European Union
European Regional Development Fund

Kainuun liitto

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UNIVERSITY OF APPLIED SCIENCES

Geomaterials project

- Geopolymer binder mix development for structural applications

Kainuun ETU

ekokymppi

KAINUUN VOIMA OY

rethink.
storaenso

Juuan Dolomiittikalkki Oy

AQUAMINERALS

oulu water alliance Ltd.

Rudus

PIELISEN BETONI OY

VALUGRILLI

OULUN YLIOPISTO
UNIVERSITY of OULU

CONSOLIS

KAMK University of Applied Sciences

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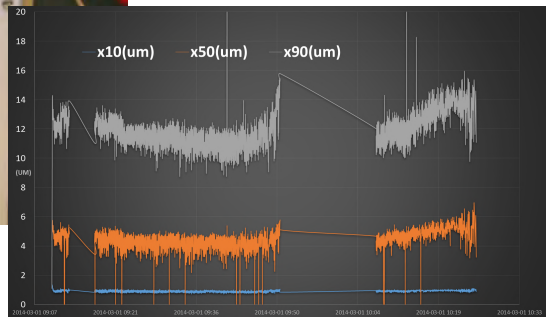
- Appr. 2000 students
- Mechanical and Mining Engineering is one focus area
- Research and development supports education and industry within the region

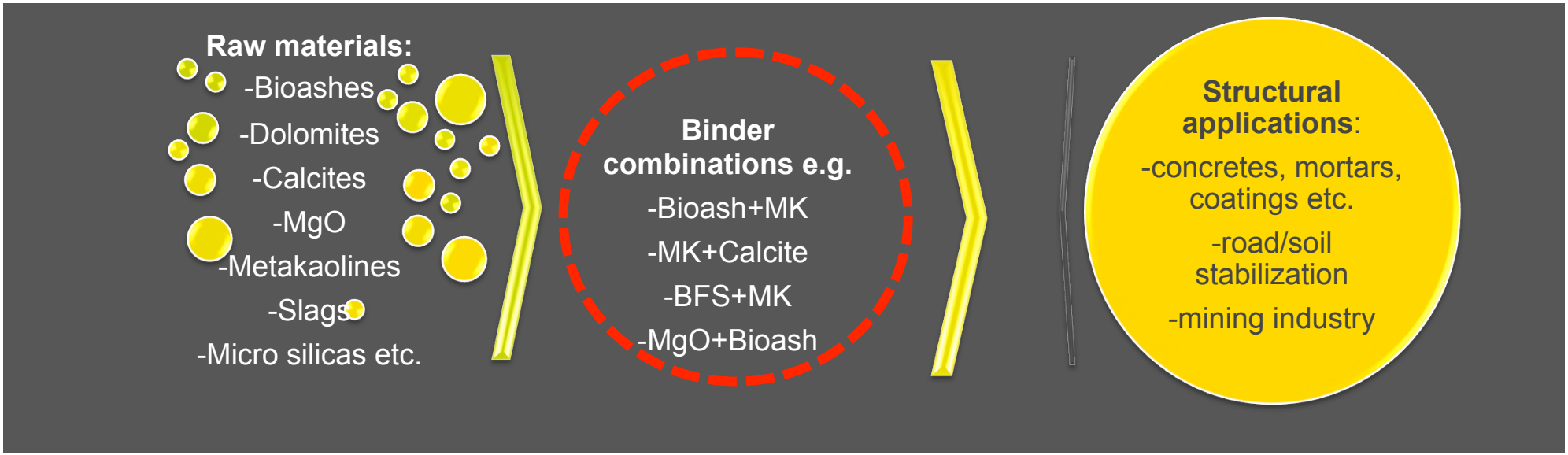


R&D Focus of the project GeoMaterials

Research and processing of regional mineral resources and industrial by-products:

- develop new methods to improve utilization of industrial by-products
- research and develop new products based on geopolymer technology
  1. applications for building industry
  2. adsorbents for waste water treatment
  3. mixes for soil stabilization

Platform concept for geopolymer binder mix development for structural applications



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XRF: fly ashes

	Näyte	Na_2O (%)	MgO (%)	Al_2O_3 (%)	SiO_2 (%)	P_2O_5 (%)	S (%)	K_2O (%)	CaO (%)	TiO_2 (%)	FeO (%)	summa
BA1	LT Stora Enso 04_02_13	1,20	1,57	5,79	28,15	1,65	1,47	2,28	42,89	0,24	5,43	90,67
	LT Stora Enso 09_12_13	1,40	2,57	7,17	26,55	3,86	3,83	2,76	32,29	0,32	11,19	91,94
BA2	NT 11-12 x < 45 µm	3,03	2,24	12,66	58,76	1,03	0,16	3,99	7,29	0,67	8,31	98,14
	NT 12 x< 35 µm 21.3.-14	2,28	1,99	12,94	51,94	1,97	1,67	3,71	10,27	0,94	8,88	96,59
	NT 12 x> 35 µm 21.3.-14	3,12	1,75	14,78	62,30	1,03	0,39	3,27	7,08	0,65	4,66	99,03
	NT 12 original 21.3.-14	2,68	1,85	13,51	57,31	1,50	0,95	3,47	8,37	0,78	6,41	96,83
	NT (11)_12 35 < x < 45 µm 26.3.	3,05	1,67	12,65	65,15	1,04	0,32	3,12	6,93	0,63	4,47	99,03
	NT 12 Kavo 20.1.	2,50	2,29	13,11	51,87	1,63	1,77	3,01	9,71	0,92	8,44	95,25
	NT 12 2013	1,88	2,66	10,59	44,56	2,09	2,23	3,14	13,46	0,57	13,92	95,10
CFA	Kivihiilituhka Hanasaari 27.12.-13	0,07	1,49	20,03	49,00	0,72	0,21	2,79	5,07	1,01	5,80	86,19
	Kivihiilituhka Salmiasaari 26.12.-13	0,55	2,23	23,19	47,00	0,63	0,36	3,07	5,64	1,12	6,28	90,05
	Kivihiilituhka Martinlaakso 26.12.-13	0,18	1,57	22,34	57,14	0,70	0,19	2,62	4,82	1,01	5,69	96,25

XRD: bioash based on wood and peat 70/30

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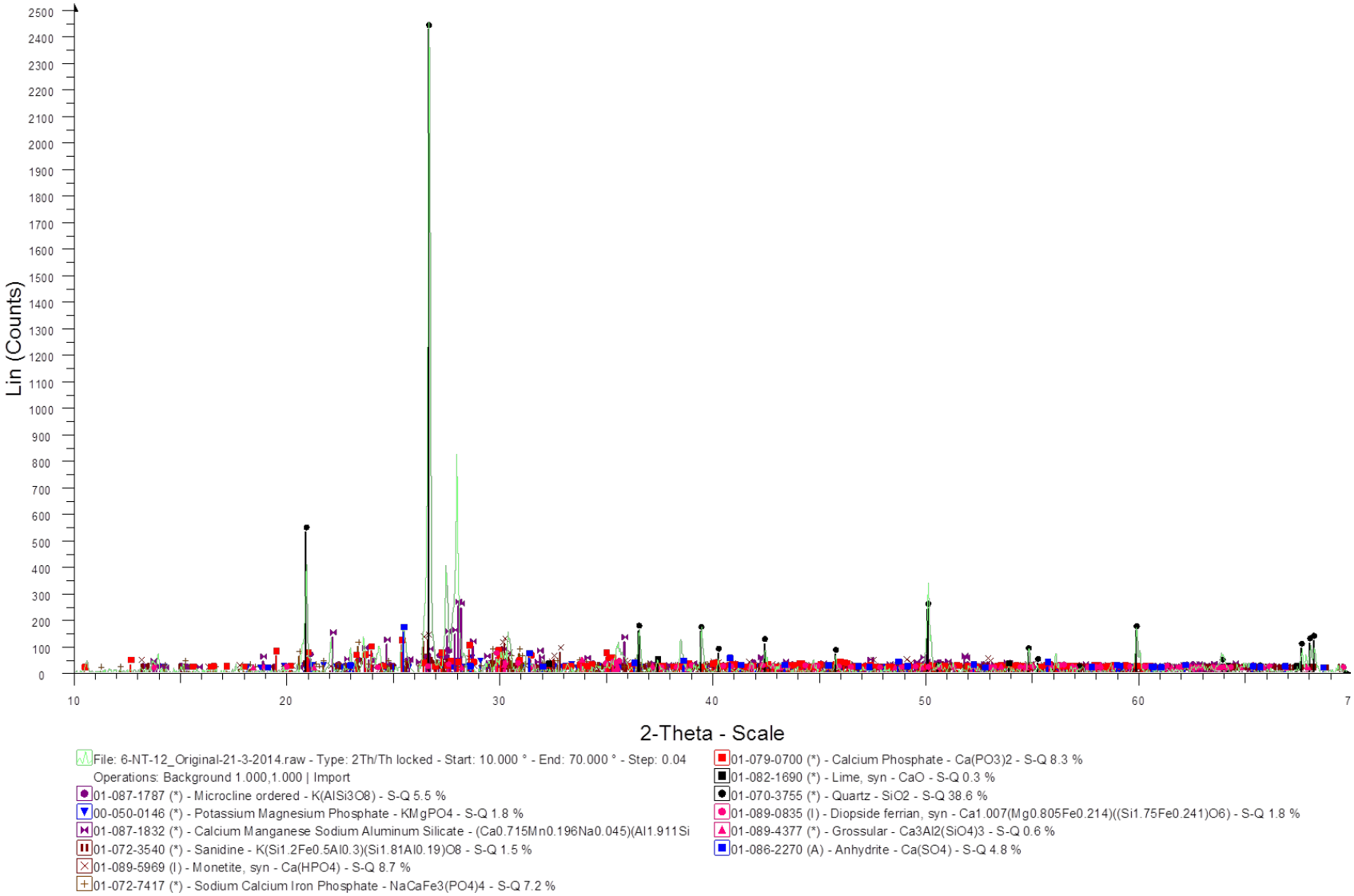
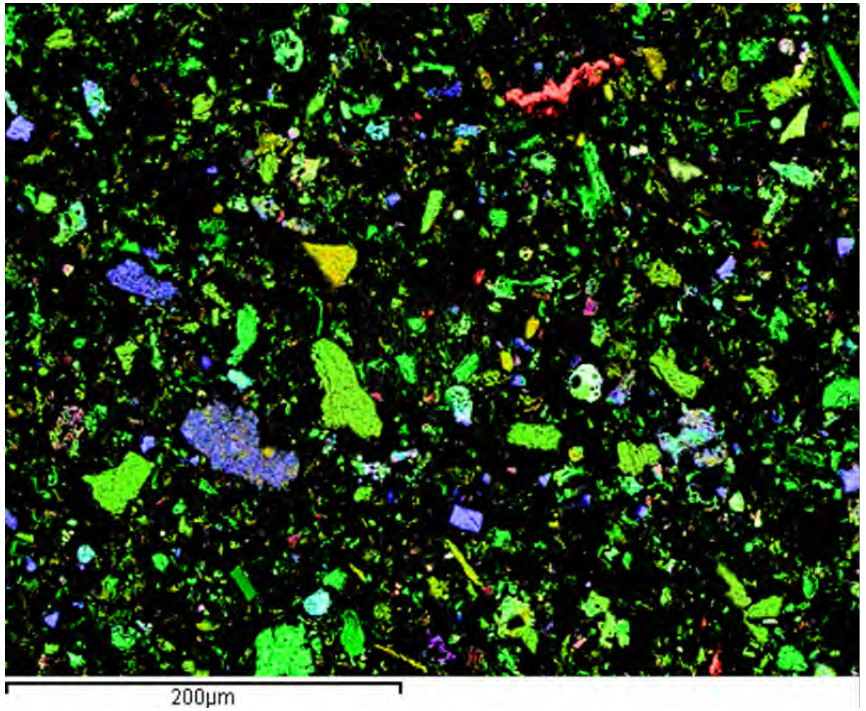
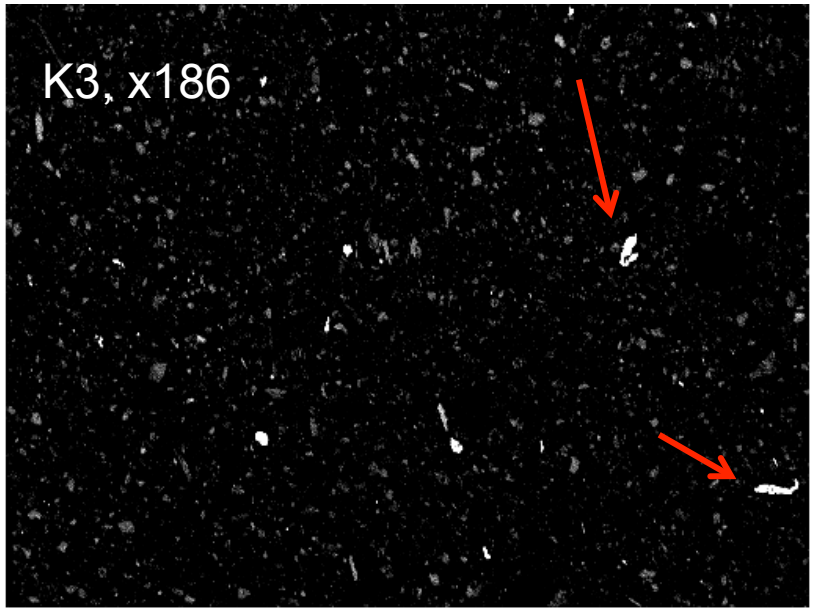


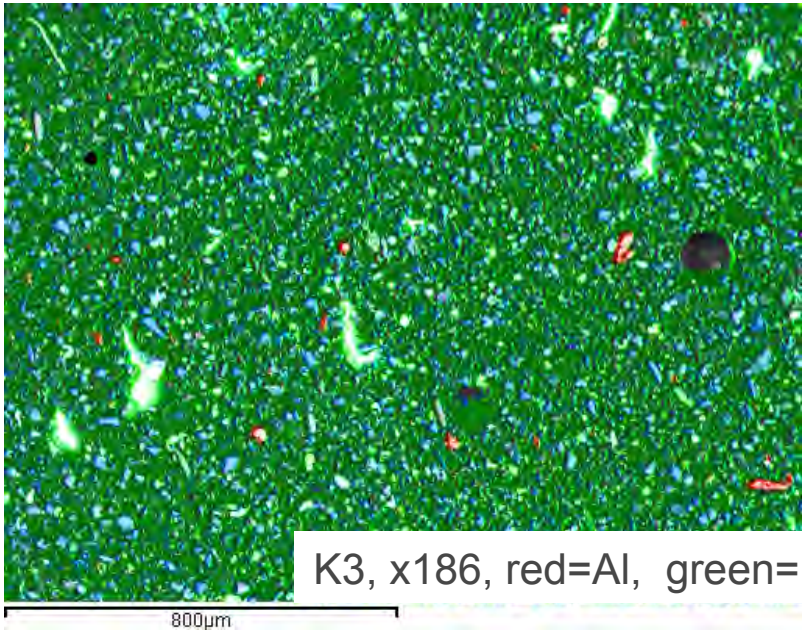
Development of bioash+MK based geopolymer concrete

Some problems …





Al Ka1



K3, x186, red=Al, green= O, blue=Si

Development of bioash+MK based geopolymer concrete

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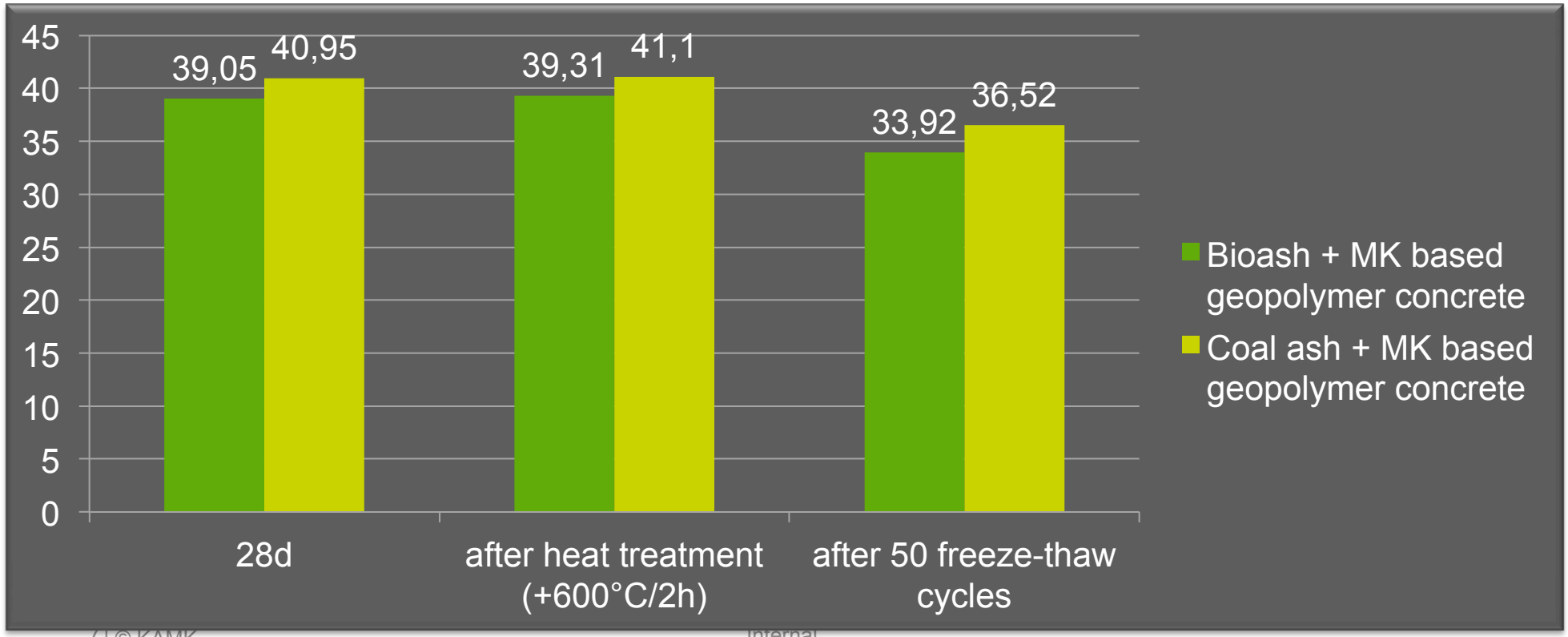
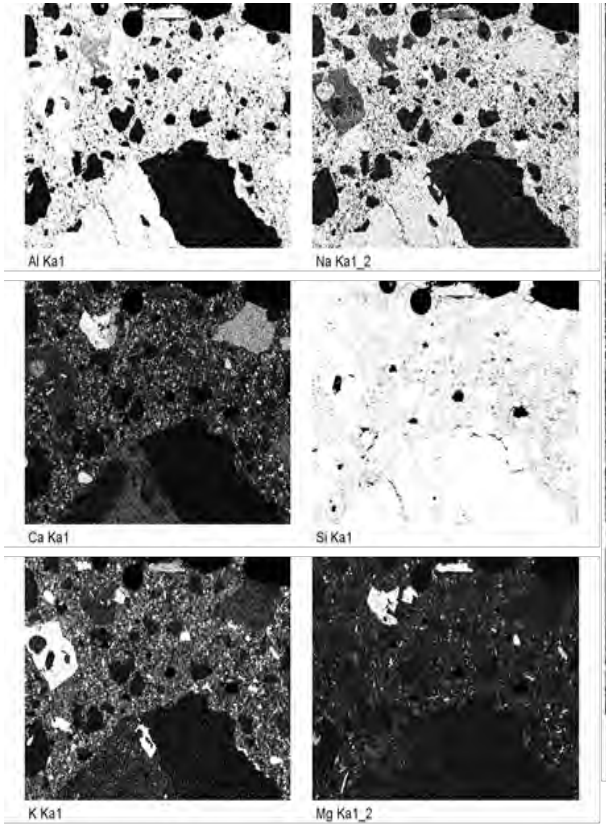
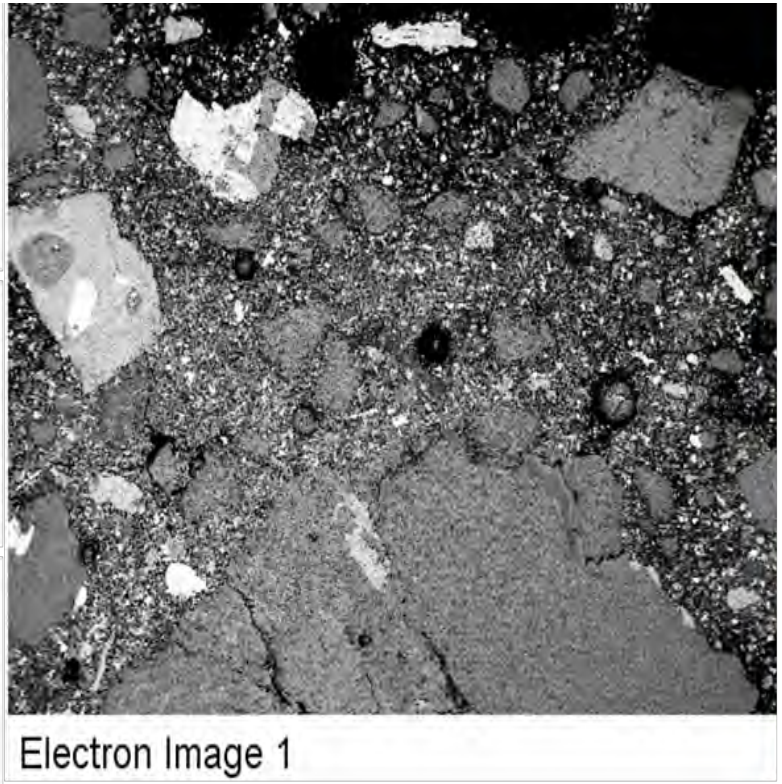
…but also relatively good results in comparison with coal fly ash (class F) +MK based geopolymer concrete

- Bioash modified: classified >35µm and ground <45µm (d90)

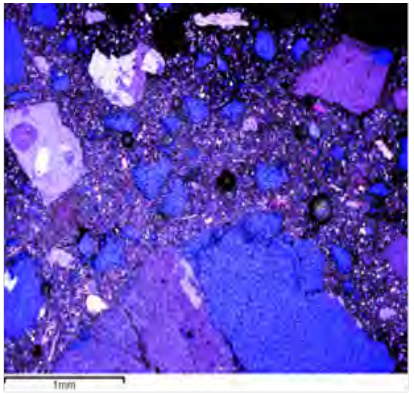


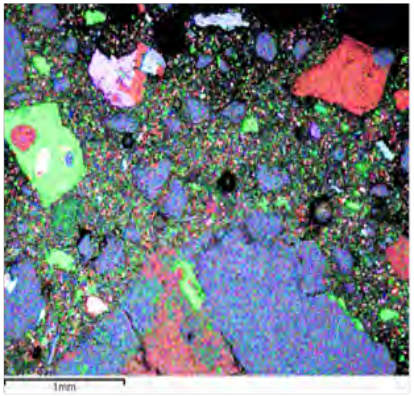
Bioash +MK based GP concrete x90





Electron Image 1





Al
Na
Si

Ca
K
Mg

Behaviour of slag based GP concrete after heating and freeze-thaw cycles

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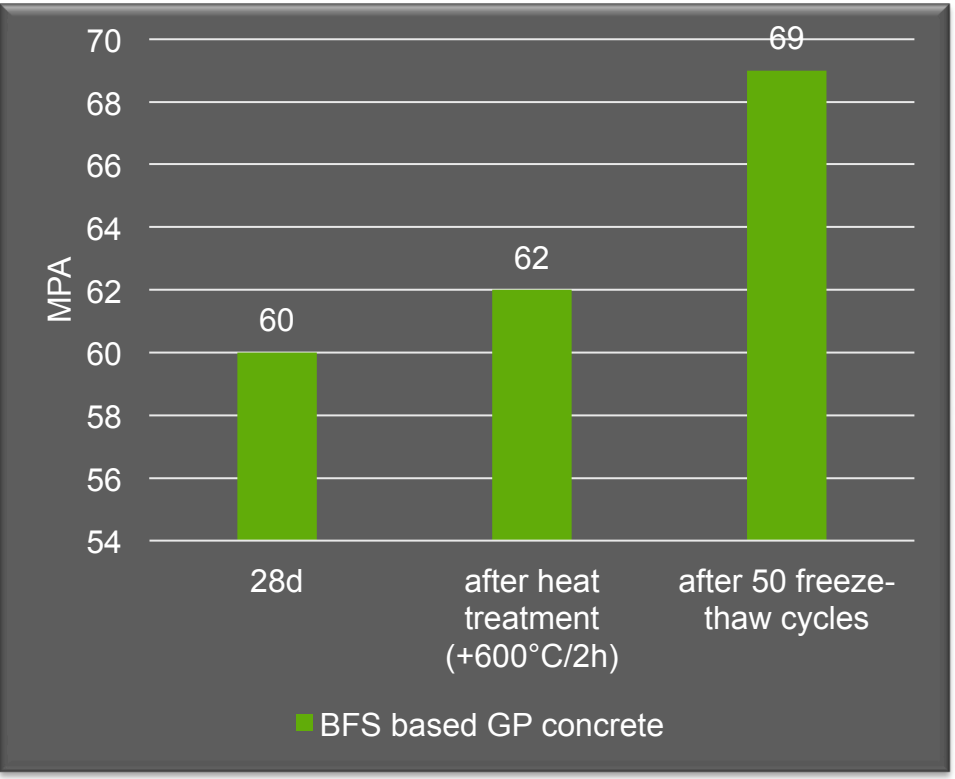
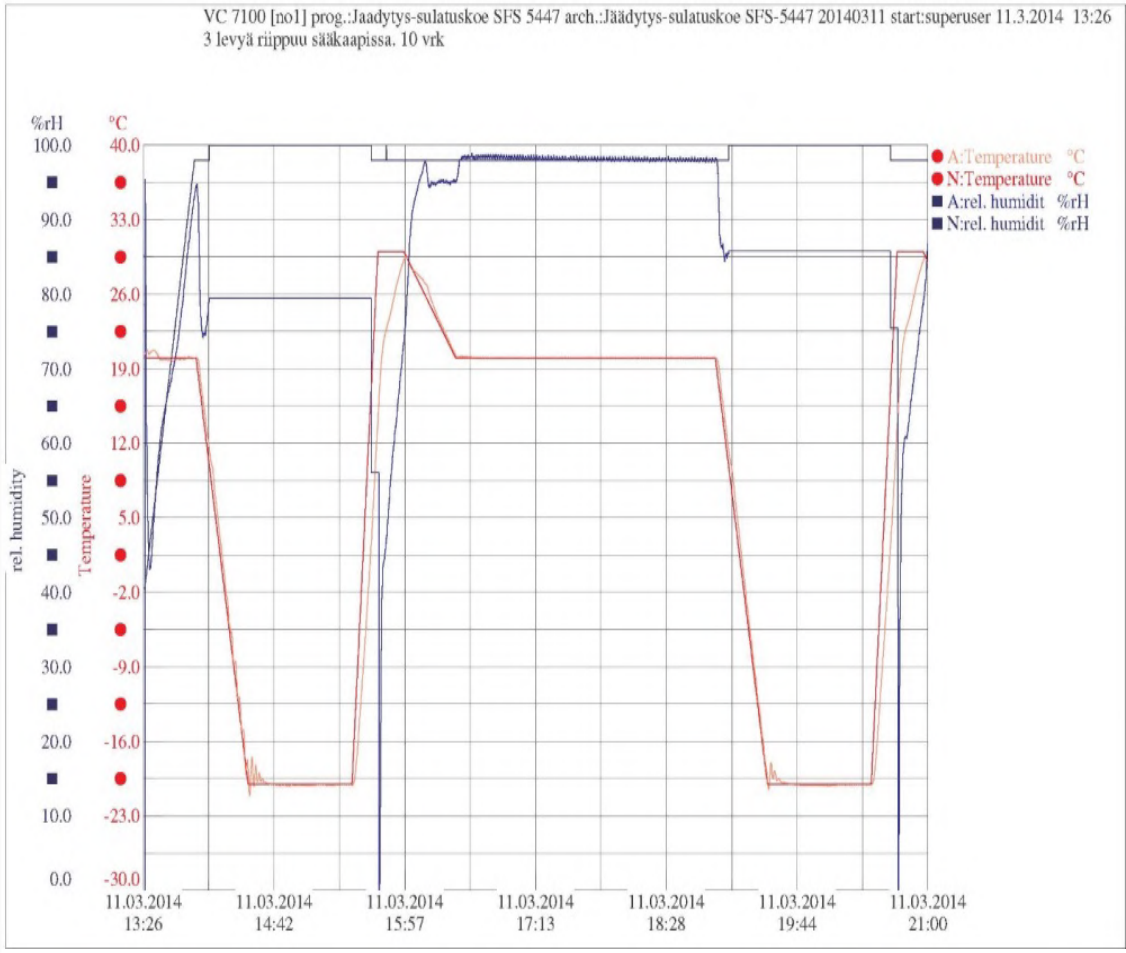
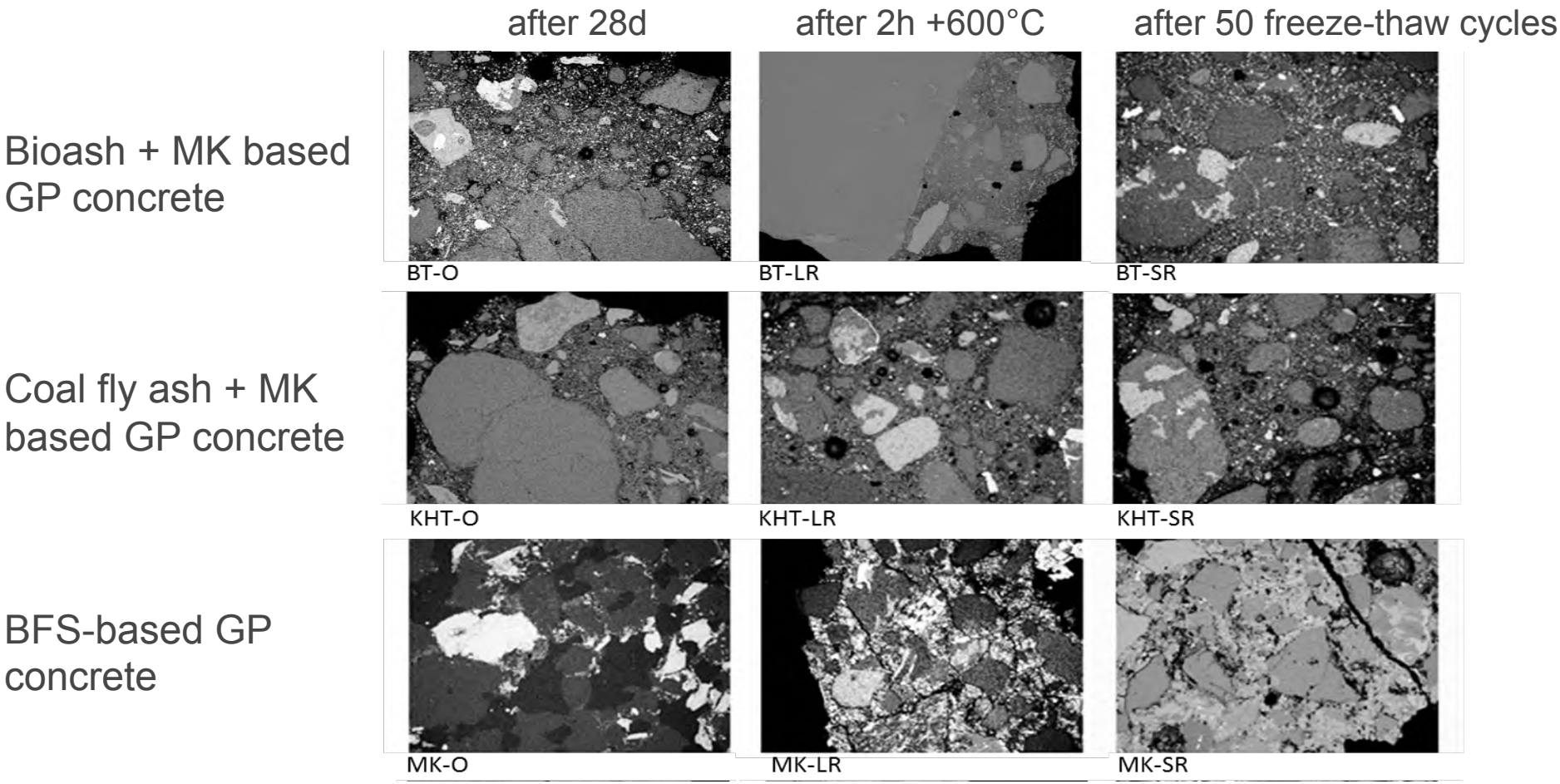
- Curing in dry and room temperature (+18°C)





Differences in concretes after heat treatment and freeze-thaw cycles



An example on tests: experimental studies with bioash based mass stabilazion binder mixes for road construction

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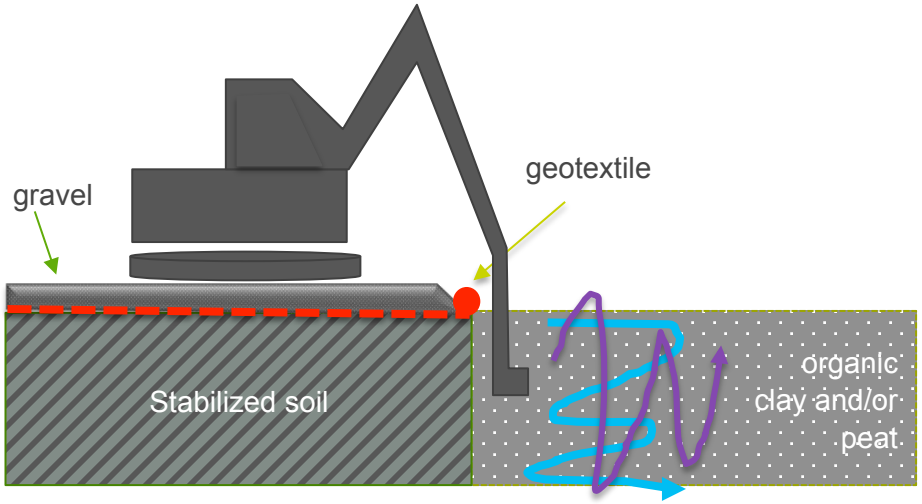

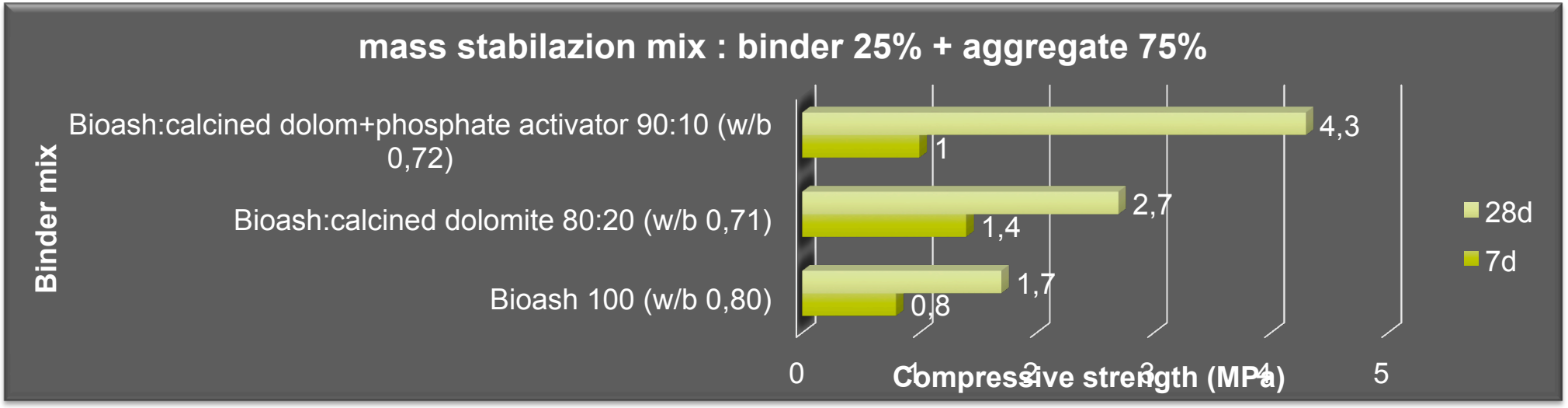

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