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Geopolymers for the Retrofit of Historic Buildings

A Sustainable Technological Solution

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Core Concept

Many buildings of outstanding historical and architectural value in Italy are protected by heritage regulations. However, there is also a vast stock of "minor" historic buildings which, although not subject to the same level of protection, deserve equal attention. These buildings are often inhabited by ordinary people who wish to preserve their historical character without sacrificing the comfort of modern living. In response to this needs we must ensure that the intervention has minimal impact and aligns with the nature of the monument and its original construction materials.

Therefore, we present here our research on an easily applicable solution, focusing specifically on thermal insulation.

A Geopolymeric Insulation Board

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- Not Flammable
- Good Insulating Chatacteristics
- Portland Cement – Free
- Compatible with materials used in the past
- Suitable for all historical finishes of all times
- Reversible
- 100% recyclable
- Possibly with the use of a certain amount of recycled material
- Pleasant and classic color – Like Cocciopesto *(Testa Tunsam)*
- Easy to use

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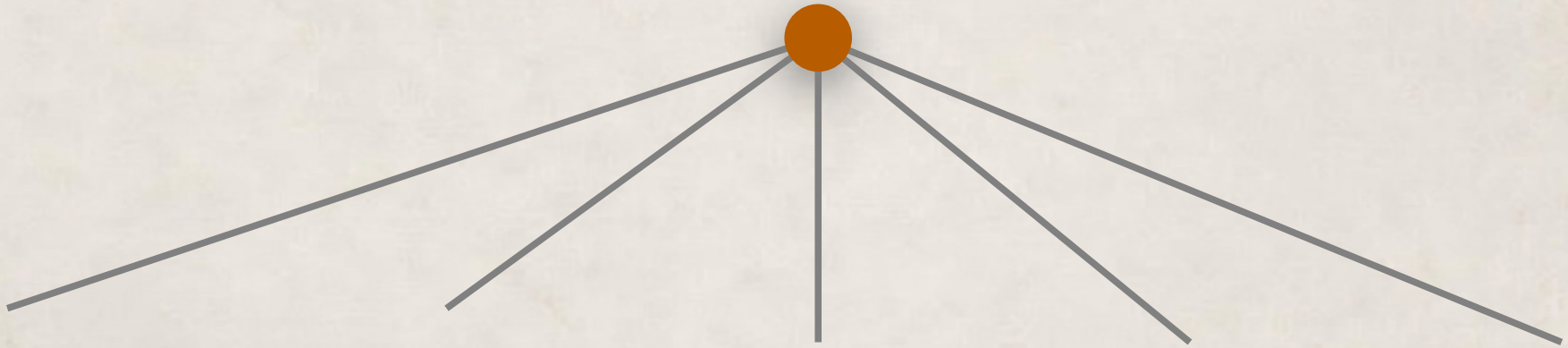
RAW MATERIALS



Potassium silicate

Red Metakaolin

Silica Filler

Poraver® *(Recycled Glass)*

Carbonatic Filler *(From Eggs)*

Porogenic Additive

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The Metakaolin

SiO_2 65 – 70 %

Al_2O_3 25 – 30 %

Fe_2O_3 < 3 %

K_2O < 0,2 %

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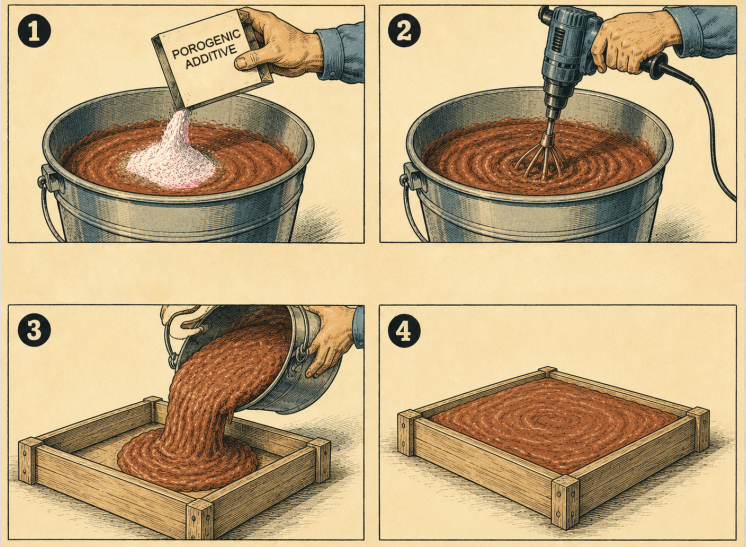

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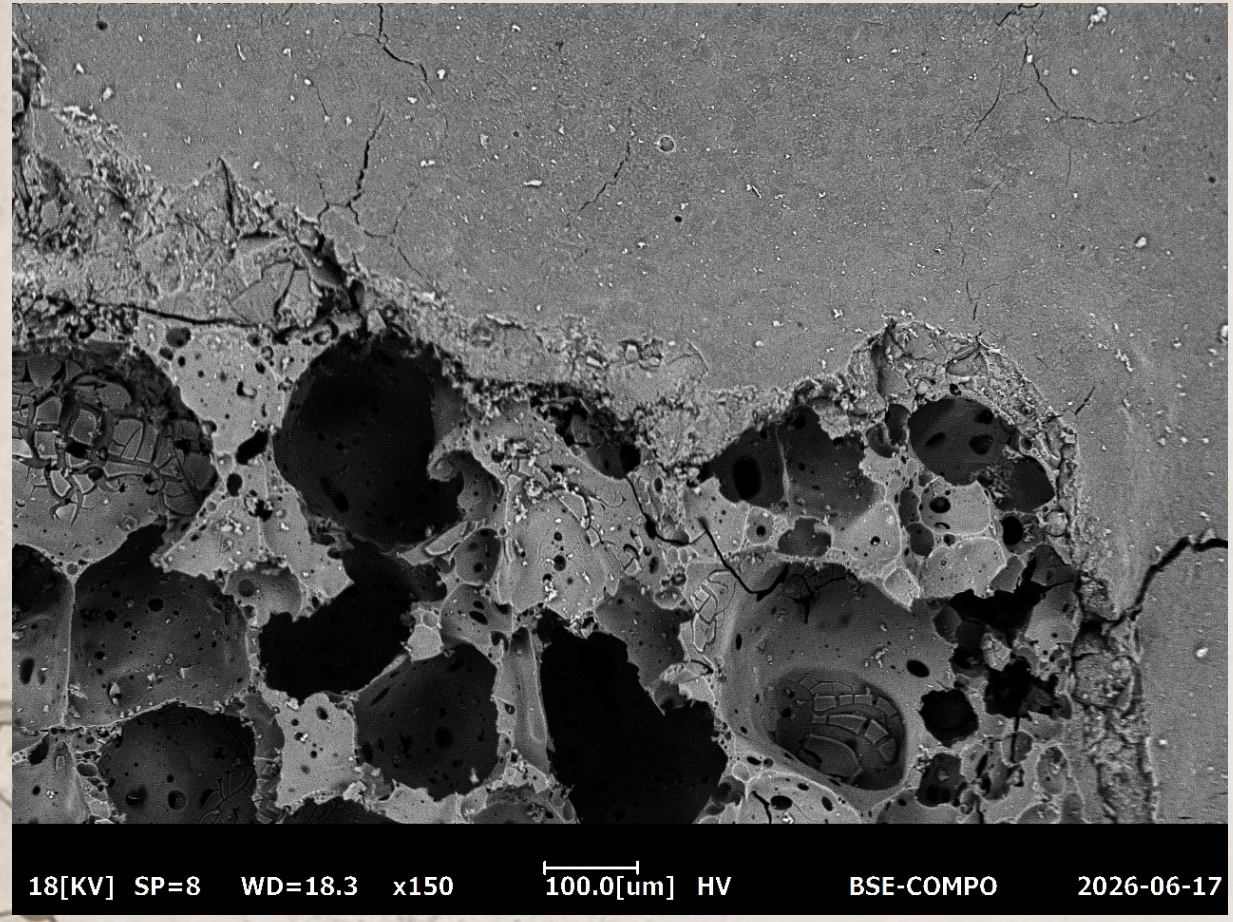
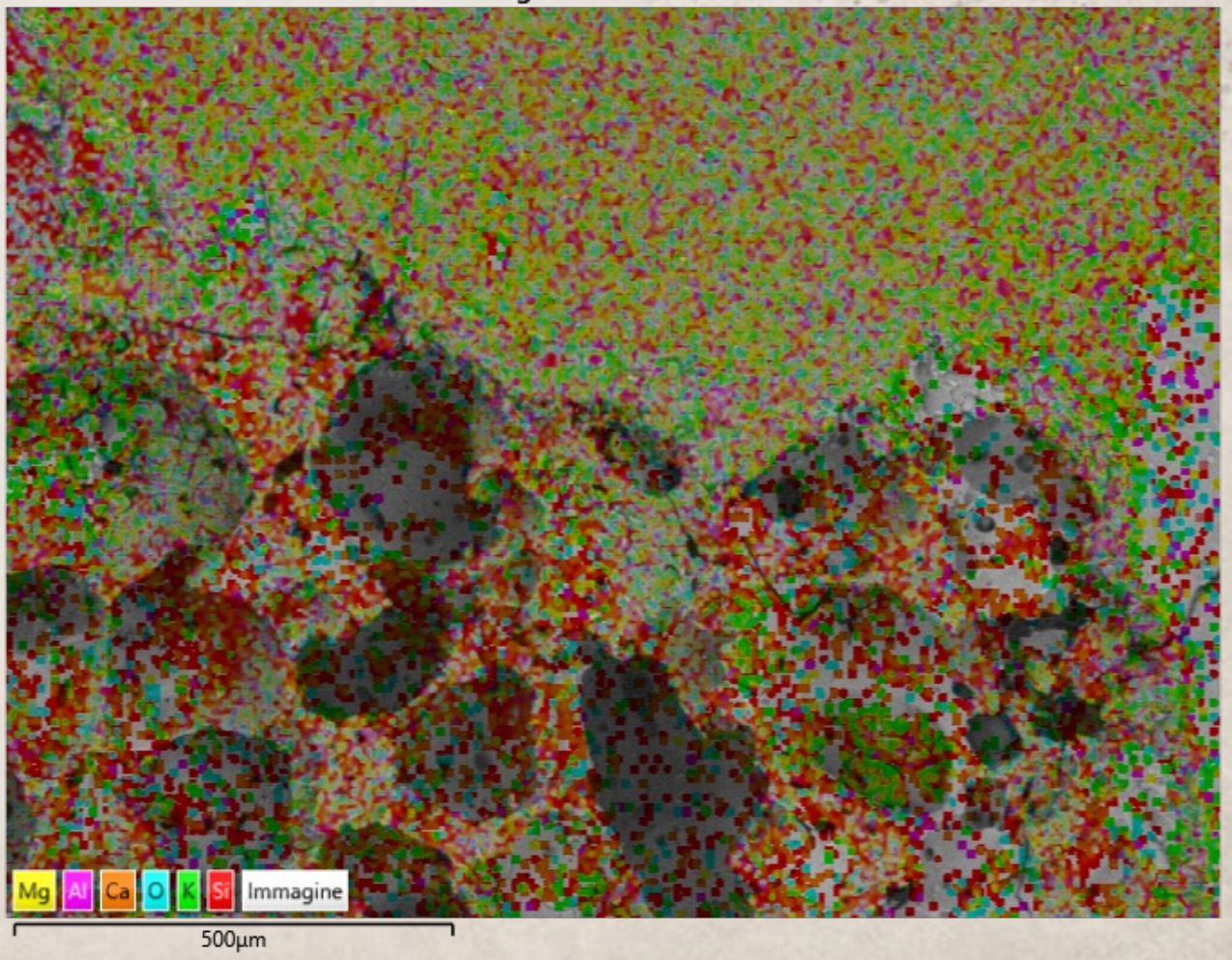


Immagine stratificata EDS 1



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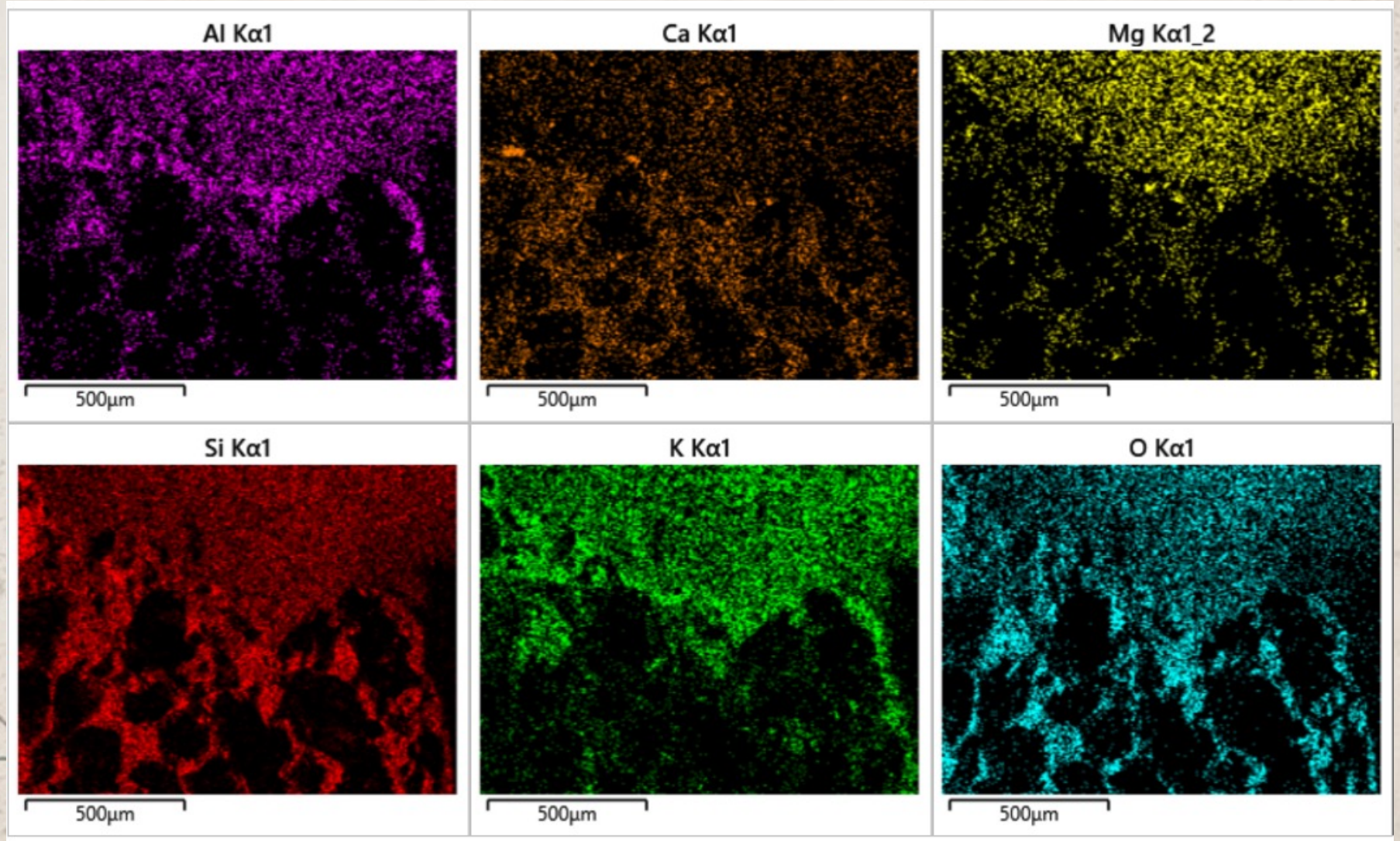

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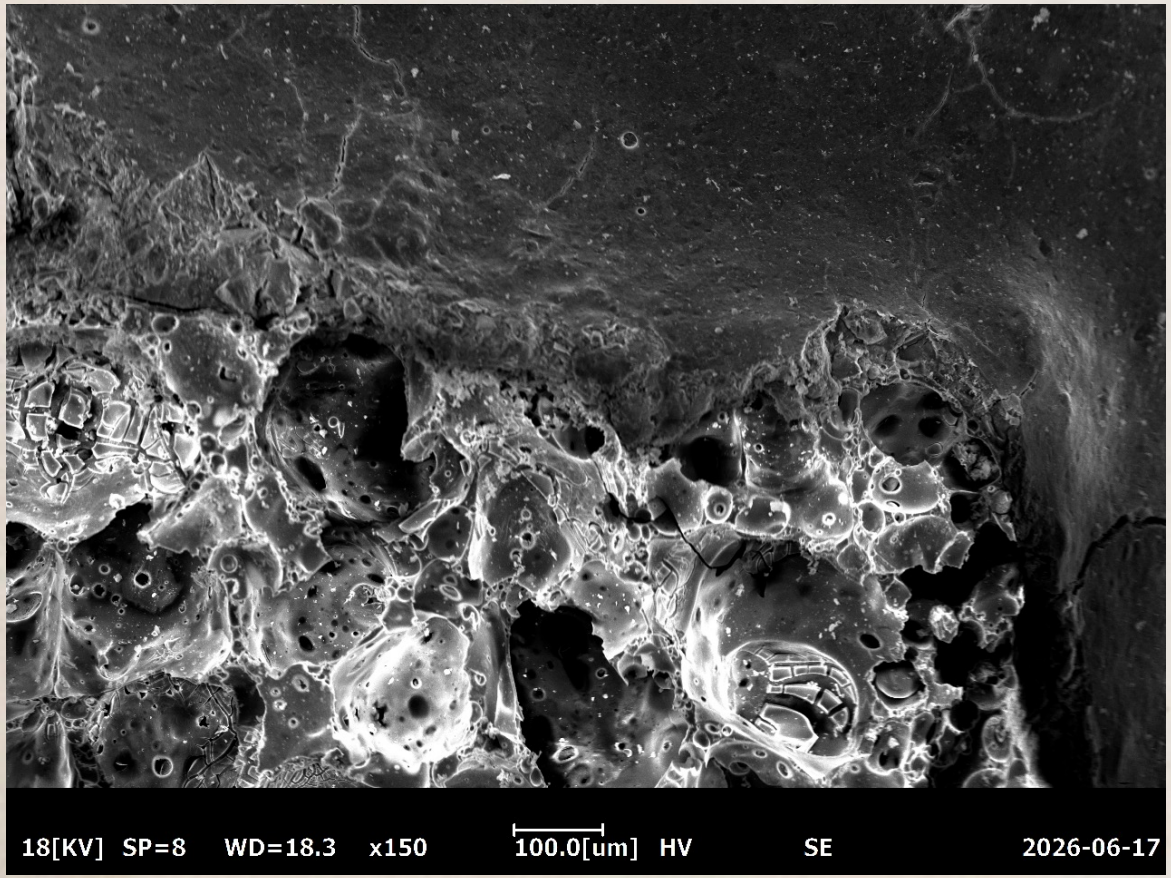

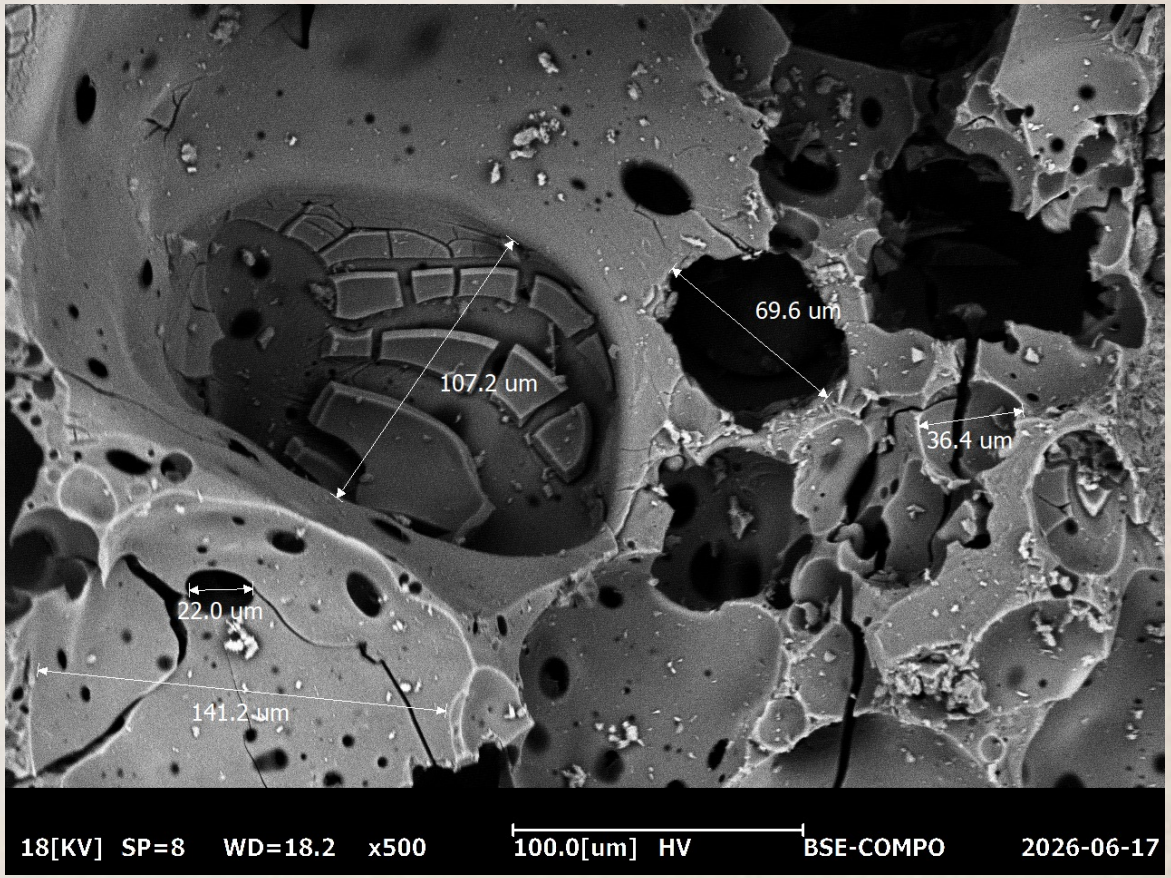

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Physical Properties

Density – UNI EN-1015-10 ~ 231 Kg/m^3

Compression Strenght – UNI EN 1015-11: 0,57 N/mm^2

- Good structural integrity;
- Reduced edge fragility compared to previous formulations;
- Improved dimensional stability;
- Good compatibility with fixing systems and finishing/rendering cycles.

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The Gepolymeric board was exposed to direct flame for a total duration of 3 minutes.

The observed results showed:

- No flame propagation;
- No melting or dripping phenomena;
- No visible structural degradation;
- Good surface stability after thermal exposure.

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Thermal conductivity

Sample	ρ	Measurement Range	α	c	c_p	λ
	$\frac{kg}{m^3}$	$\frac{W}{m \cdot K}$	$\frac{m\,m^2}{s}$	$\frac{MJ}{m^3 \cdot K}$	$\frac{J}{kg \cdot K}$	$\frac{W}{m \cdot K}$
FH-PA-20	228	0.04-0.3	0.29	0.18	803	0.054
FH-PA-21	232	0.04-0.3	0.54	0.09	392	0.049
FH-PA-22	237	0.04-0.3	0.27	0.20	828	0.053
FH-PA-23	239	0.04-0.3	0.31	0.17	725	0.053
FH-PA-24	236	0.04-0.3	0.33	0.16	671	0.052
Average	234±4	0.04-0.3	0.35±0.10	0.16±0.04	684±156	0.052±0.002

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Vapour diffusion

Water vapour transmission properties. The table reports for each specimen: density (ρ), water vapour diffusion-equivalent air layer thickness (Sd), and water vapour diffusion resistance factor (μ). Uncertainties (k=2) are also reported.

Sample	ρ	μ	S_d
	kg/m³	-	m
PA 0	226.0	2.2	0.07
PA 1	225.6	2.3	0.07
PA 2	233.7	2.2	0.07
Average (Dry)	228.4 ± 2.6	2.2 ± 0.0	0.07 ± 0.00

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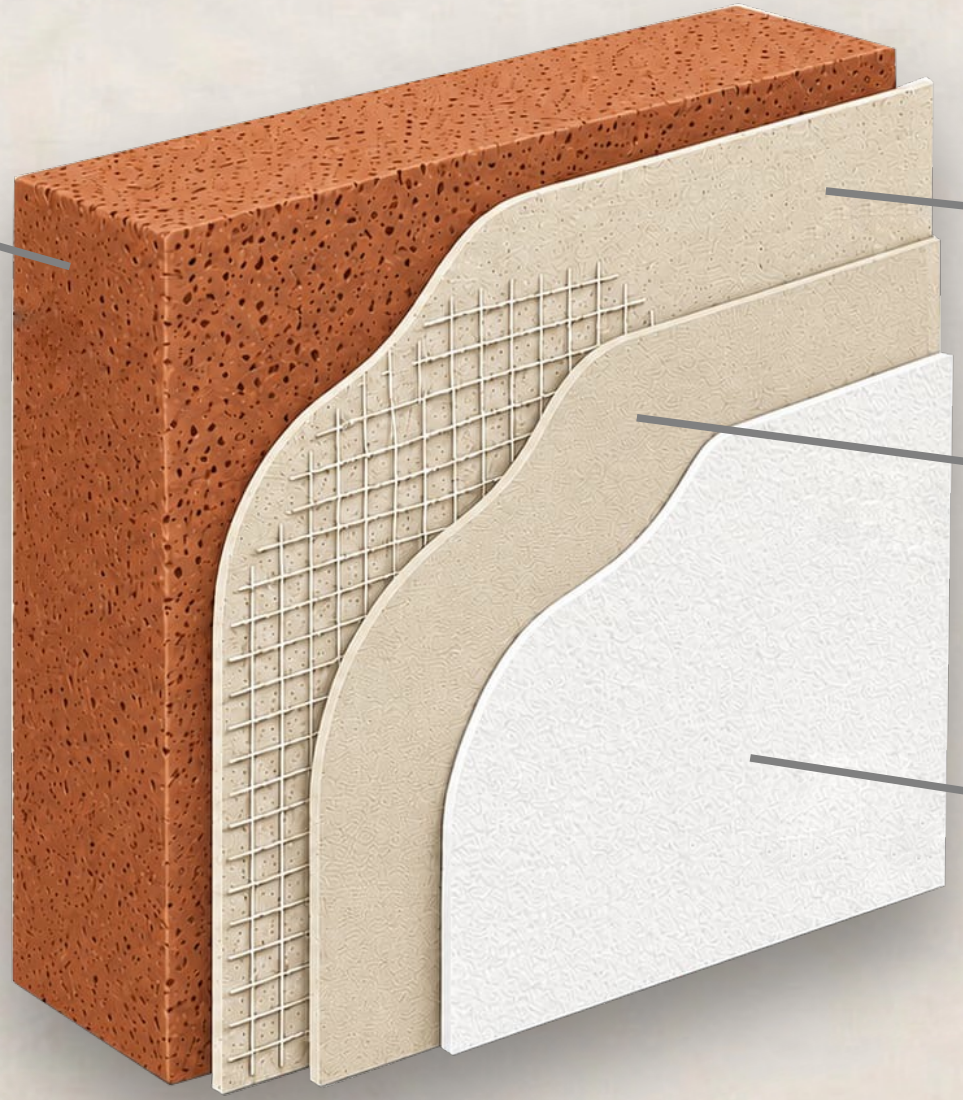
GEOPOLYMERIC INSULATION BOARD



POZZOLANIC LIME SKIN COAT
Alkali Resistant Mesh

SECOND LAYER OF POZZOLANIC LIME SKIN COAT

POTASSIUM SILICATE PAINT

Thank you for your time and attention!

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