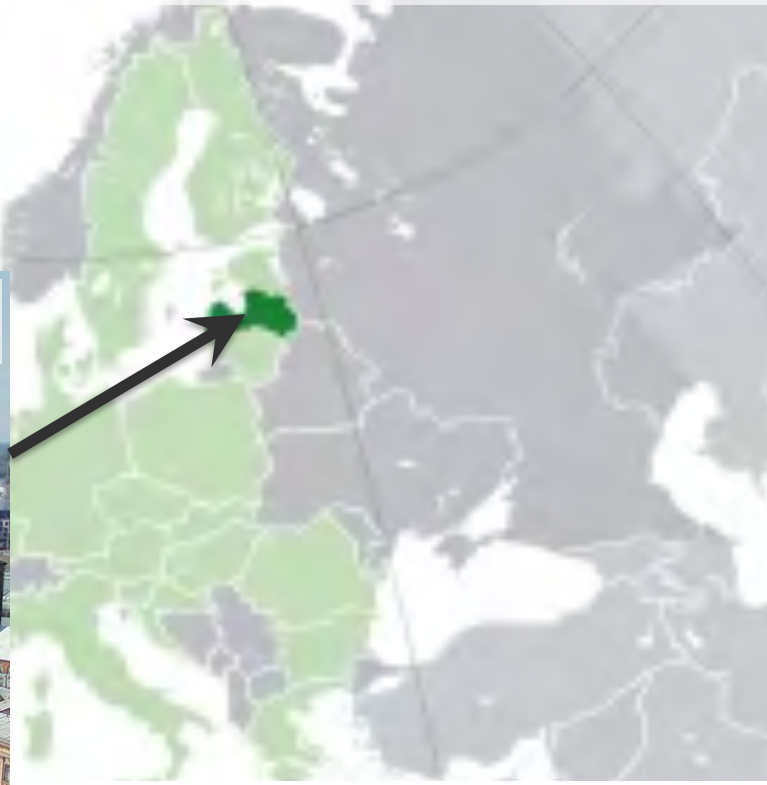
Saint-Quentin, 2019

Latvia

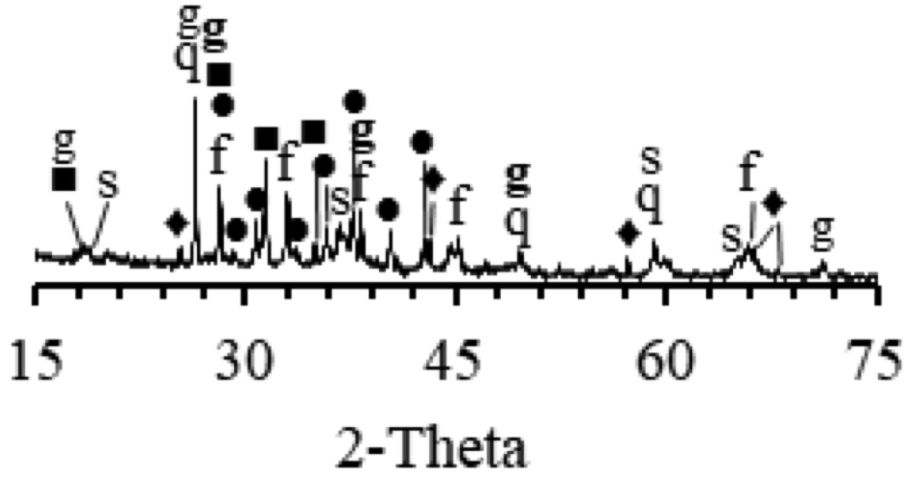
64589 km^2

1.93 milj. people

Riga (founded in 1201)



Raw materials:
Aluminium Scrap Recycling Wastes



q - quartz (83-2187)
f - iron oxide (32-0469)
s - spinel (75-1799)
● - aluminium iron oxide (18-0633)
■ - calcium aluminium iron oxide (21-0830)
♦ - magnesium aluminium silicate (30-0788)
g - gibsite (70-2038)

Chemical composition:

Al_2O_3	63.19%
SiO_2	7.92%
CaO	2.57%
MgO	4.43%
Fe_2O_3	4.54%
K_2O	2.75%
Na_2O	3.84%
Others	6,95%

Raw materials:
Clays (aluminium silicate source)

1. Calcined Illite clay
2. Metakaolin (industrial by-products produced by «Stiklaporas» Ltd., Lithuania)
3. Low Qality Chammotite («Keramserviss» Ltd., Latvia)
4. Firebrick sawing residues («Morgan Thermal Ceramics» Ltd., UK)

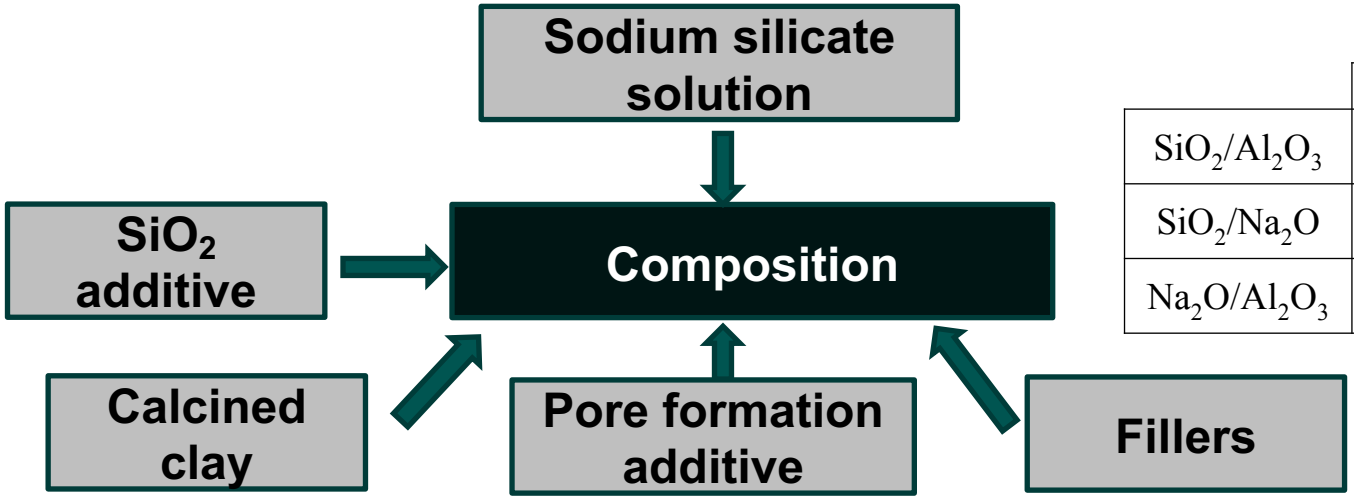
Raw materials:
Glasses (additional silicate source)

1. Bore-silicate lamp glass

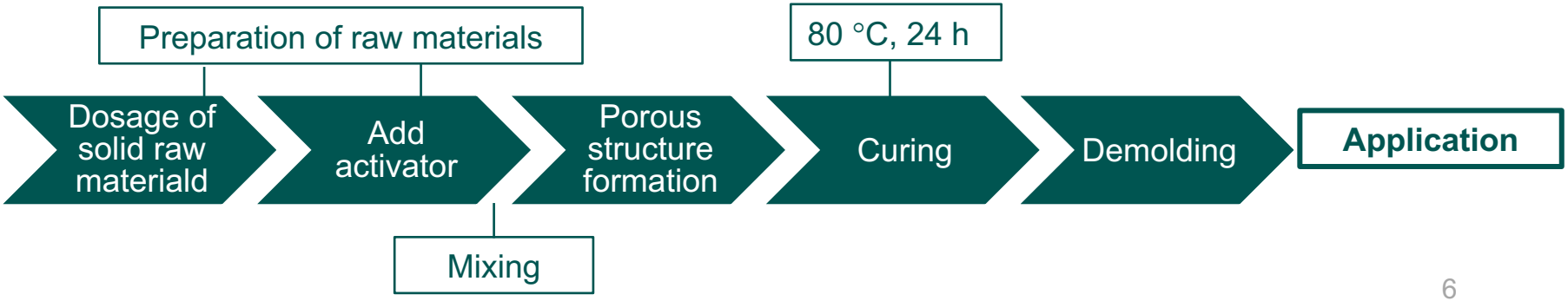
2. Two type of glasses - E-glass and K-glass, by-products (overlefts) from glass fibre production («Valmieras Stiklašķiedra» Ltd., Latvia)

Production of Porous Geopolymer Materials

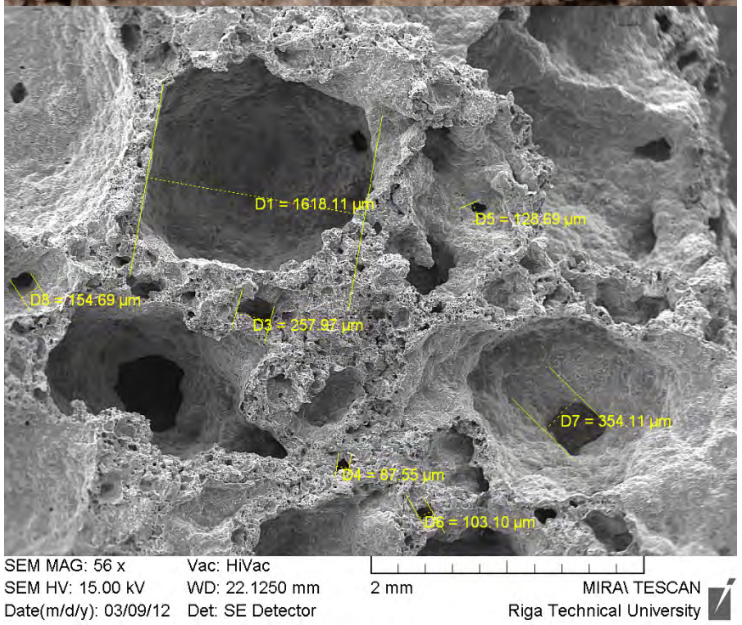
Properties depends from then oxide ratio: SiO_2/Al_2O_3; SiO_2/Na_2O; Na_2O/Al_2O



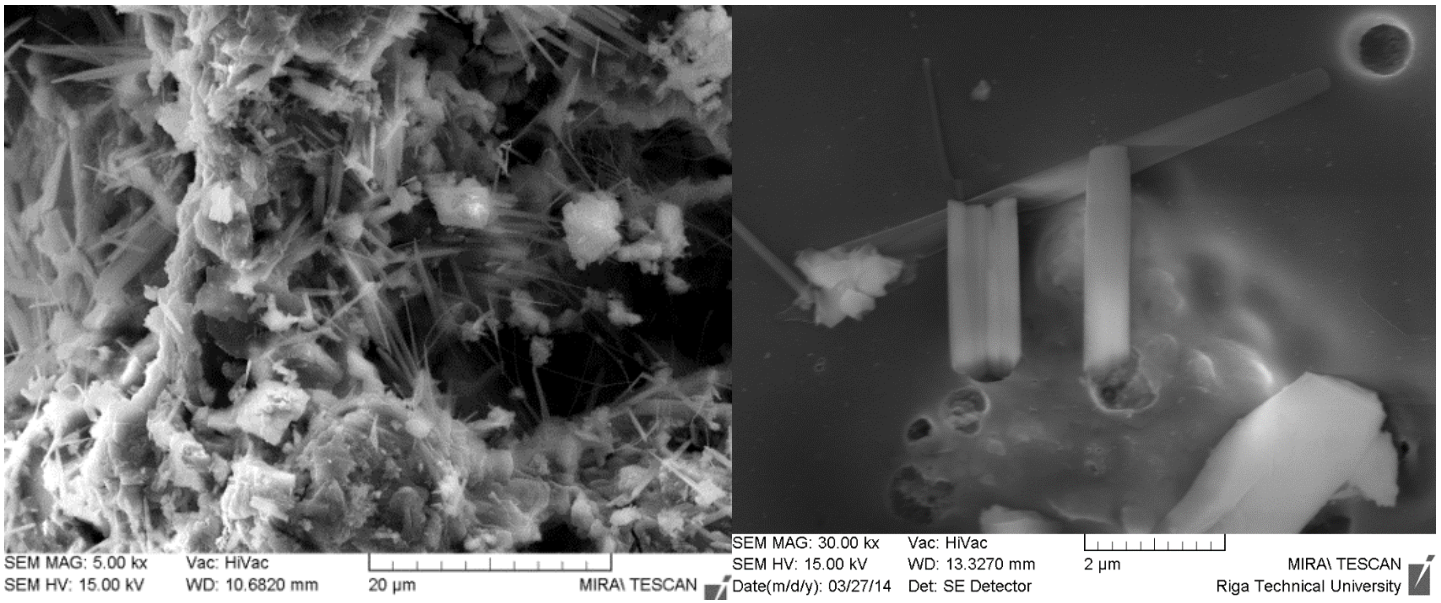
	min	max
SiO_2/Al_2O_3	0.77	2.50
SiO_2/Na_2O	3.10	5.08
Na_2O/Al_2O_3	0.17	0.67



Macro and microstructure of Porous Geopolymer Materials



Porous Geopolymer granules - catalysts for pH adjustment



Microstructure of Porous Geopolymer granules made by using metakaolin: crystallization of alkalis crystals after leaching test

- Chemically un-bounded alkalis remains in the microstructure of Porous Geopolymer Materials after their preparation.
- Porous structure of Porous Geopolymer Materials with specific pore size and distributions ensures long lasting and steady leaching process of un-bounded alkalis. Thereof pH of media increases in time.
- The optimal teat treatment temperature is 200 ° C to ensure long time adjustment of pH.

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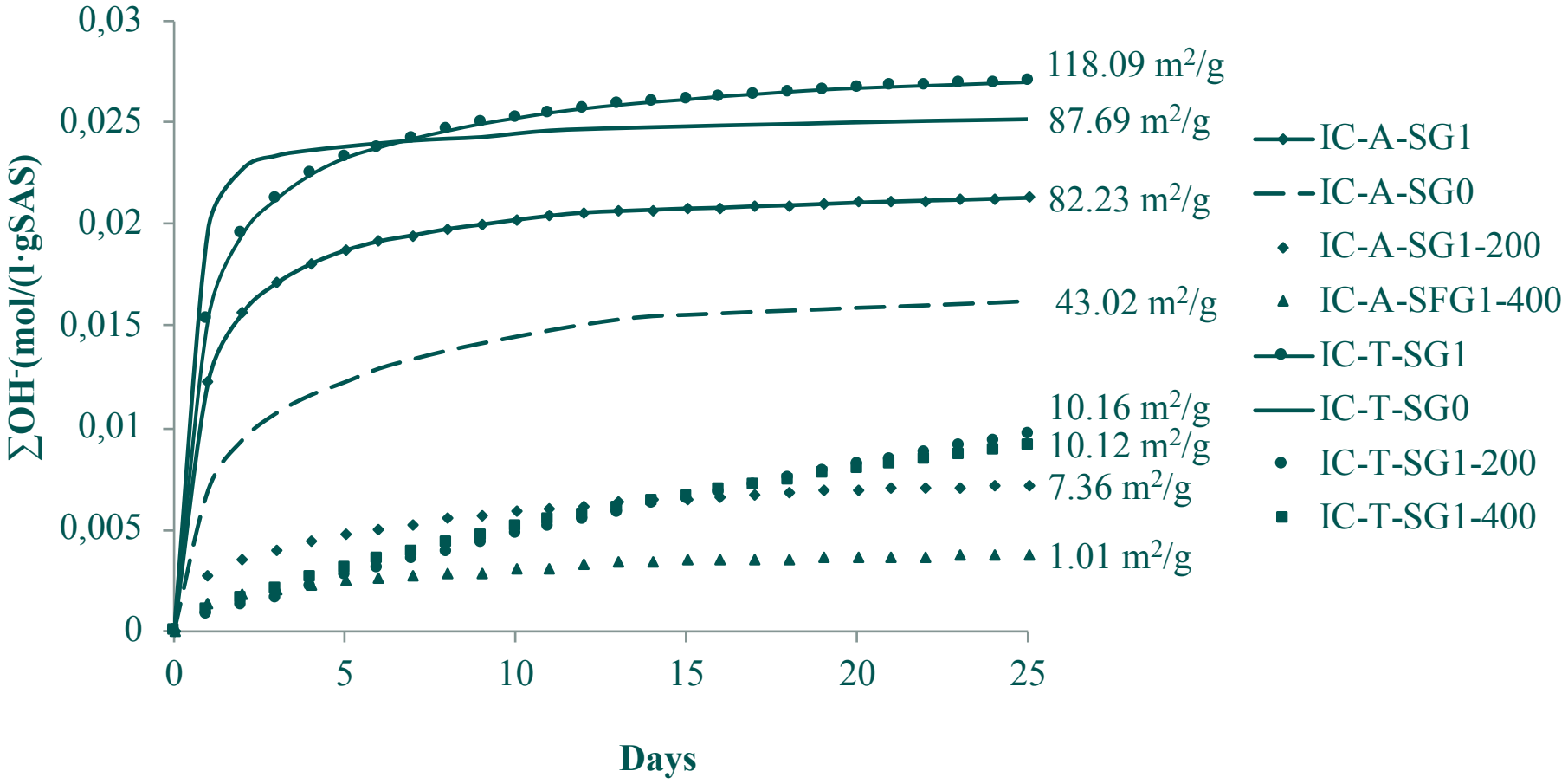
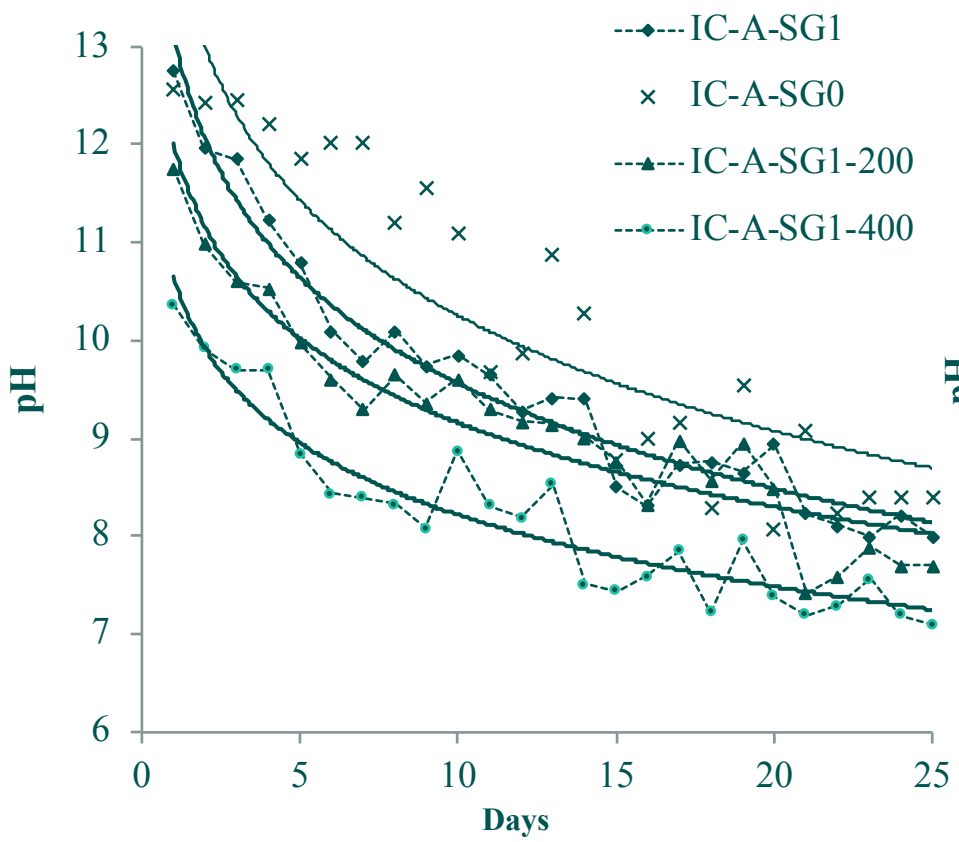
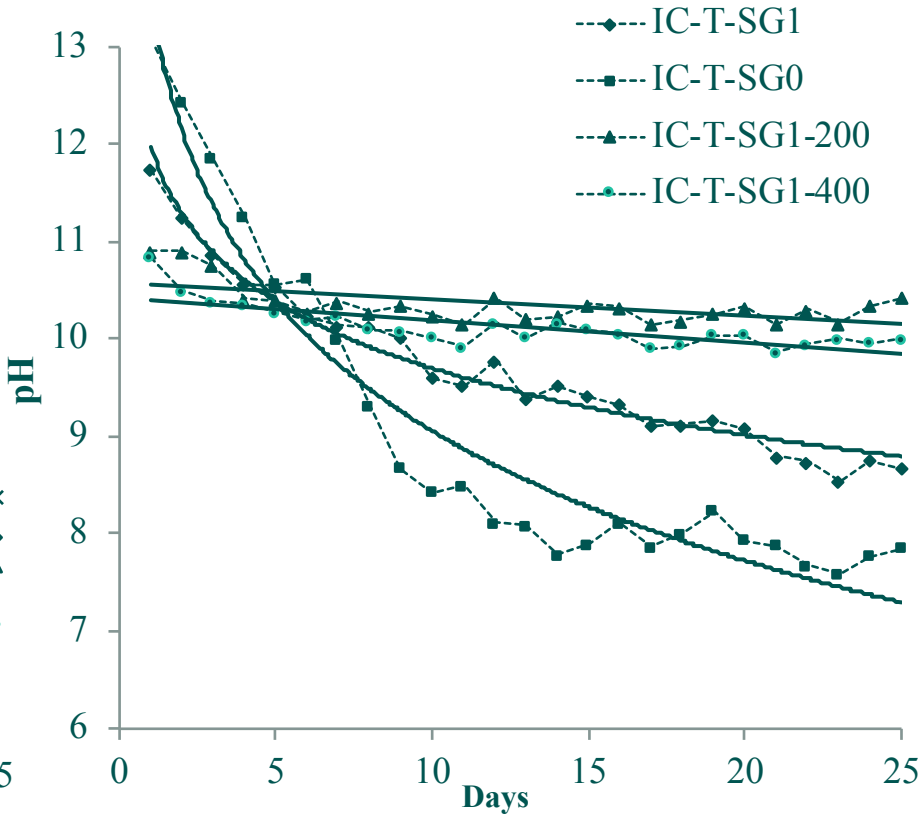


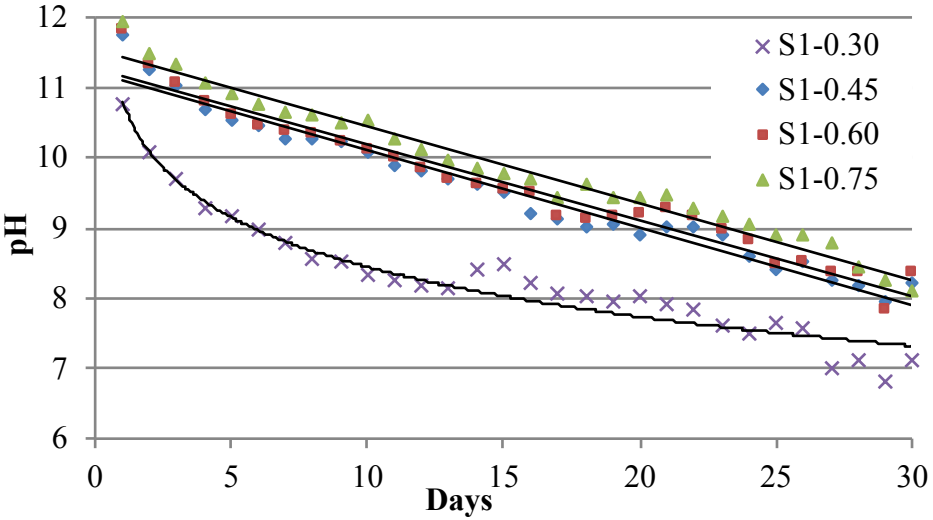
Porous Geopolymer granules - catalysts for pH adjustment



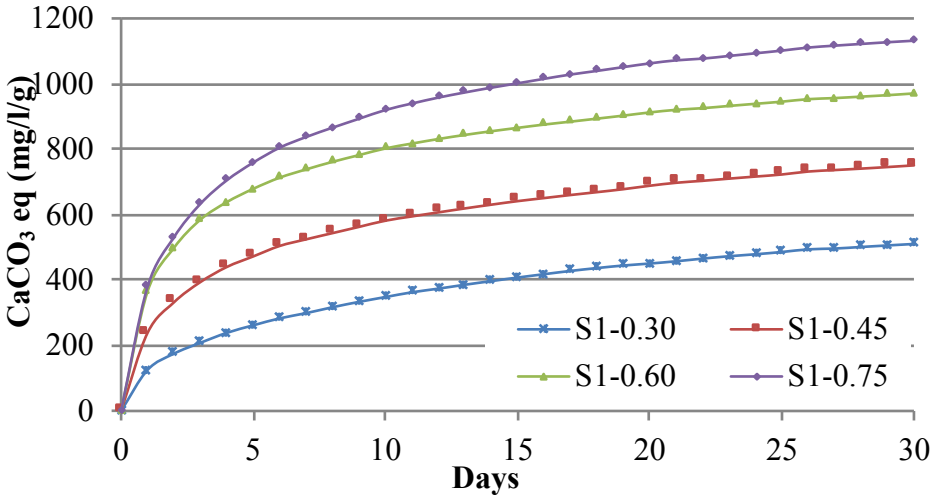


Porous Geopolymer granules - catalysts for biogas production systems

- Porous Geopolymer granules could be used as new progressive porous material for pH control without automatic pH controlling systems;
- Biogas yield increased up to 30% in batch tests;
- Porous Geopolymer granules are favorable environment for bacteria growing.

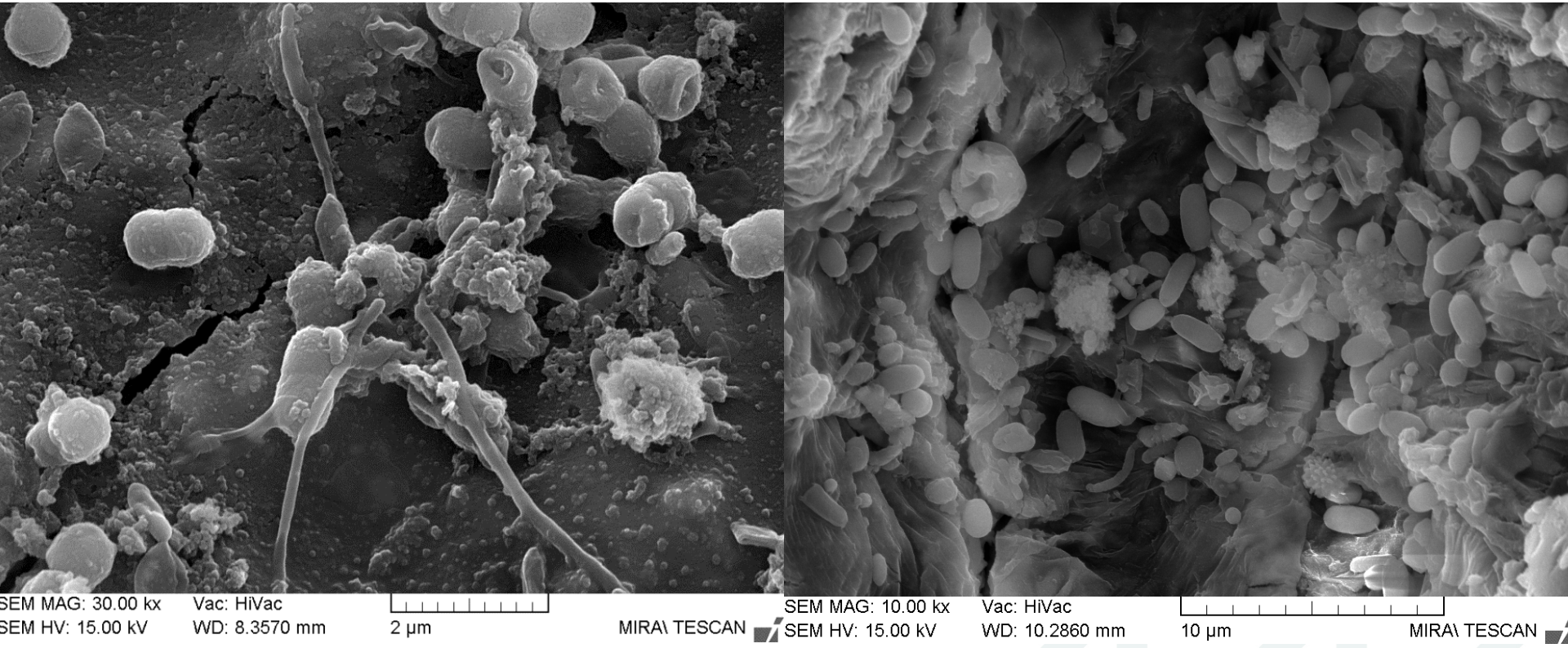


The changes of the pH level in solution which is used in the biogas digestion process



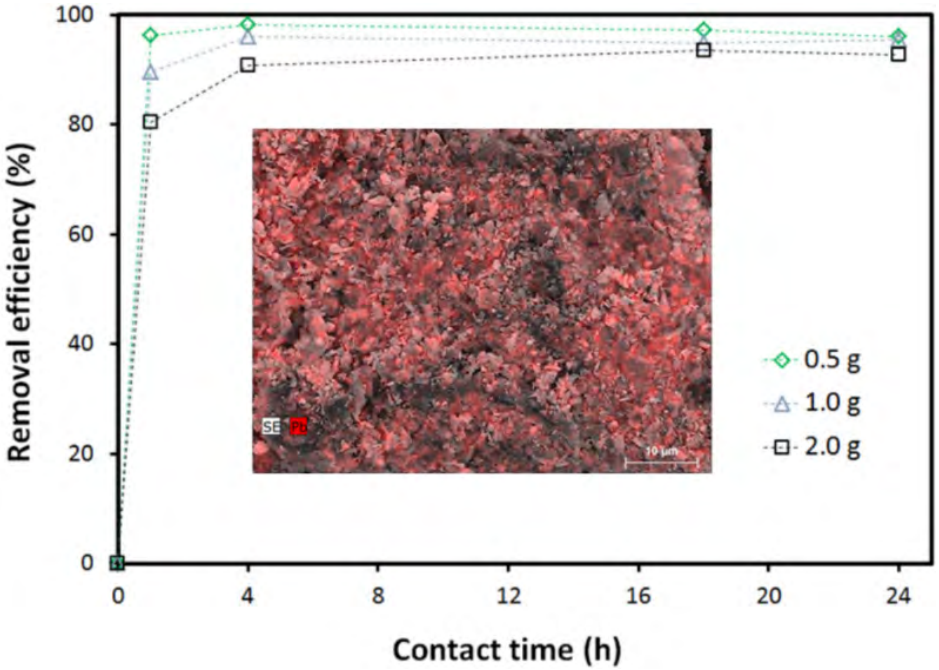
Buffer capacity in solution which is used in the biogas digestion process

Porous Geopolymer granules - catalysts for biogas production systems

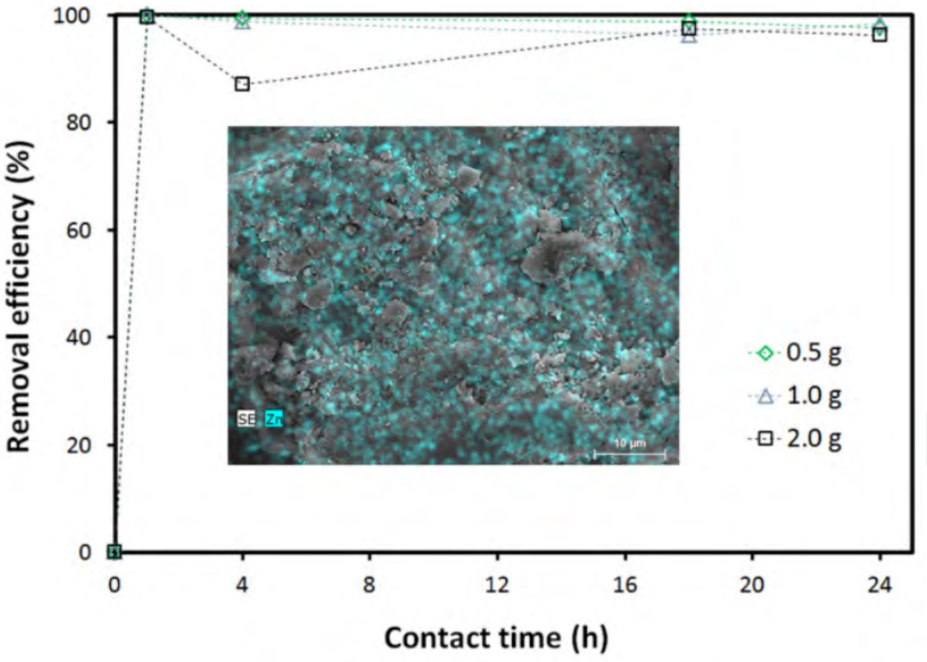


Growth of bacteria on Porous Geopolymer granules during biogas digestion

Porous Geopolymer granules for heavy metal (Pb and Zn) removal from wastewater

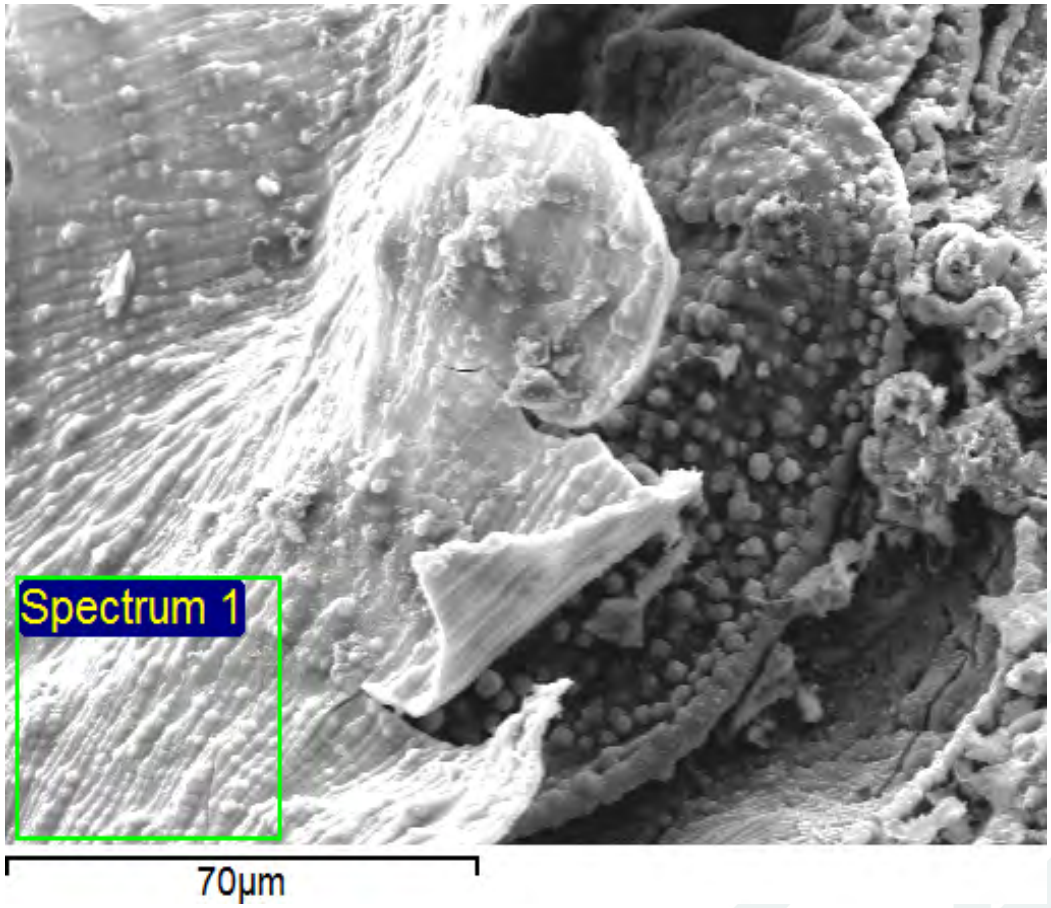


Lead removal efficiency with Porous Geopolymer granules and Pb mapping



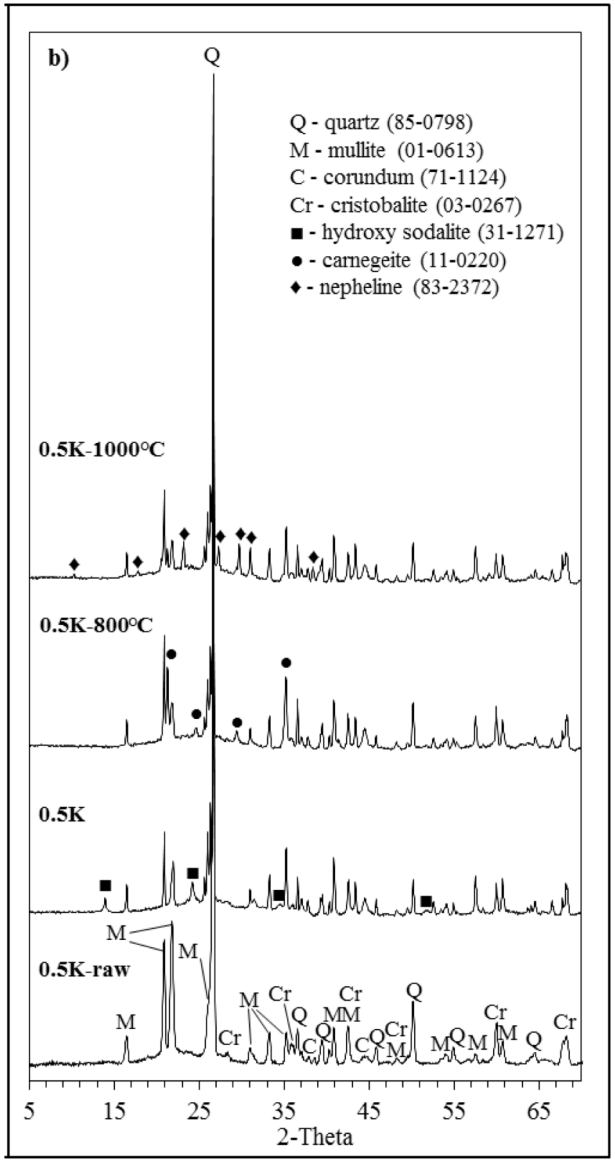
Zinc removal efficiency with Porous Geopolymer granules and Zn mapping

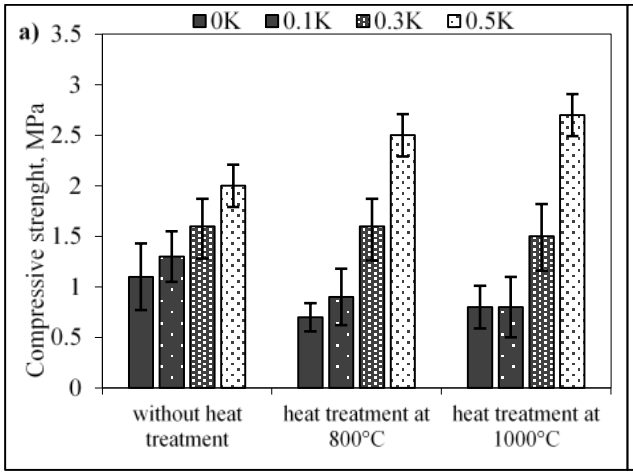
Porous Geopolymer granules for heavy metal (Pb and Zn) removal from wastewater

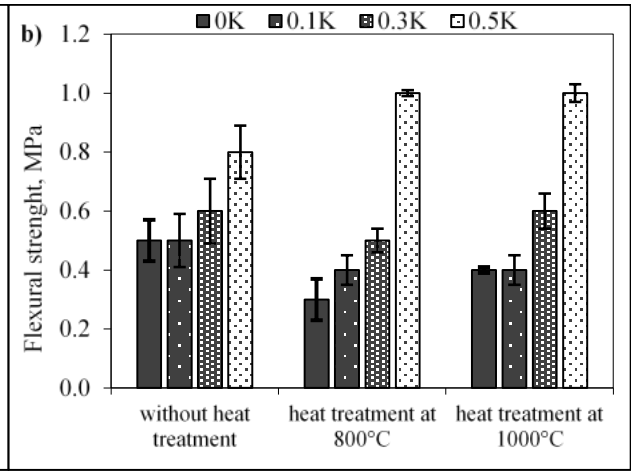


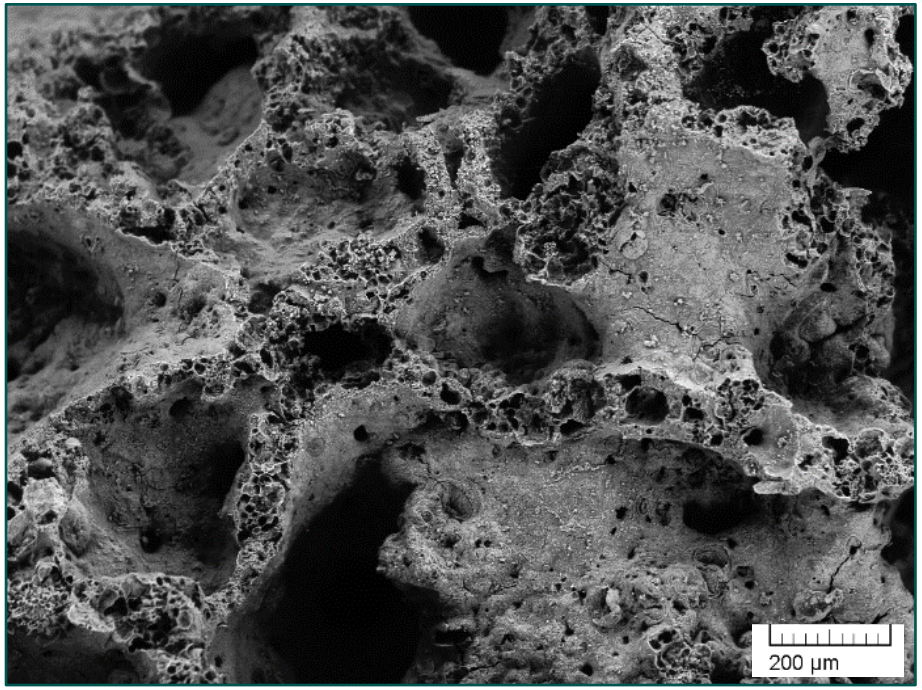
Zn containg film (~2% Zn) on surface of the Porous Geopolymer granule

Porous Geopolymers - heat insulation materials for industrial application

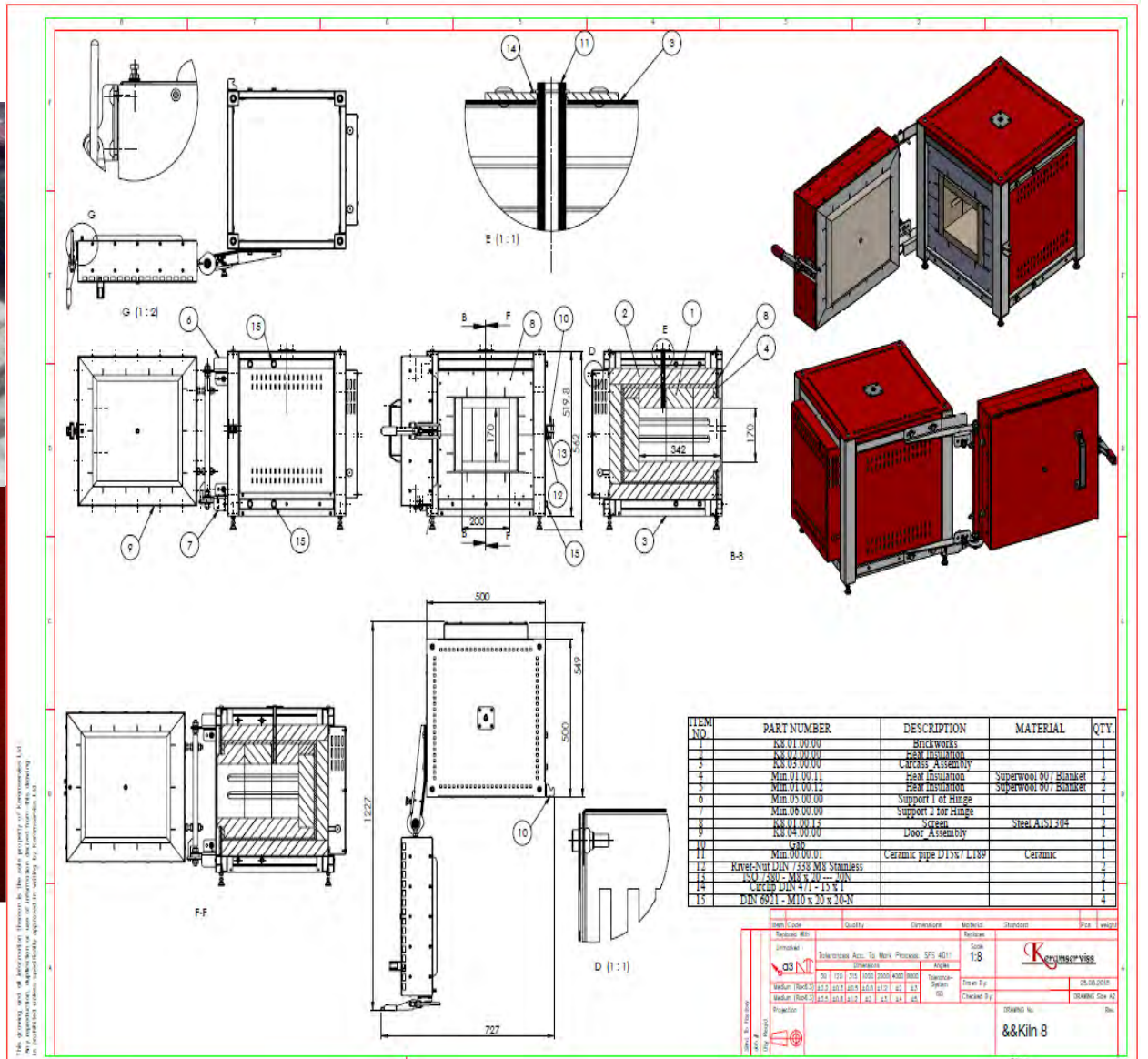






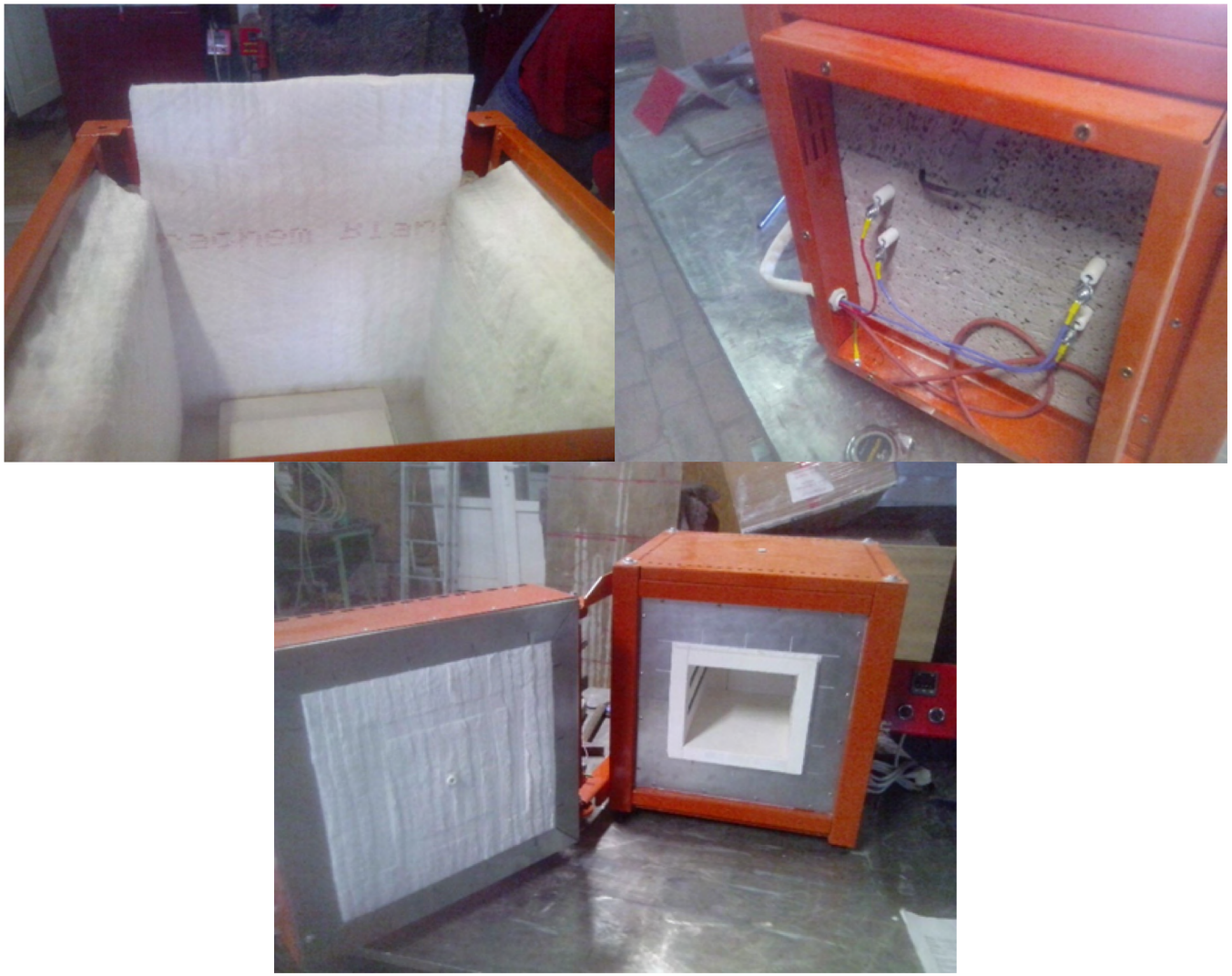


Porous Geopolymers - heat insulation materials for industrial application

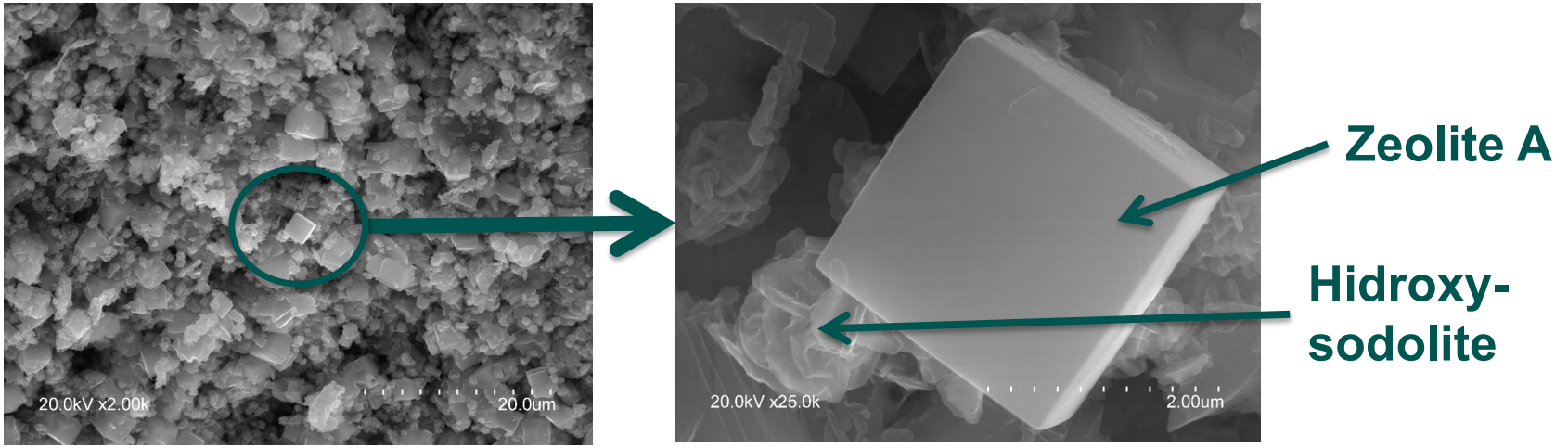


ITEM NO	PART NUMBER	DESCRIPTION	MATERIAL	QTY
1	KS.01.00.00	Brickworks		1
2	KS.02.00.00	Heat Insulation		1
3	KS.03.00.00	Carcass Assembly		1
4	Min.01.00.11	Heat Insulation	Superwool 607 Blanket	2
5	Min.01.00.12	Heat Insulation	Superwool 607 Blanket	2
6	Min.05.00.00	Support 1 of Hinge		1
7	Min.06.00.00	Support 2 for Hinge		1
8	KS.01.00.13	Screen	Steel AISI 304	2
9	KS.04.00.00	Door Assembly		1
10	OBS			1
11	Min.00.00.01	Ceramic pipe D15/7 L189	Ceramic	1
12	Rivet-Nut DIN 7338 M8 Stainless			2
13	ISO 7380 - M8 x 20 --- 20N			2
14	Circlip DIN 471 - 15 x 1			1
15	DIN 6921 - M10 x 20 x 20-N			4

Porous Geopolymers - heat insulation materials for industrial application



Geopolymer binders with increased content of zeolites



- Zeolites are sinthesized at hydrothermal conditions;
- Raw materials contained amorphous oxides of aluminum and silica are used. They can be natural minerals or wastes / by-products from different industry;
- Zeolites are ensuring ion exchange, catalise and adsorbtion.
- Natural or artificial zeolites can be added to the composition of Geopolymers to improve catalytic properties


Thank you for your attention!