



LiComPerl

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

PI Annual Meeting Sept. 14th – 15th 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- TiO_2 & 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

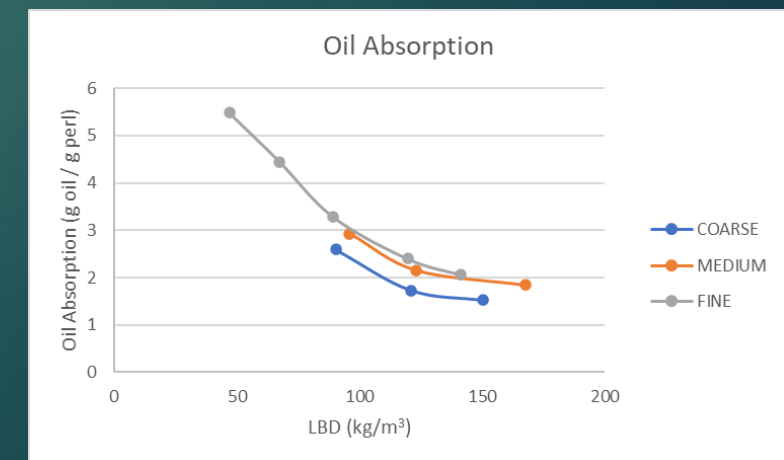
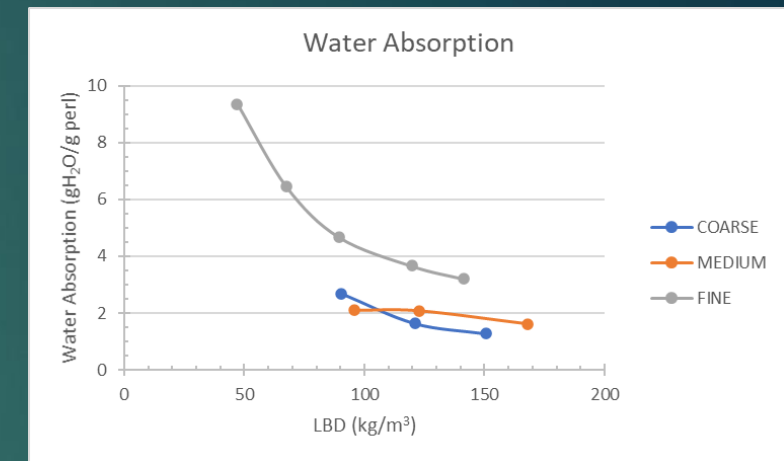
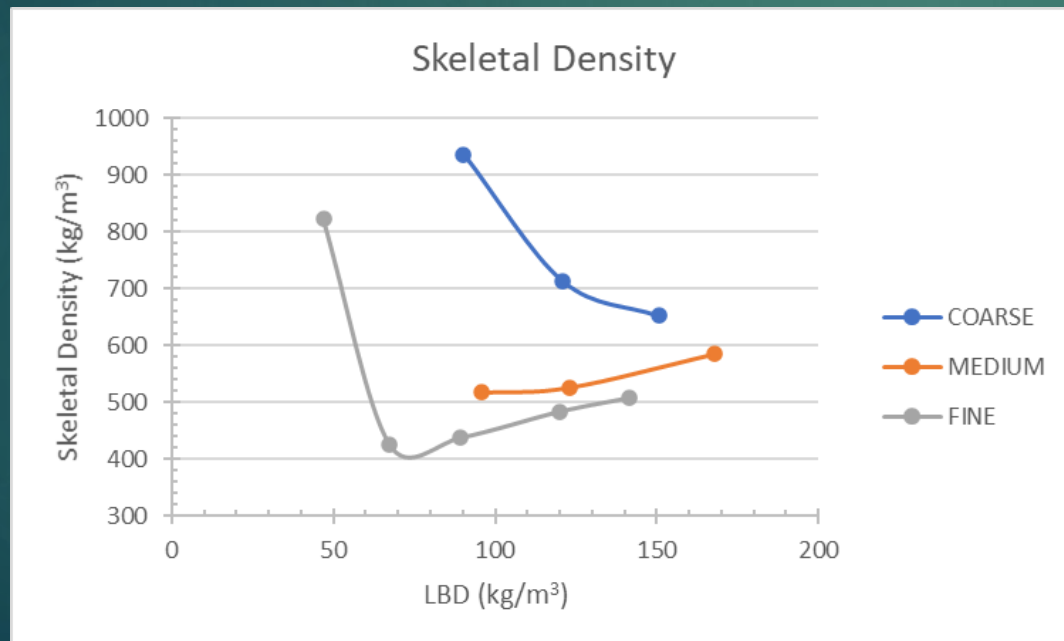
- Loose Bulk Density – LBD
- He- apparent density (Skeletal Density → Open/closed Structure)
- Sinks-Shattered-Floats – %v/v SSF
- Mechanical properties (Compressibility, attrition, coverage)
- Water & Oil absorption
- Optical - SEM observation



Work up to date (II)

Expanded materials with different physical properties

- Coarse 90 – 120 -150 kg/m³
- Medium 110 – 130 – 170 kg/m³
- Fine 45 – 70 – 90 – 120 – 140 kg/m³

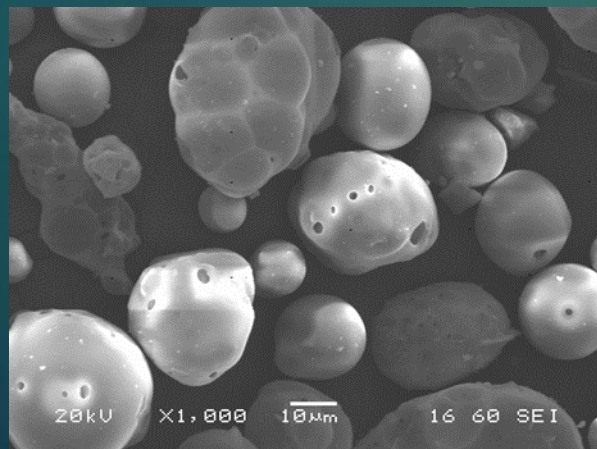


Work up to date (III)

Expanded materials with different physical properties

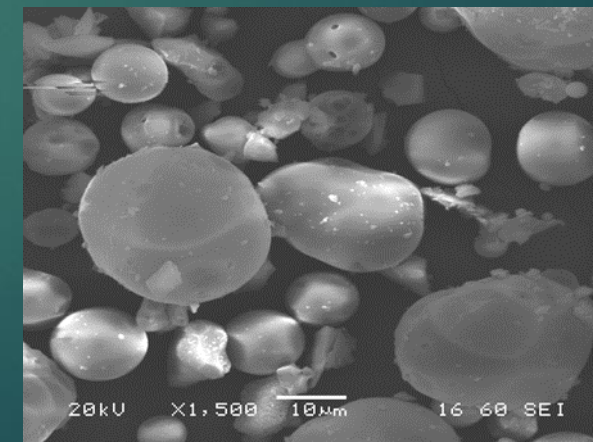
- Ultra fines -63 μ m (D_{63} 20 & 10 μ m)
 - Optimum expansion conditions to 200 – 240 kg/m³

Κωδικός	LBD (kg/m ³)	Coverage Test (%)	Compresibility (%)	Oil Absorption		Skeletal Density (kg/m ³)
				(g oil/g perlite)	(g oil/100cc perlite)	
ULTRA FINE						
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:

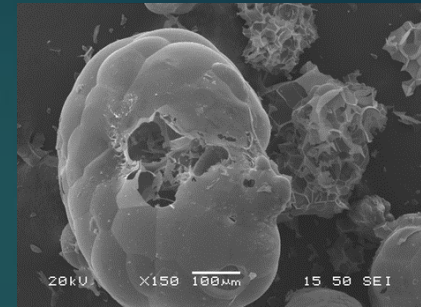
- ✓ Final application
- ✓ Technical data



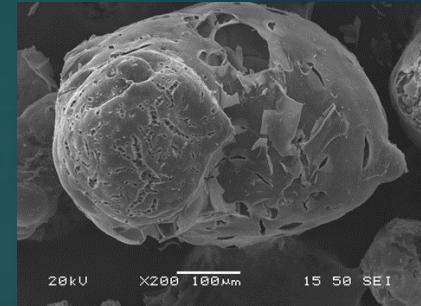
VTC Analysis

Expanded Fine Grades

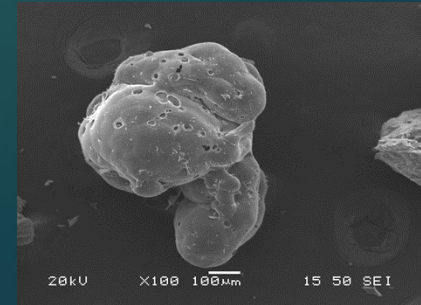
45 kg/m³



90 kg/m³



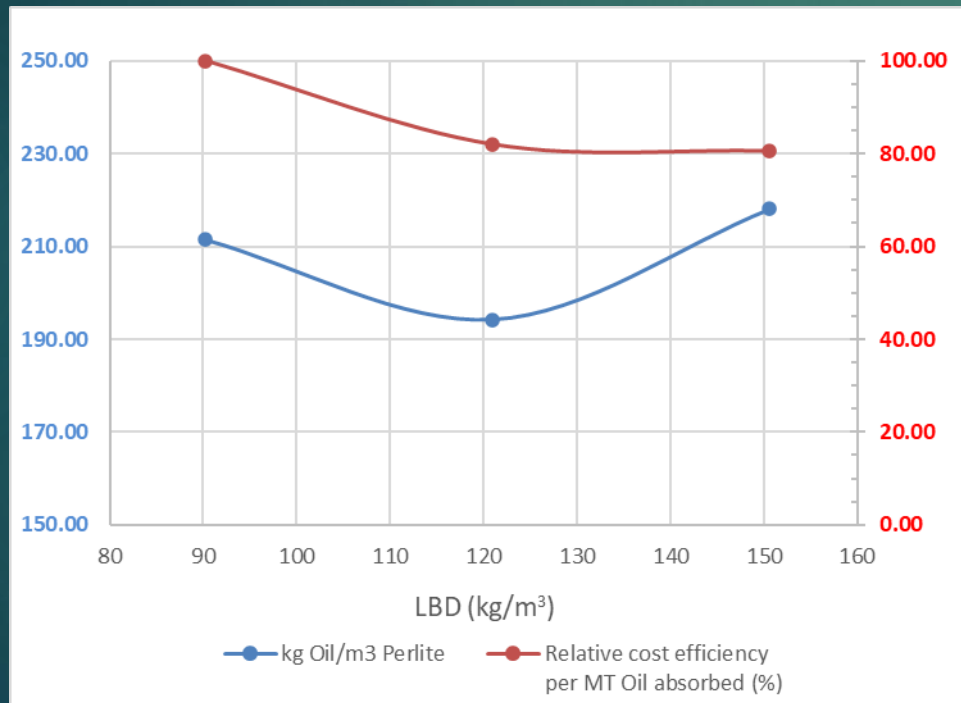
140 kg/m³



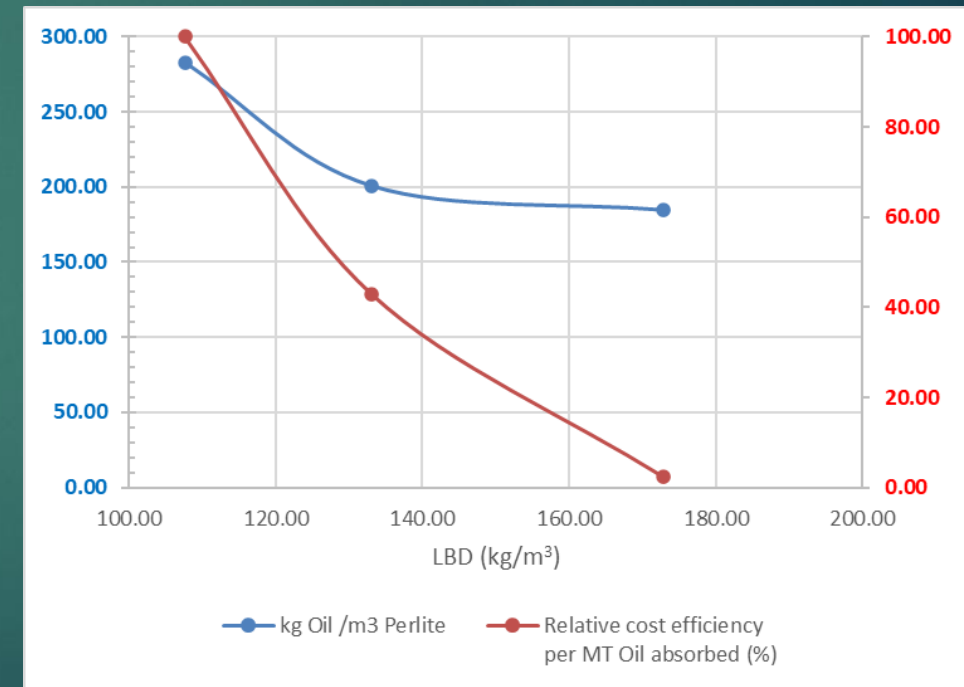
VTCA: “Oil Absorption Case” (I)

- 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)

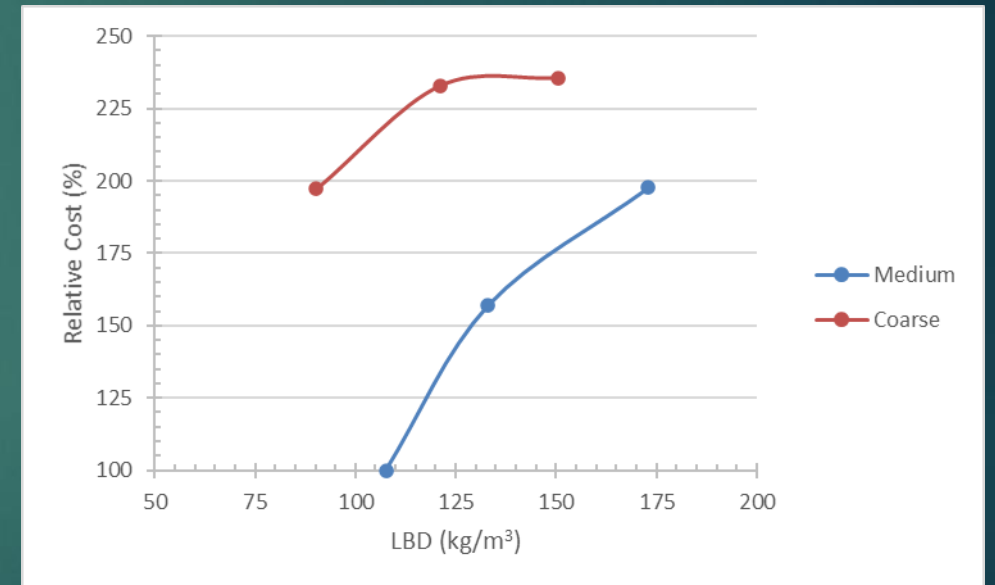
Comparison of different grades

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



Further Testing

- Medium grade 110 kg/m³
- Coarse grade 90 kg/m³



Reference: Medium 110 kg/m³

Acknowledgements

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Thank you for your attention



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