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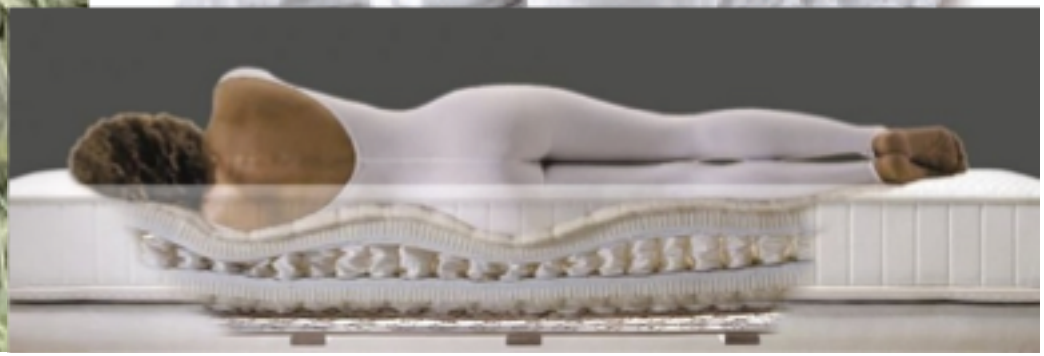
Progress through performance

The future of comfort cushioning, ...a future beyond foam?

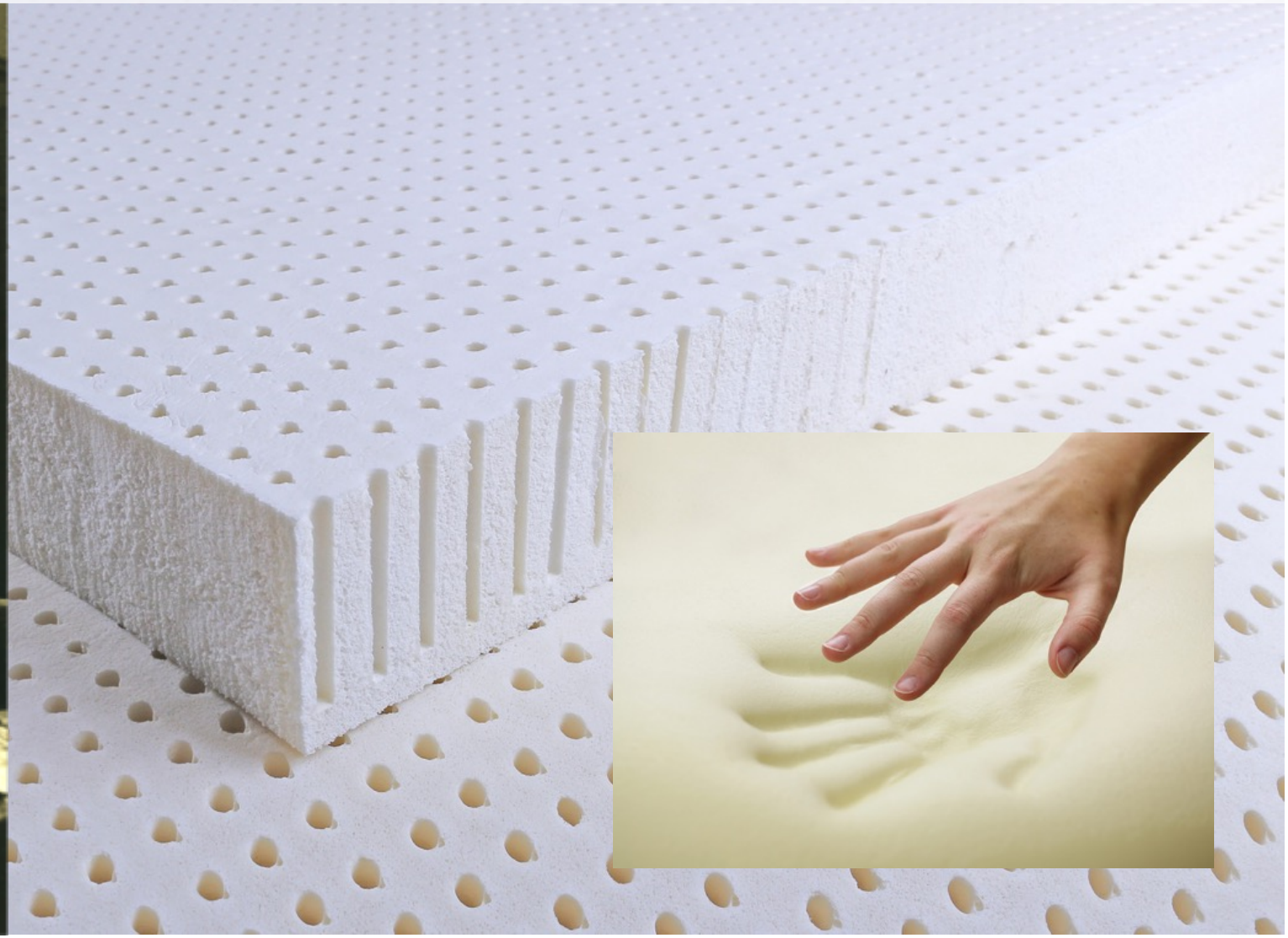
Leo Smit, Döne Yesildag, Jan Mahy
New Ventures Team


Cushioning Areas

From natural materials ..... towards metal springs .....



…….. to FOAM as the workhorse in comfort cushioning



Challenges: Recycling

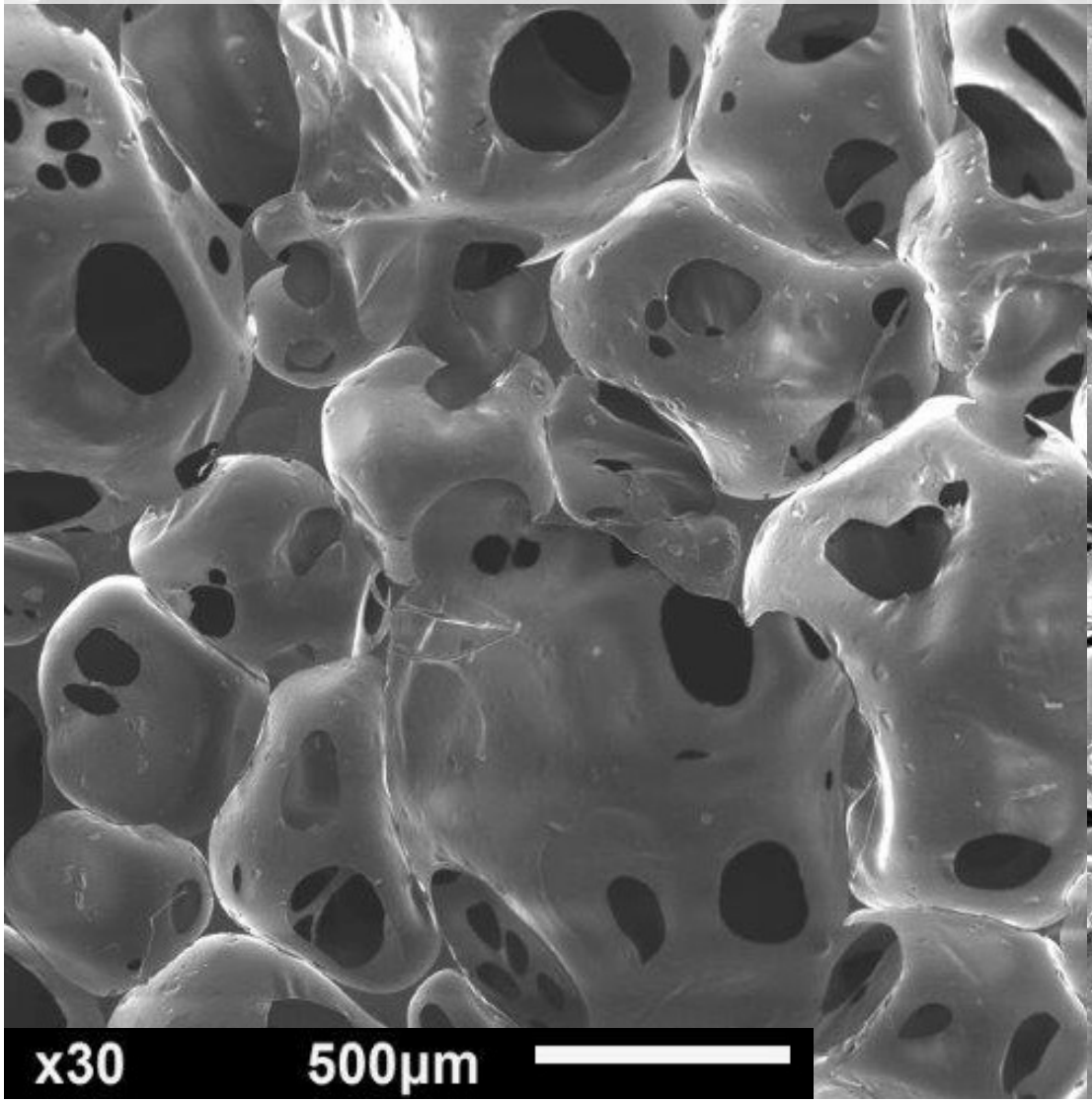
- Reduced performance
- Presence of legacy chemicals
- Availability of output markets
- Logistics (costs)

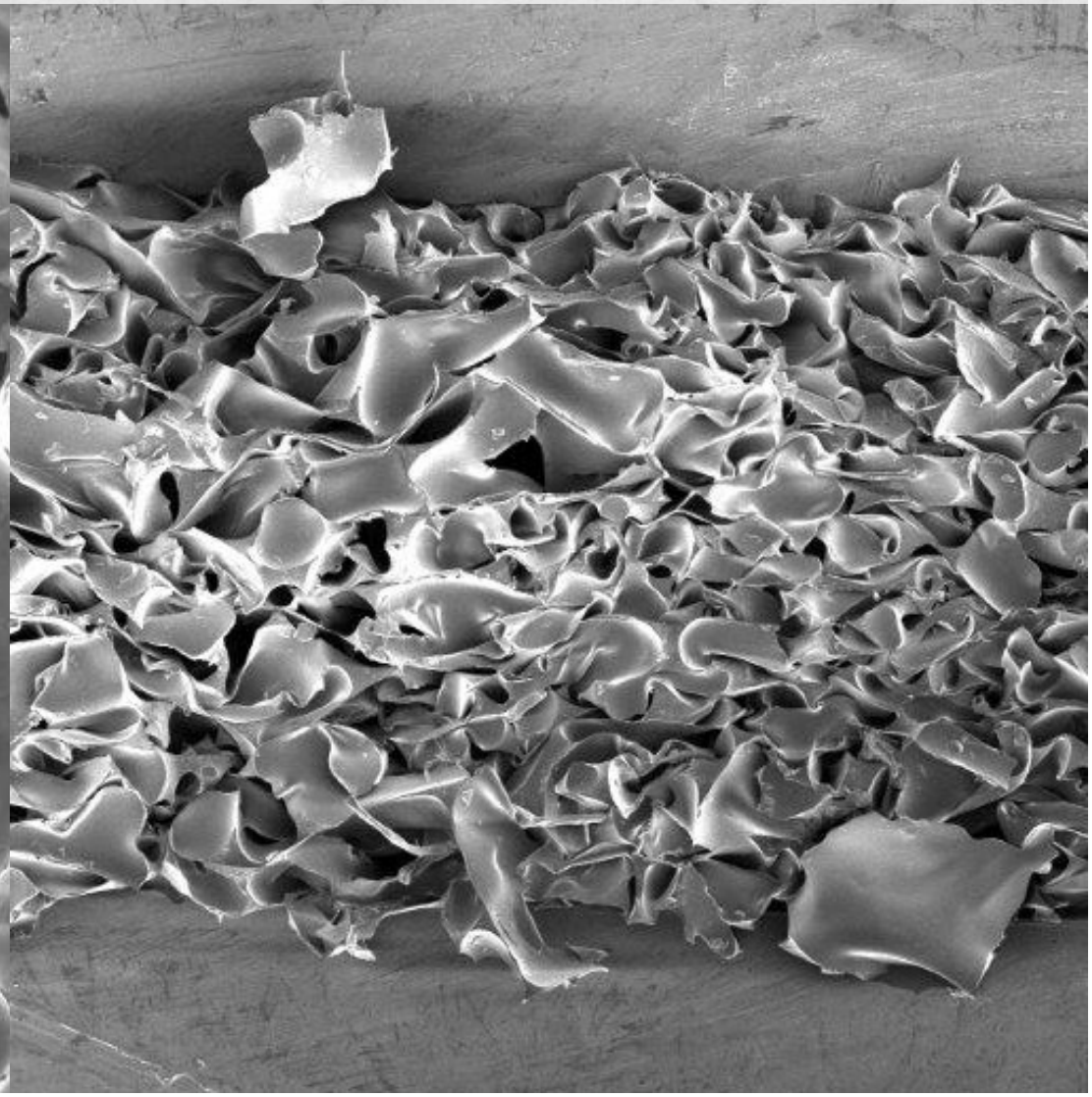
Data: EMPA Consult for Europur, 2012, Europe

Challenges: Hygiene – a growing concern

a human body is emitting up to 600 ml of moisture during eight hours of sleep. Excess moisture may cause hygienic problems and is nurturing dust-mite population.

Challenges: Ventilation





Challenges: Lightweighting in transportation

Fuel / Electricity saving
for
Cost/CO_2 reduction and range extension

Societal trends influencing cushioning applications

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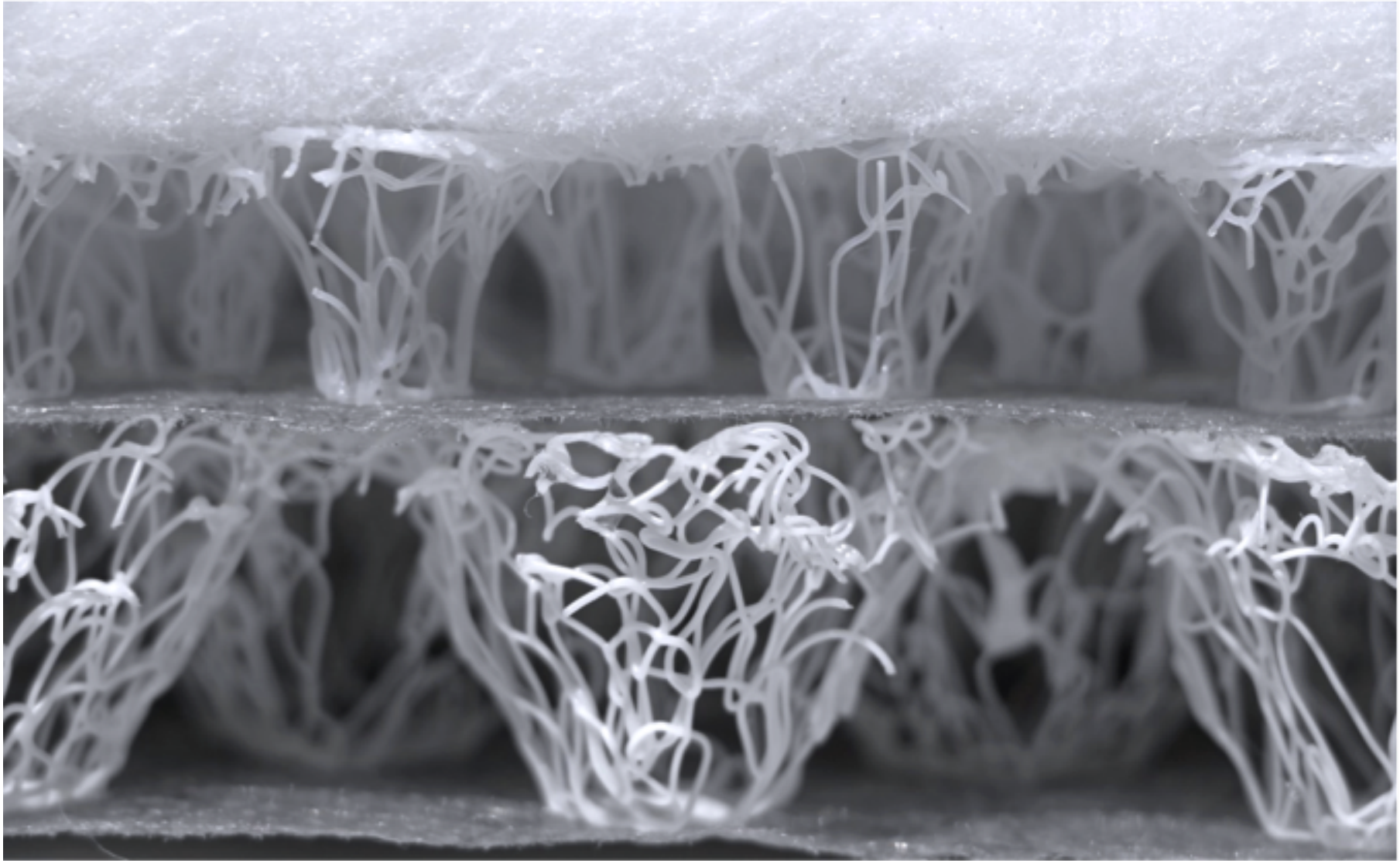
3D extruded filament mat
Honeycomb
Foam Substitution
3D knitted Spacer fabric
V-lap

Our approach: A novel Enkamat – V-lap sandwich structure



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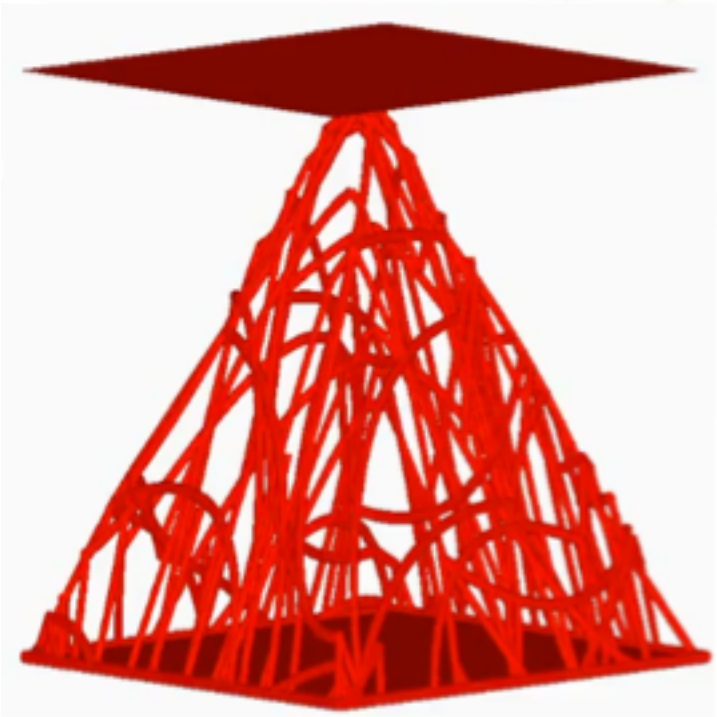
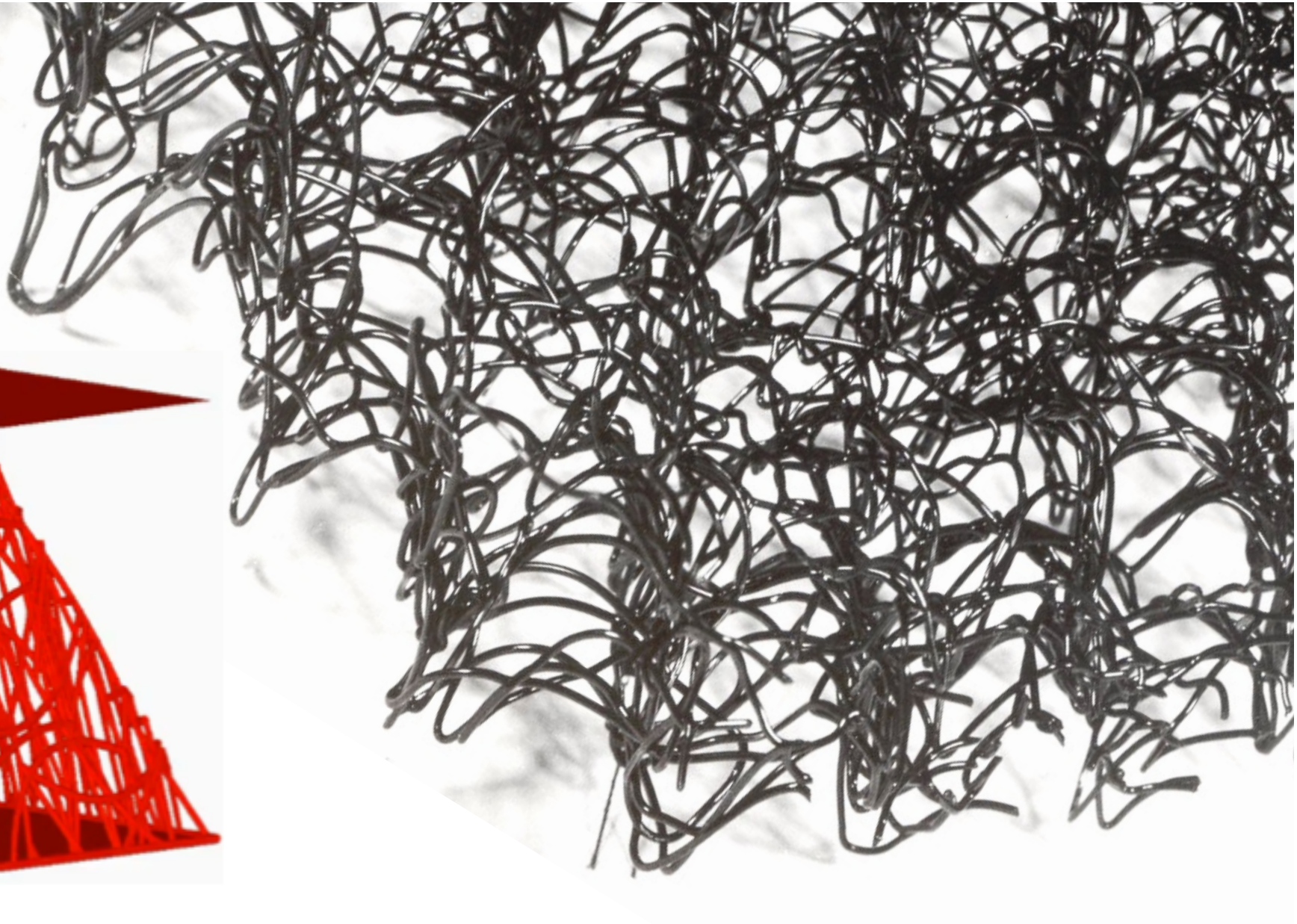
Enkamat®





Pyramidal truss structures excel in strength/weight ratio

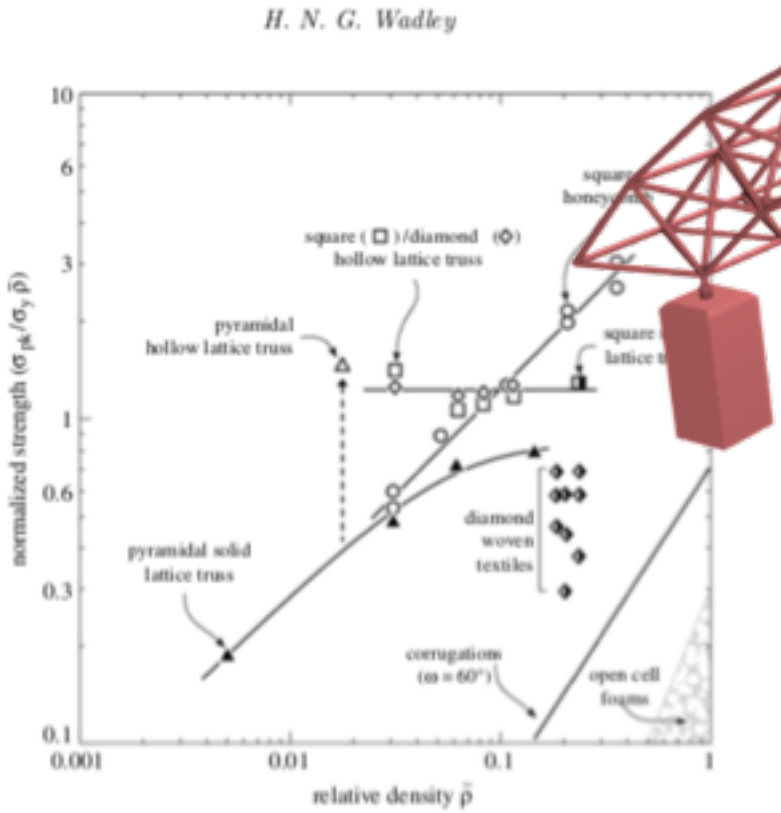
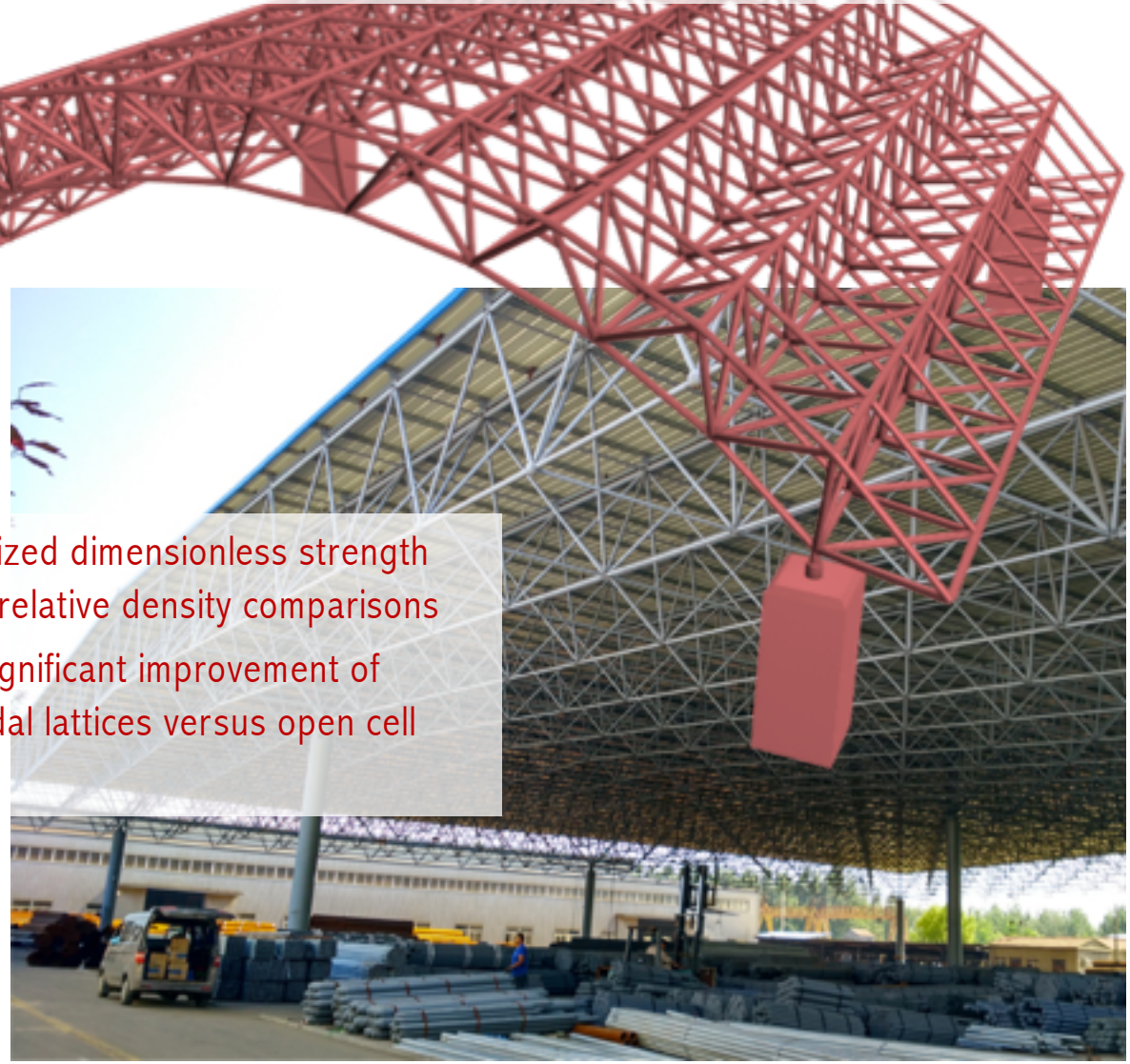


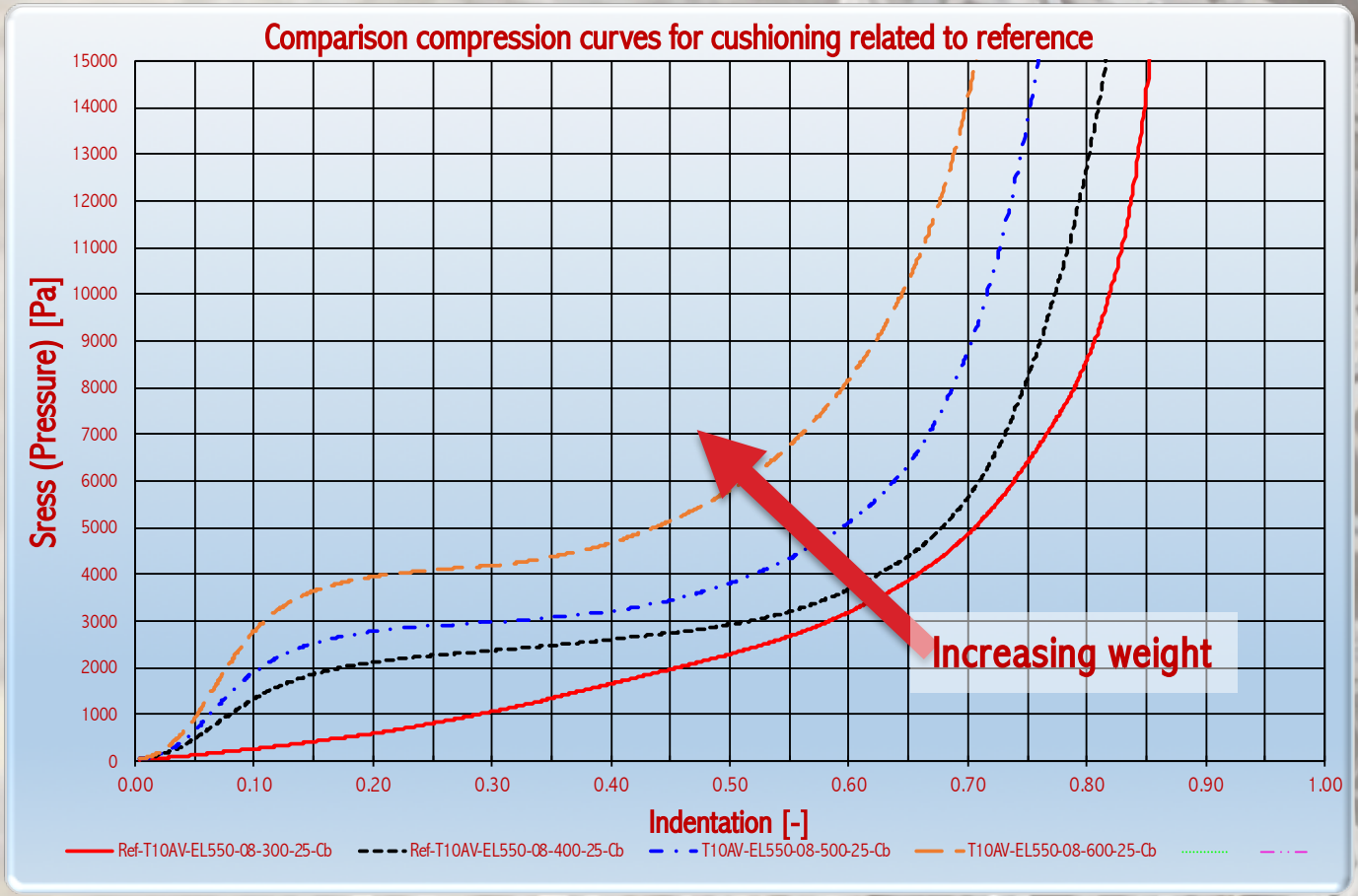
Figure 18. Normalized strength variation with relative density for cellular metals.



Normalized dimensionless strength versus relative density comparisons show significant improvement of pyramidal lattices versus open cell foams.

Multifunctional periodic cellular metals, Haydn N.G. Wadley,
Phil. Trans. R. Soc. A (2006) 364, 31–68 doi:10.1098/rsta.2005.1697 Published online 2 December 2005

Steerable properties



Compression resistance is steerable through multiple parameters:

- Weight
- Filament diameter
- Hardness polymer
- Pyramid shape

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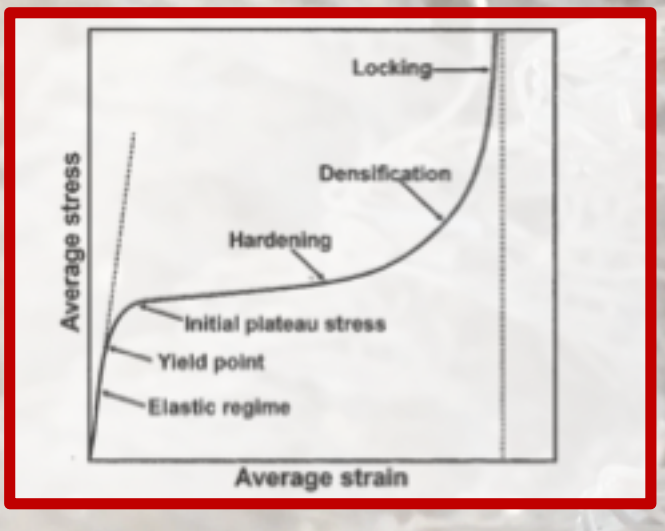
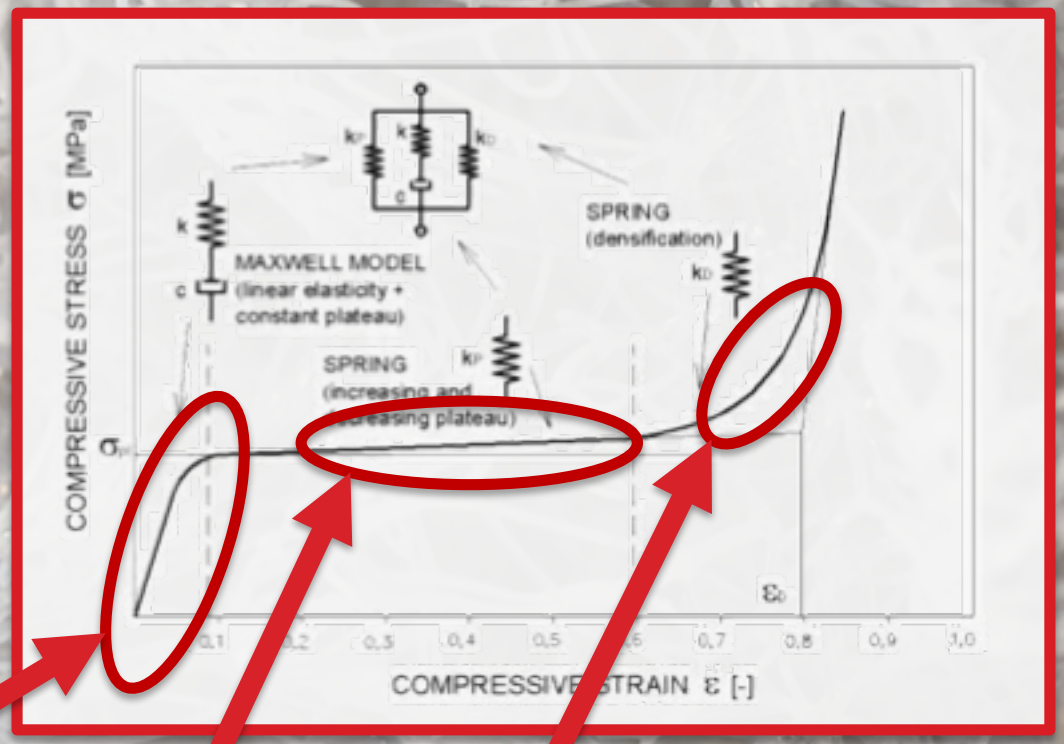
Compression model





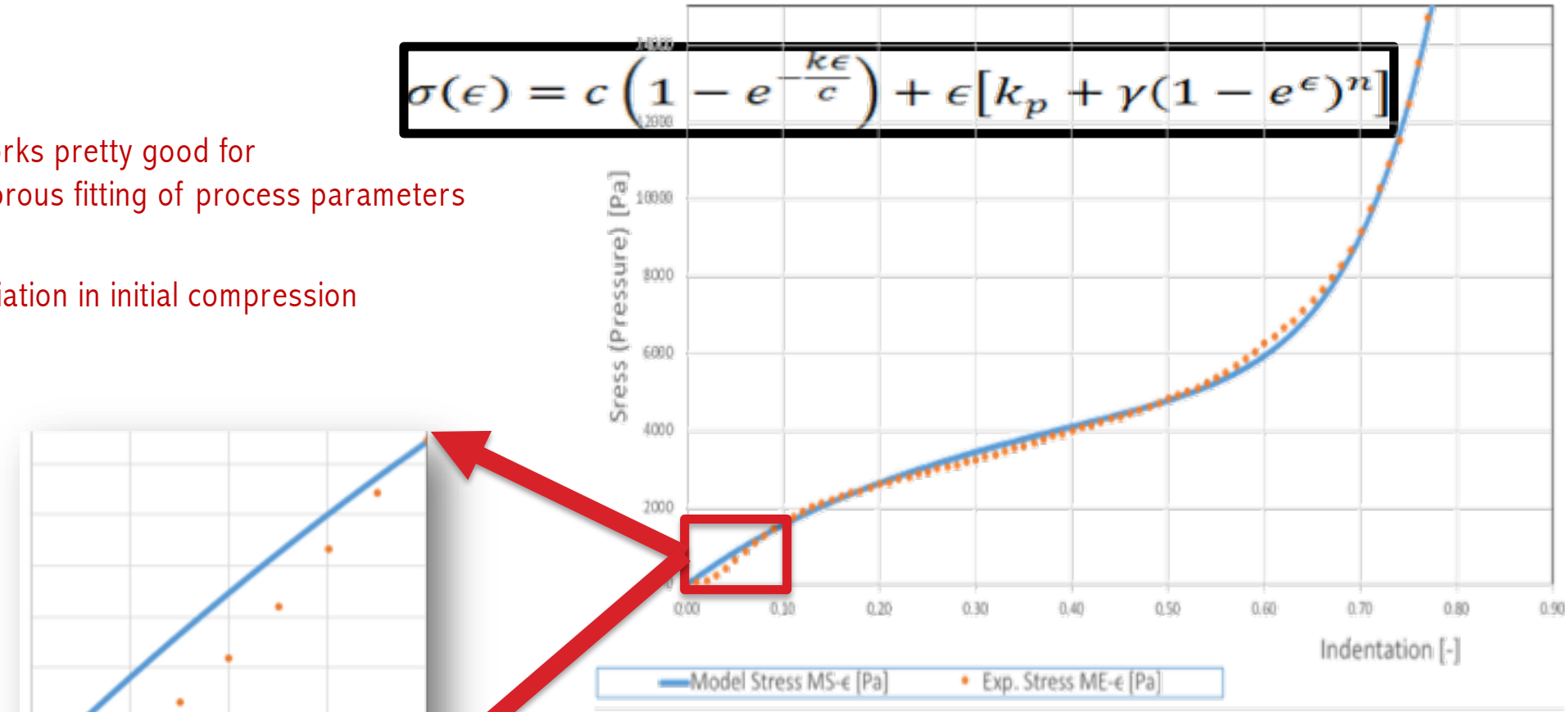
$$\sigma(\epsilon) = c\left(1 - e^{-\frac{k\epsilon}{c}}\right) + \epsilon\left[k_p + \gamma(1 - e^{\epsilon})^n\right]$$

Compression model

Model works pretty good for
rigorous fitting of process parameters

Main deviation in initial compression

$$\sigma(\epsilon) = c\left(1 - e^{-\frac{k\epsilon}{c}}\right) + \epsilon\left[k_p + \gamma(1 - e^{\epsilon})^n\right]$$



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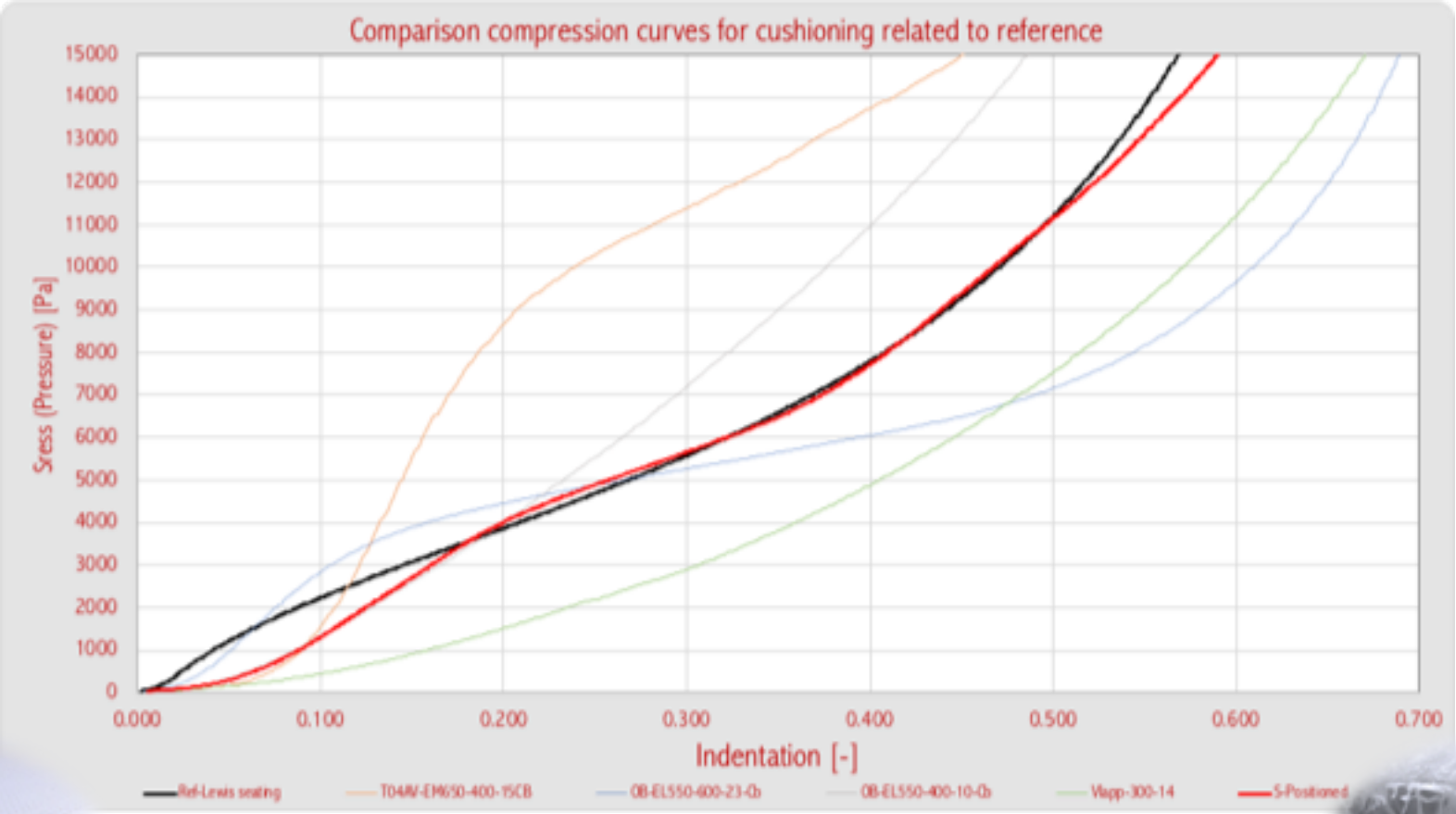
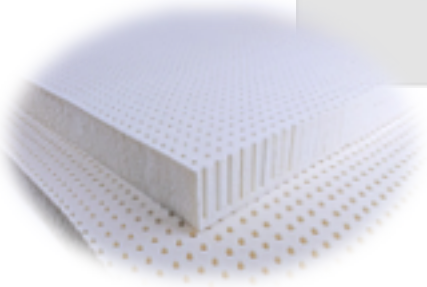
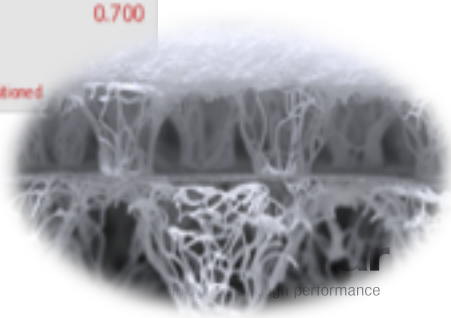
Cushion design - countertyping

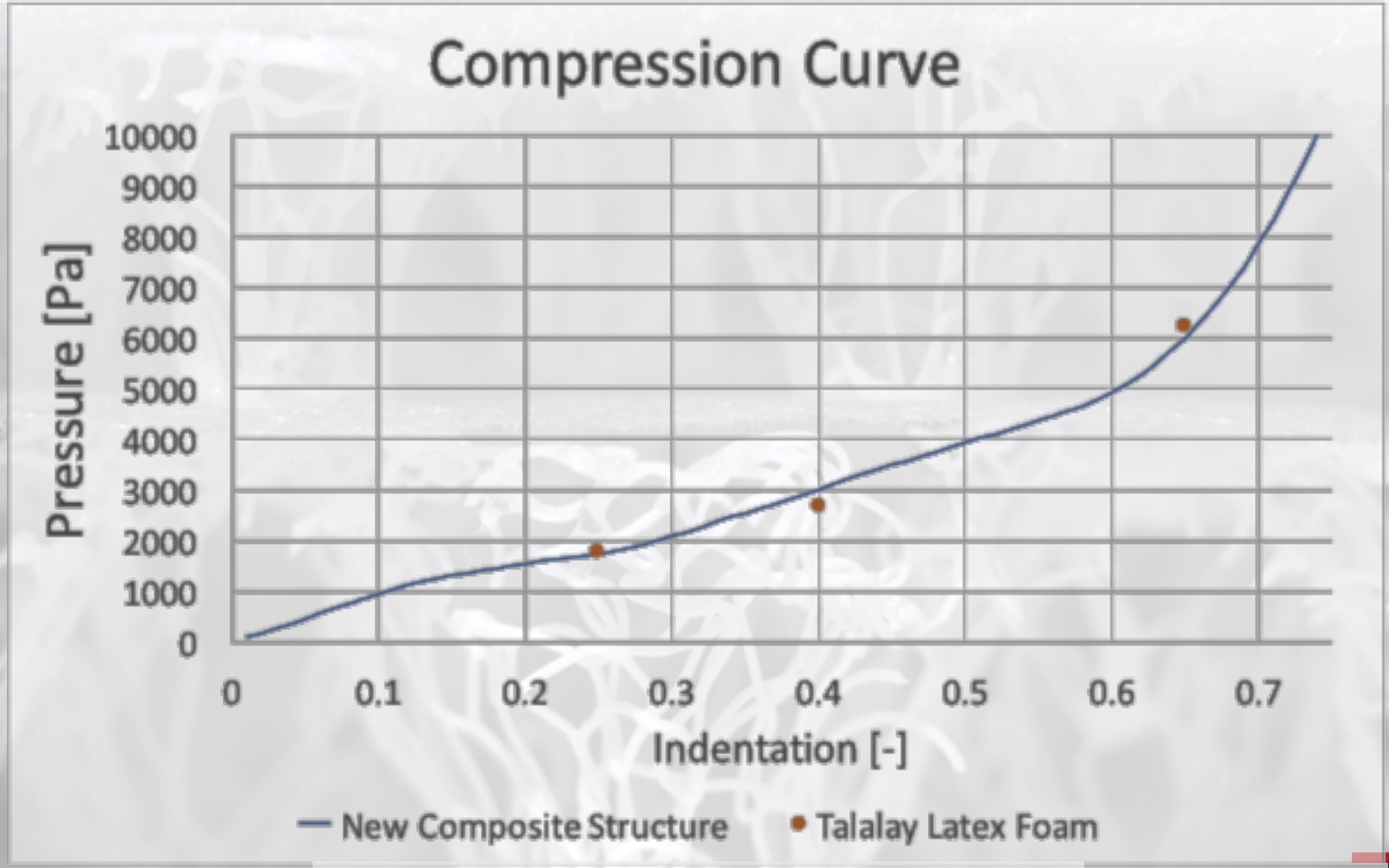






Compression

Weight saving



32kg/m3 ← → 70 kg/m3

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TPE polymer provides long term durability

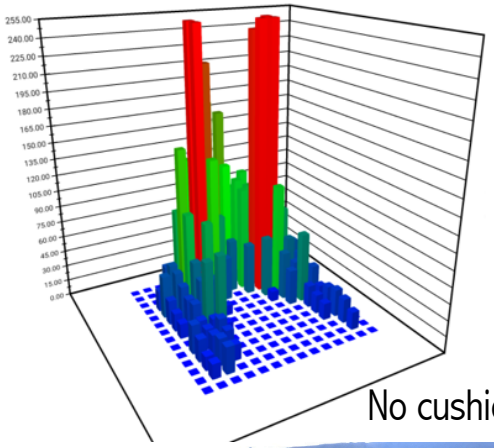
Mattress Resilience Test (80k Cycles)

New Enkamat-TPE structures : passed (4.2 – 5.6%)

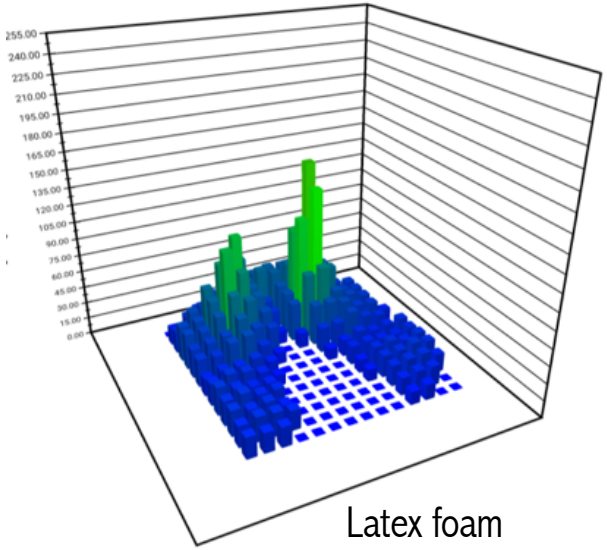
Test conditions (ISO 3385 and 2439):
Standard Instron circular stamp 200 mm
80 K cycles between 65% and 25% indentation

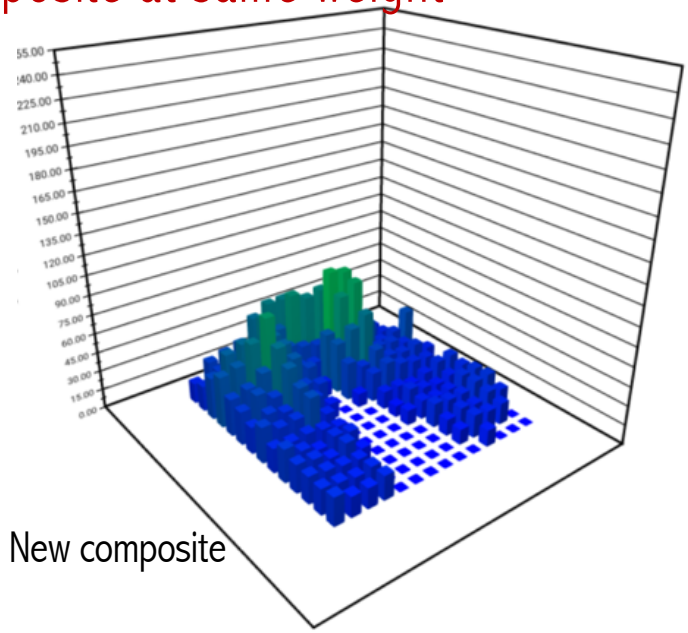
Frequency: 70 cycles/minute
Determination of change in uncompressed thickness

Pressure redistribution – optimized wheelchair cushion



Latex versus new composite at same weight





	No cushion	Latex foam	New composite
Max	25.5 kPa	14.7 kPa	8.4 kPa
Mean	6.6 kPa	3.1 kPa	2.8 kPa
Area	92	143	155

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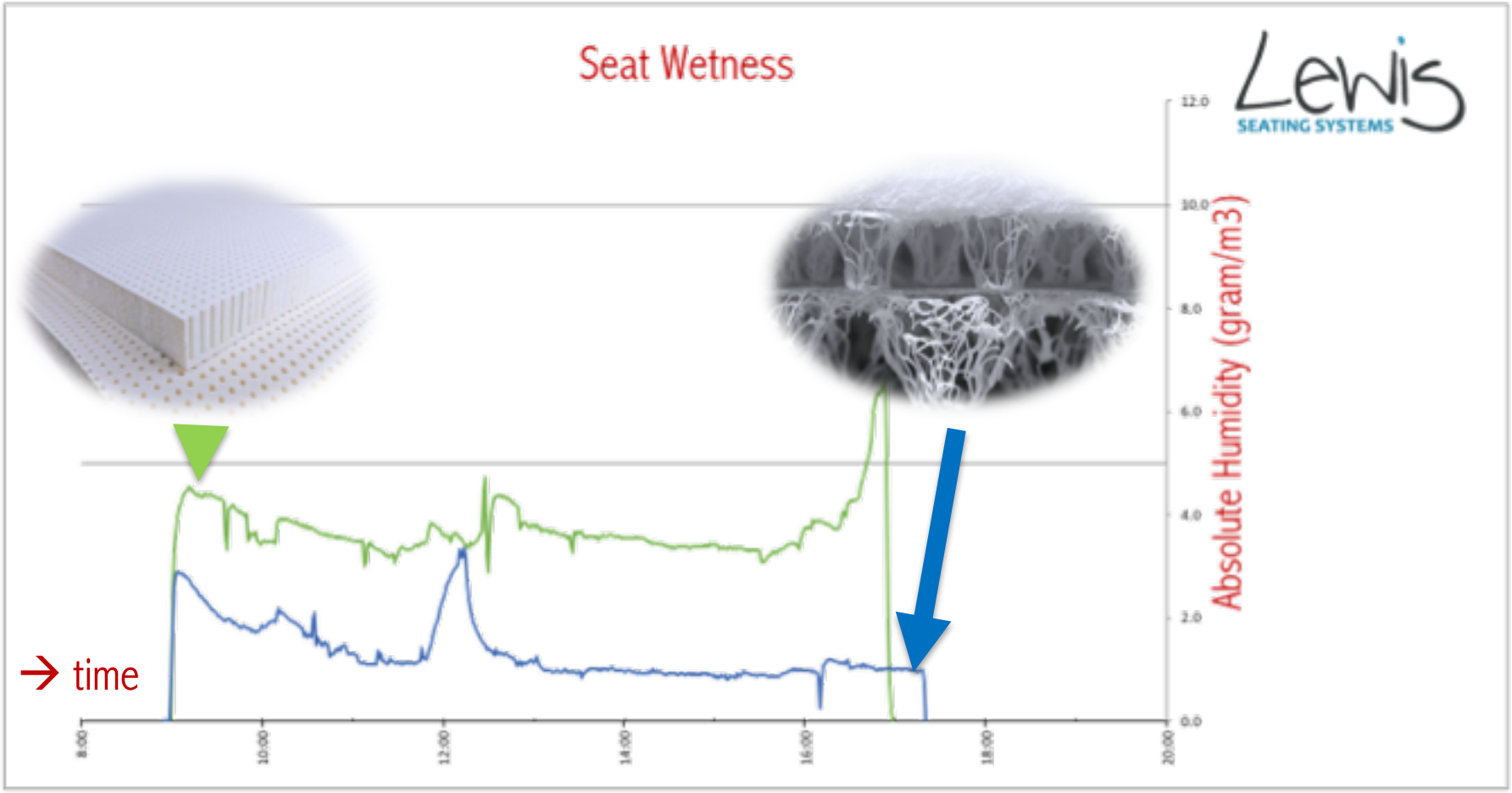
First prototypes

Supporting “Active Air Flow” in wheelchair cushions

Wheelchair ventilation – comparison perforated latex vs Enkamat-TPE



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The future of cushioning – a future beyond foam?

Foam substitution products effectively target core properties:

- ✓ local pressure redistribution
- ✓ durability
- ✓ hygiene / washability
- ✓ micro-climate
- ✓ lighter weights
- ✓ recyclability

Where can foam innovate?

Where can we collaborate?

THANK YOU

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Acknowledgements

Rolf-Dieter Böttcher

Jeff Denton

Aaron Swanger

Jim Mathis

Martin van Wijk

Martin Koerntjes

Majorie Bussink