



## LiComPerl

**DEVELOPMENT OF COMPOSITE LIGHTWEIGHT MATERIALS WITH UPGRADED  
PHYSICOCHEMICAL FUNCTIONALITY AND IMPROVED ECONOMIC FEASIBILITY**

**PI Annual Meeting Sept. 14<sup>th</sup> – 15<sup>th</sup> 2021**



Perlite Institute  
Associate member

# Project's Scope (I)

Acquire know-how on the development of composite lightweight materials, which can be applied to a variety of materials and applications:

- ▶ Perlite substrates of different particle size distributions (coarse, medium, fine, ultrafine expanded grains) expanded at different conditions
- ▶ Multi-functional materials of various physicochemical characteristics as coatings, e.g. inorganic and/or organic, photocatalytic, nano-materials
- ▶ Different preparation techniques: coating and/or impregnation



VTCA based on optimization of physicochemical functionality and therefore economics.

# Project's Scope (II)

## Applications:

- ▶ **Construction: lightweight & insulation**
  - ▶ Functional material: Aerogel, PCMs
  - ▶ Perlite grades: fine, medium, coarse
- ▶ **Environmental: Photocatalysis, oil & dye removal, water treatment (heavy elements)**
  - ▶ Functional material: nano-  $\text{TiO}_2$  &  $\text{ZnO}$ , alginate, emulsifiers, chitosan
  - ▶ Perlite grades: medium, coarse, fine, ultra fines
- ▶ **Agriculture: hydroponics, soil beneficiation**
  - ▶ Functional materials: zeolite, nutrients
  - ▶ Perlite grades: coarse, medium

# Work up to date (I)

## ➤ **Materials preparation**

- Coarse (2.5/1.2), Medium (1.2/0.5), Fines (0.3/0.075), Ultra-Fines ( $-63\ \mu\text{m}$ )

\* The presented results and observations concern the tested materials.

## ➤ **Module for microspheres expansion**

## ➤ **Expanded materials with different physical properties**

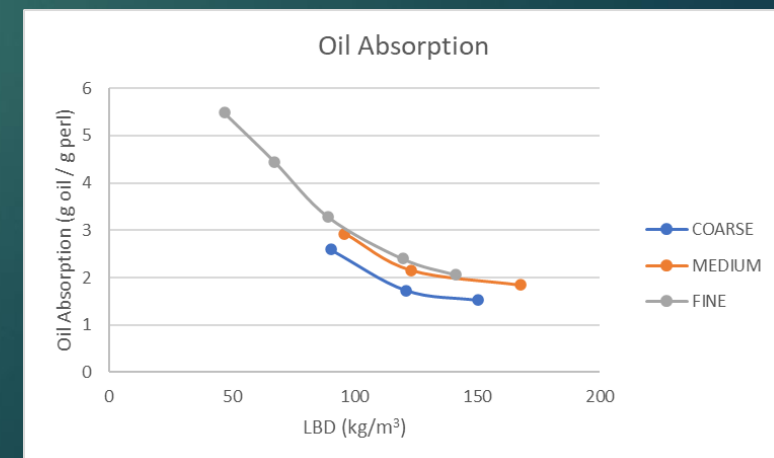
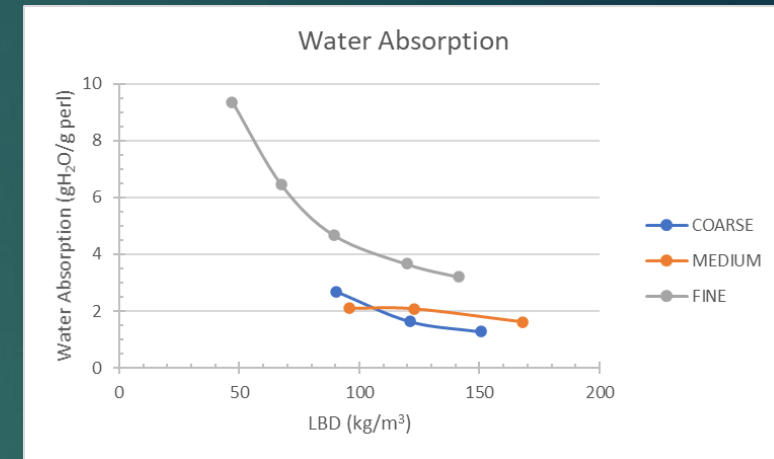
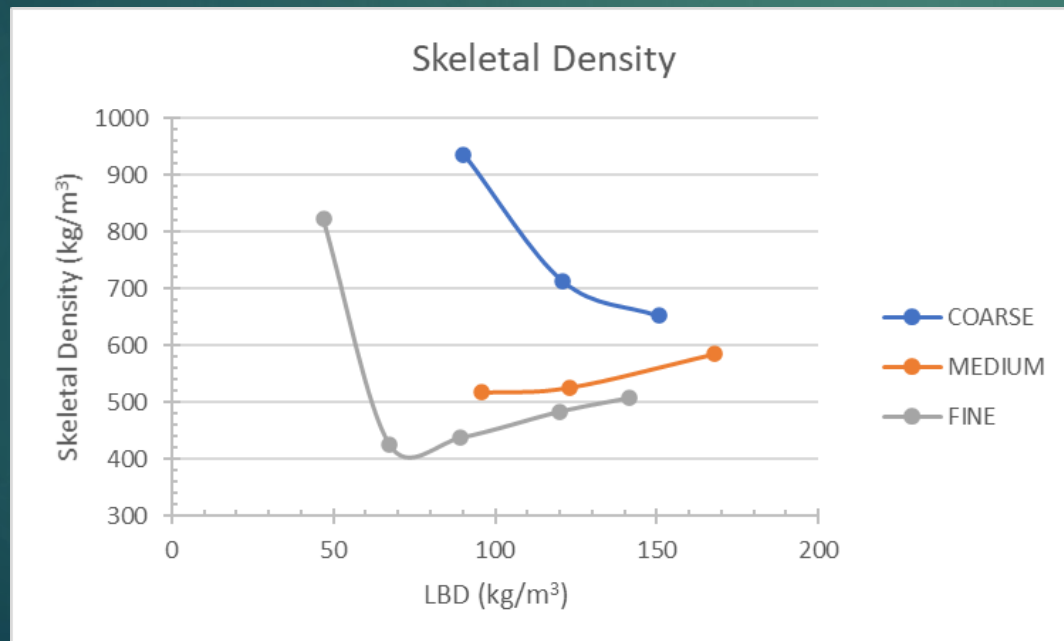
- Loose Bulk Density – LBD
- He- apparent density (Skeletal Density → Open/closed Structure)
- Sinks-Shattered-Floats – %v/v SSF
- Mechanical properties (Compressibility, attrition, coverage)
- Water & Oil absorption
- Optical - SEM observation



# Work up to date (II)

## Expanded materials with different physical properties

- Coarse 90 – 120 – 150 kg/m<sup>3</sup>
- Medium 110 – 130 – 170 kg/m<sup>3</sup>
- Fine 45 – 70 – 90 – 120 – 140 kg/m<sup>3</sup>

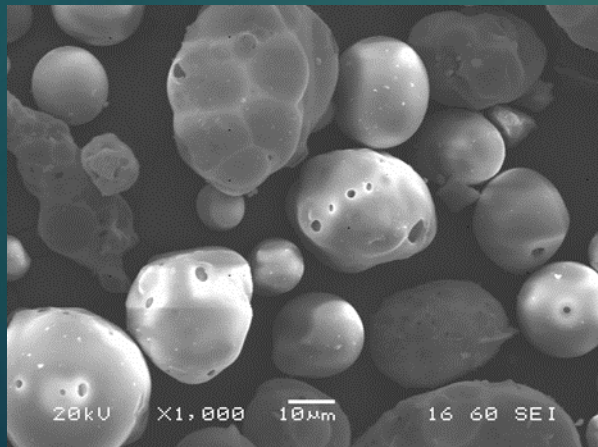


# Work up to date (III)

## Expanded materials with different physical properties

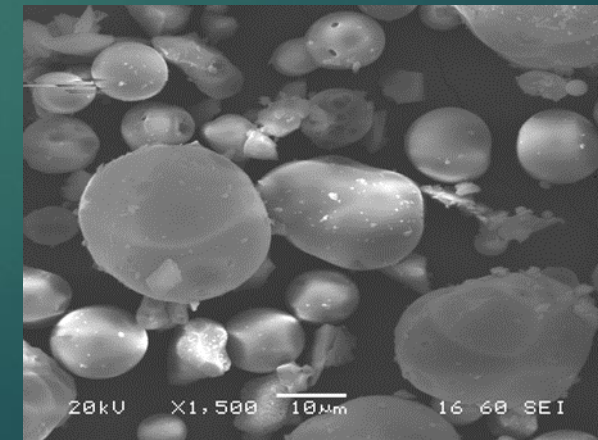
- Ultra fines -63 $\mu$ m ( $D_{63}$  20 & 10  $\mu$ m)
  - Optimum expansion conditions to 200 – 240 kg/m<sup>3</sup>

Κωδικός	LBD	Coverage Test	Compresibility	Oil Absorption		Skeletal Density
				(g oil/g perlite)	(g oil/100cc perlite)	
ULTRA FINE	(kg/m <sup>3</sup> )	(%)	(%)			(kg/m <sup>3</sup> )
PE-20012/4-20	216	72.8%	34.6%	1.17	25.7	1214.2
PE-20012/6-10	242	76.0%	30.9%	0.94	22.7	1237.4



PE-20012/4-20

PE-20012/6-10





# Decision Making for Next Steps

## Next Steps:

- ✓ Preparation of composite samples
- ✓ Evaluation of the technical & economic feasibility

## Qualitative Screening:

- ✓ Employed grade:
  - ✓ Final application (e.g. ultra fines for photocatalytic plasters, medium or coarse for aerogel/perlite insulation)
- ✓ Impregnation / Coating Technique
  - ✓ Open / Closed Structure: CSP for coatings, OPS for impregnation

## Quantitative Criteria for choosing the expanded grades:

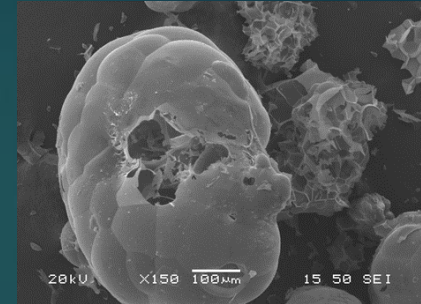
- ✓ Final application
- ✓ Technical data



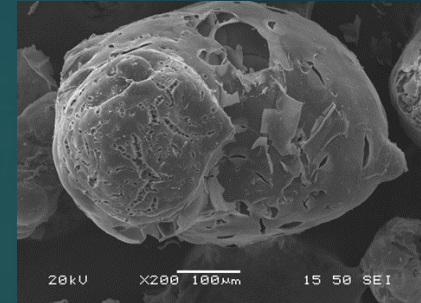
**VTC Analysis**

## Expanded Fine Grades

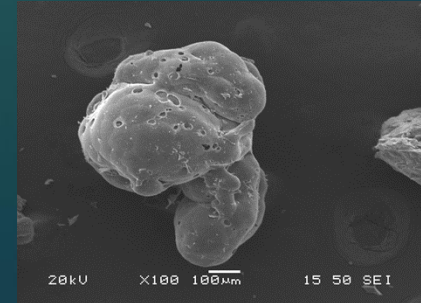
**45 kg/m<sup>3</sup>**



**90 kg/m<sup>3</sup>**



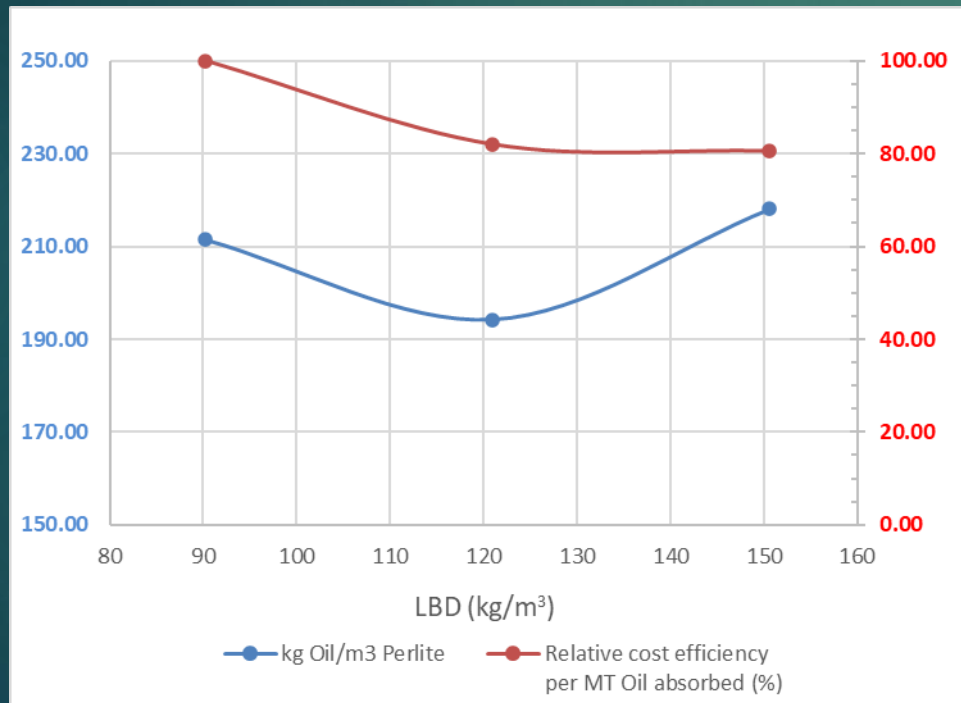
**140 kg/m<sup>3</sup>**



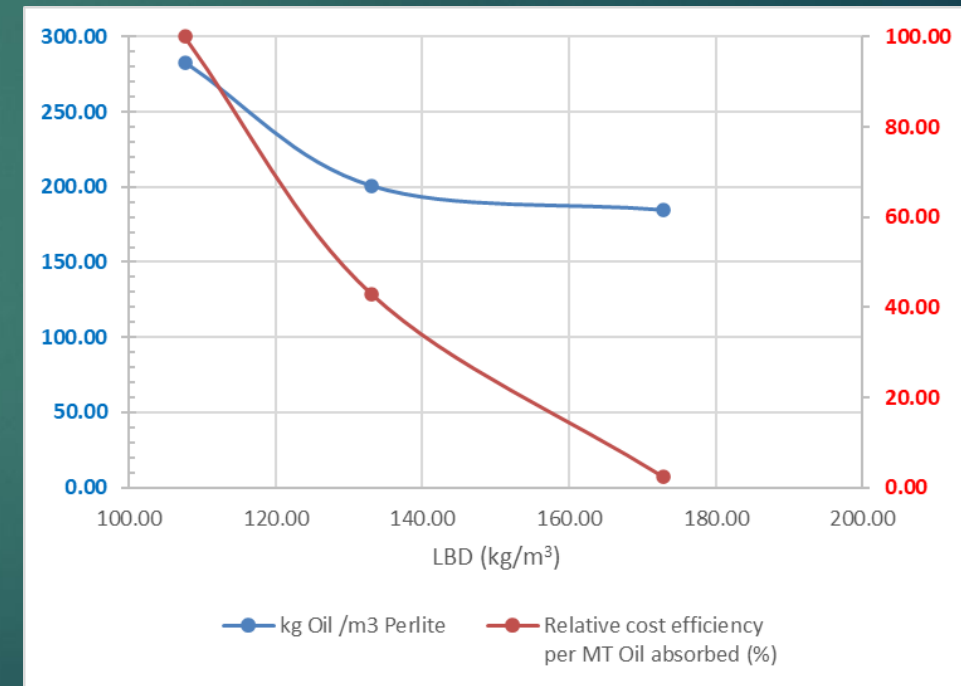
# VTCA: “Oil Absorption Case” (I)

- Perlite substrate acts as an oil absorbent
- Composite: with nano-absorbents / emulsifiers

PE-20012/1 Coarse



PE-20012/2 Medium



Reference: Coarse 90 kg/m³, Medium 110 kg/m³



# VTCA: “Oil Absorption Case” (II)

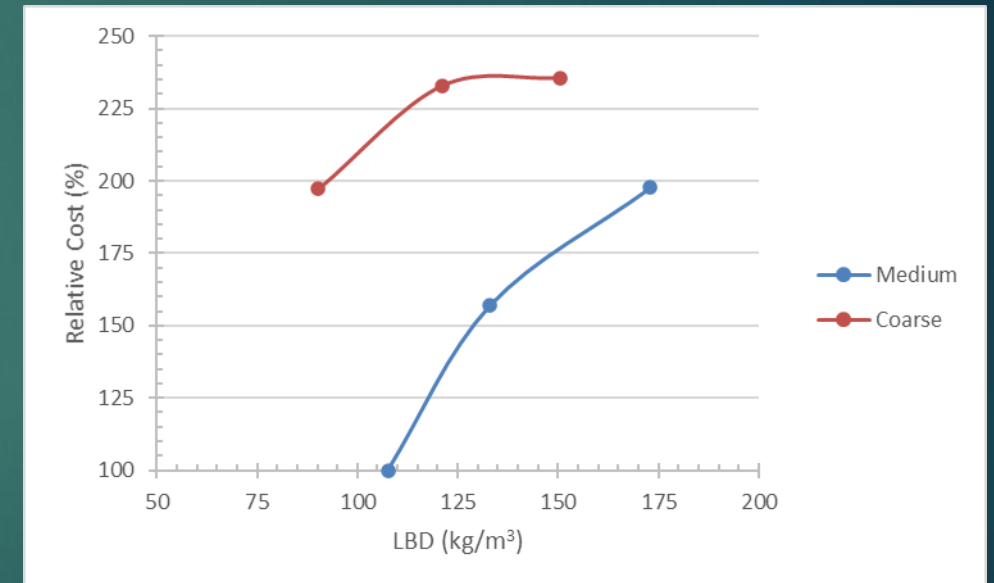
## Comparison of different grades

- Medium grades: higher efficiencies due to increased oil absorption
- Coarse grades: qualitative advantages (easier handling, booms construction etc.)



## Further Testing

- Medium grade 110 kg/m<sup>3</sup>
- Coarse grade 90 kg/m<sup>3</sup>



Reference: Medium 110 kg/m<sup>3</sup>

# Acknowledgements

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# Thank you for your attention



## **Innovative Insulating & Inorganic Materials Laboratory**

Lavrion Technological & Cultural park, P.O. Box 504, 195 00, Lavrion, Greece

T: +30 2292 300659, M: +30 69747538 & +30 6977692680

e-mail: [info@in-mat-lab.eu](mailto:info@in-mat-lab.eu)

Website: [www.in-mat-lab.eu](http://www.in-mat-lab.eu)

You can also follow us in LinkedIn: <https://www.linkedin.com/company/in-mat-lab>