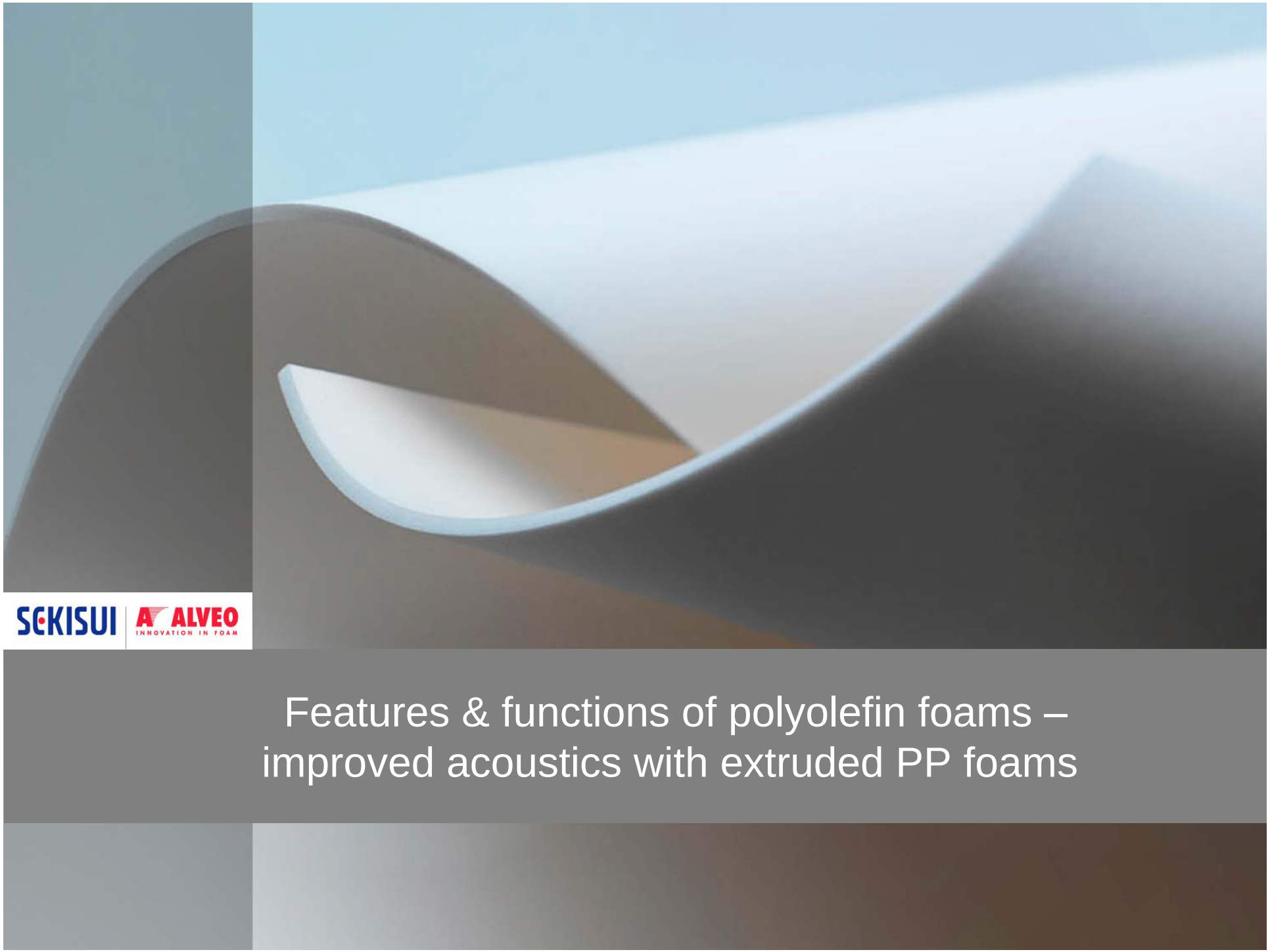

Features & functions of polyolefin foams – improved acoustics with extruded PP foams

Content

- facts and figures about Sekisui Alveo
- introduction into the world of Polyolefin Foams
- typical applications using Polyolefin Foams
- special applications with improved acoustic performance
- summary and outlook for acoustics

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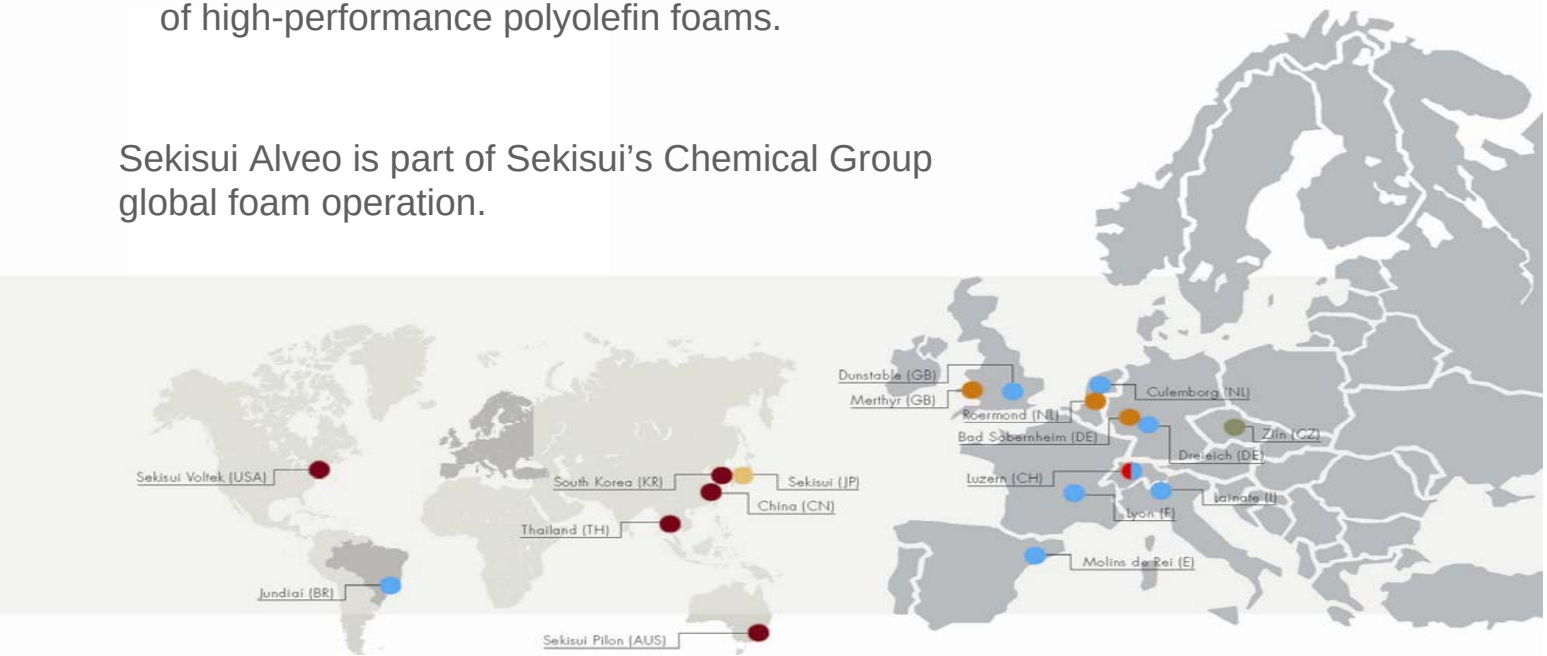
Company

Sekisui Alveo is the European market leader in:

- the development
- production
- marketing and sales

of high-performance polyolefin foams.

Sekisui Alveo is part of Sekisui's Chemical Group global foam operation.



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Facts and figures

- Establishment of Sekisui Alveo 1971
- Employees ~ 450
- Turnover ~ 100 Million Euro

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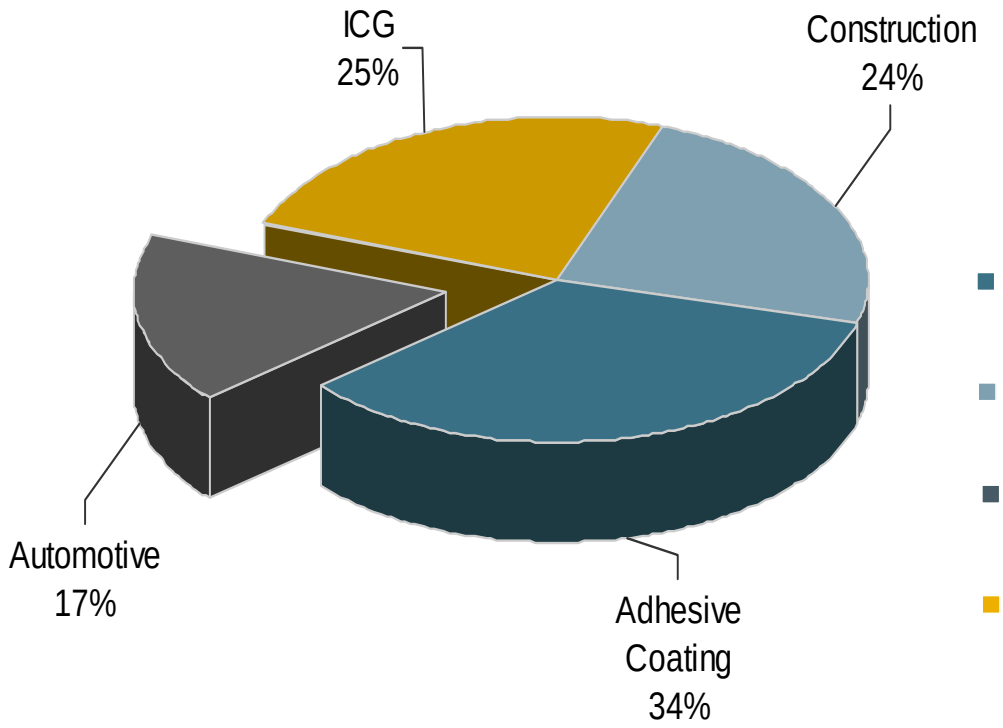
Market Segment Split – Sekisui Alveo

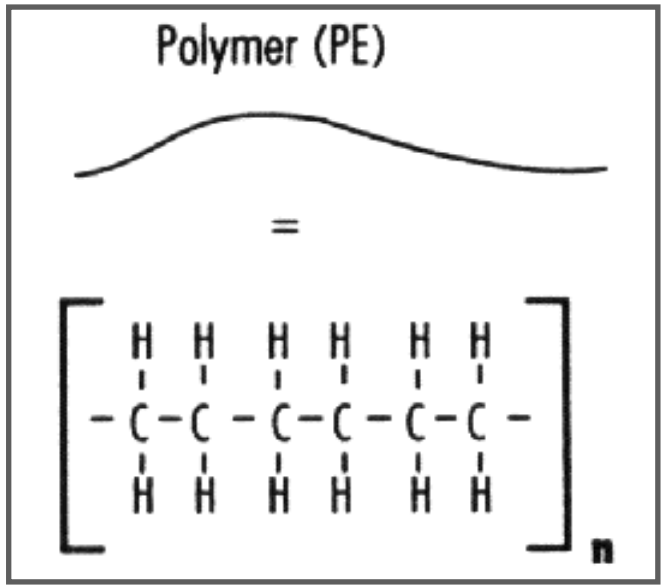


- **AC - Adhesive Coating**
- **CO - Construction**
- **AU - Automotive**
- **ICG – Industrial, Consumer General, Converting**

What are polyolefins ?

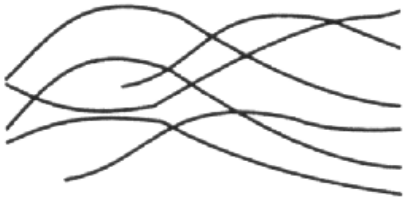
- PE (Polyethylene)
- PP (Polypropylene)
- EVA (Ethyl-Vinyl acetate)
- modified Co-Polymers (EAA, EMA)

General Structure:



What is the effect of cross linking?

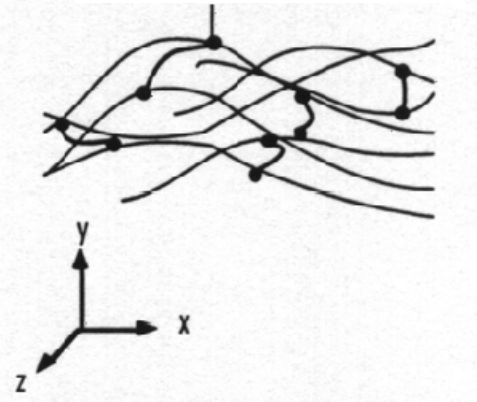
non cross linked PE



defined melting point

cross linked PE

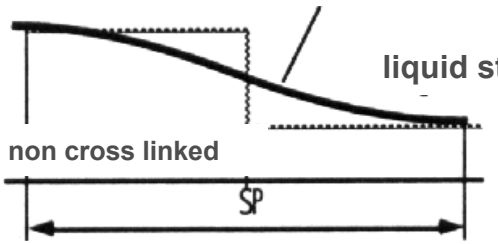
cross link bonds



solid state cross linked

liquid state

non cross linked



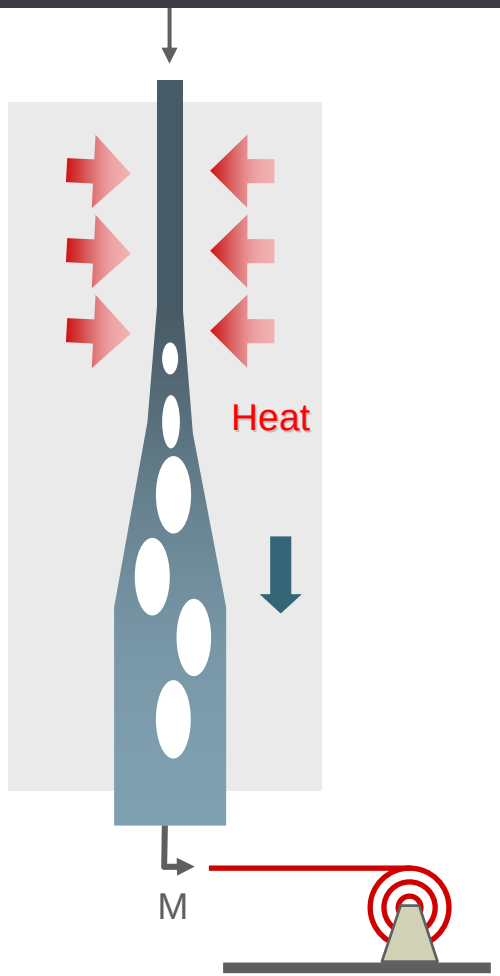
no defined melting point

Sekisui Alveo product families

Alveolit

- cross linked PO foams
- vertical foaming process

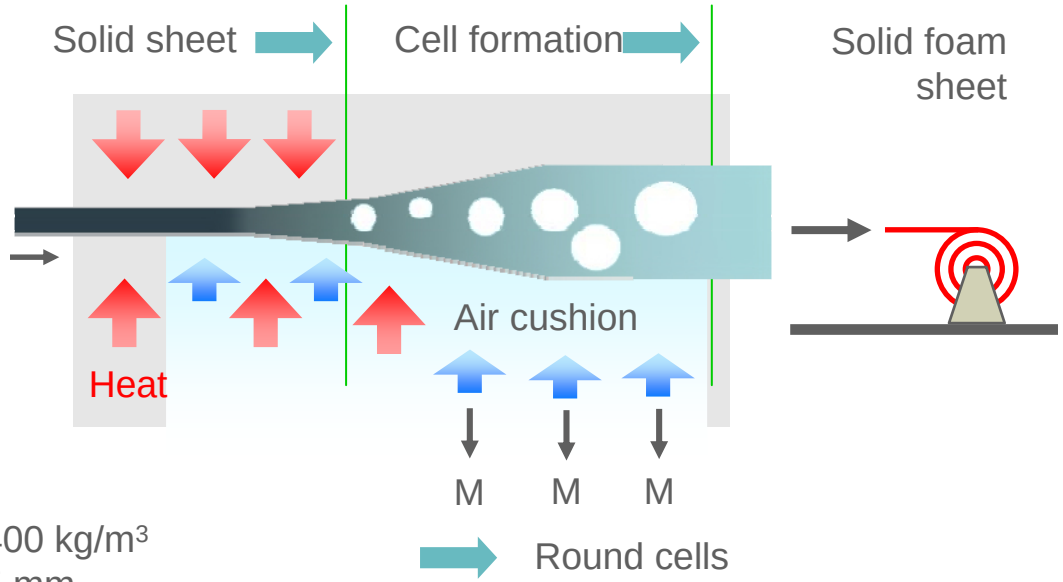
Densities	25 – 330 kg/m³
Thickness	0,2 – 8 mm
Width	up to 2,2 m



Sekisui Alveo product families

Alveolen

- cross linked PO-foams
- horizontal foaming process

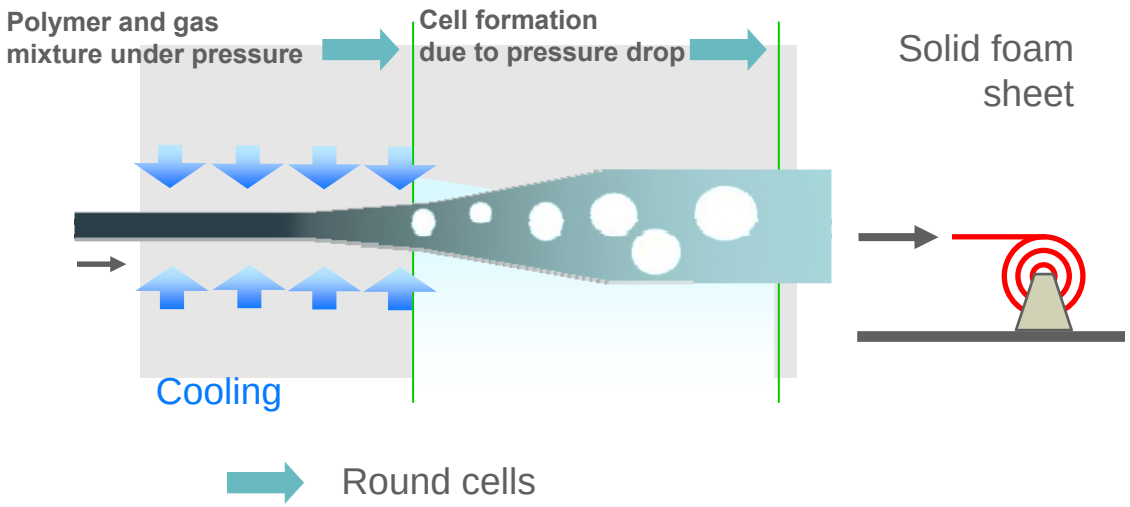


Densities	28 – 400 kg/m³
Thickness	3 – 15 mm
Width	up to 2,5 m

Sekisui Alveo product families

Alveocel

- extruded PO-foam
- horizontal foaming process

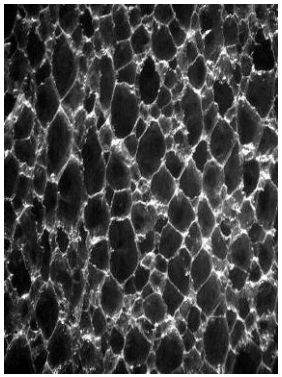


Densities	37 – 500 kg/m³
Thickness	1.5 – 8 mm
Width	up to 2,2 m

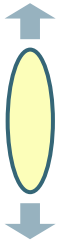
Sekisui Alveo product families

Cell comparison

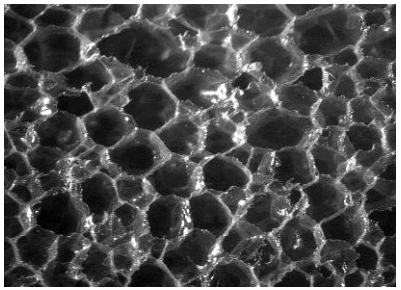
Alveolit



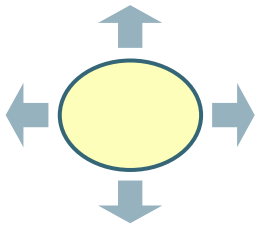
0,1 – 0,9 mm



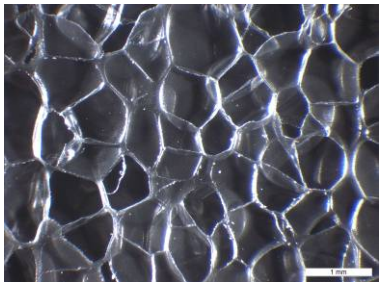
Alveolen



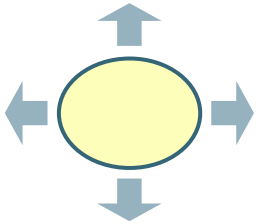
0,6 – 1,3 mm



Alveocel



0,6 – 1,3 mm



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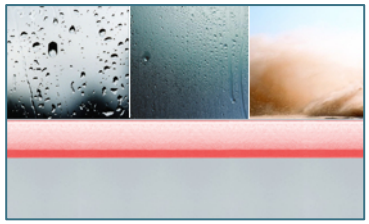
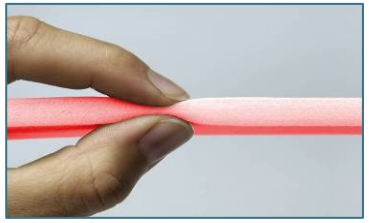
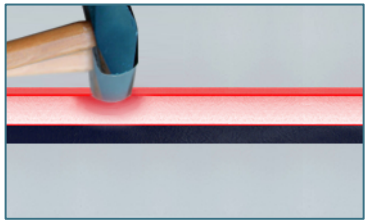
Main functions of PO-foam



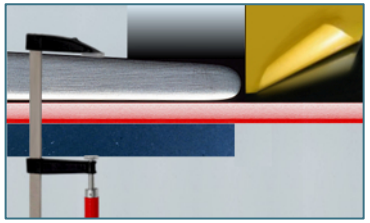
Sealing against water, humidity, dust



Improving soft touch and comfort

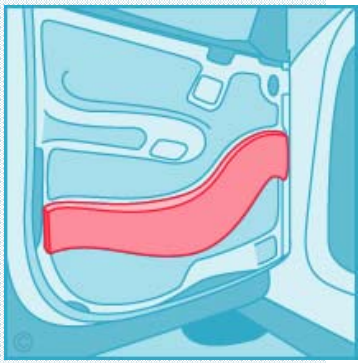


Protecting decorative layer in manufacturing processes

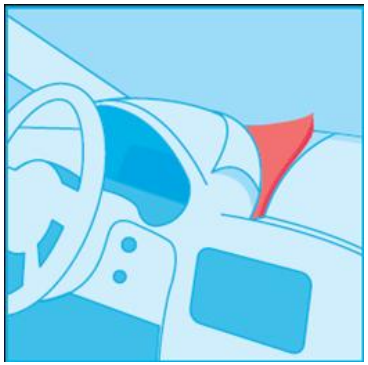


Fixing parts onto car body

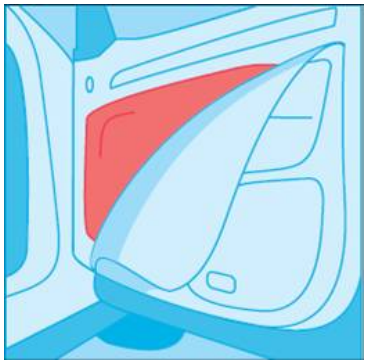
Automotive applications with Polyolefin-foams



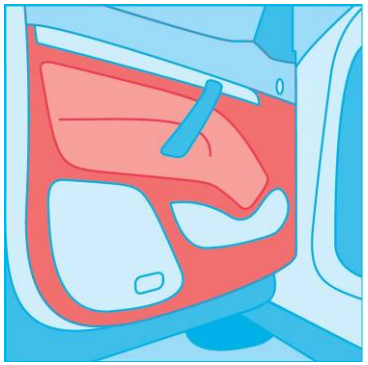
Air Duct



Instrument panel

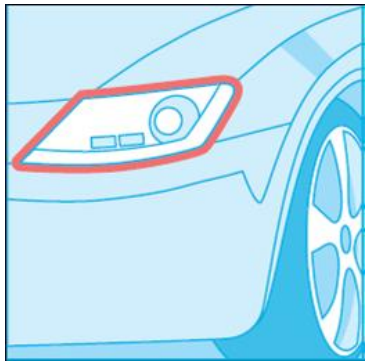


Water shield

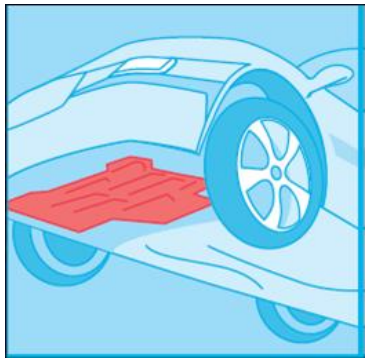


Door panel

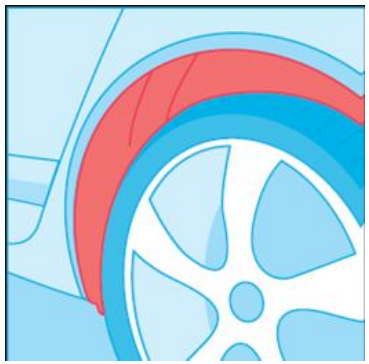
Arm Rest



Gaskets



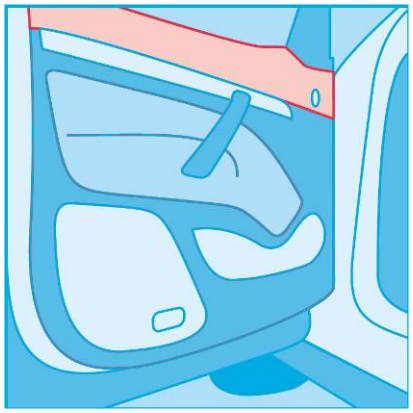
Engine under shield



Wheel house cover

haptic and visual appearance

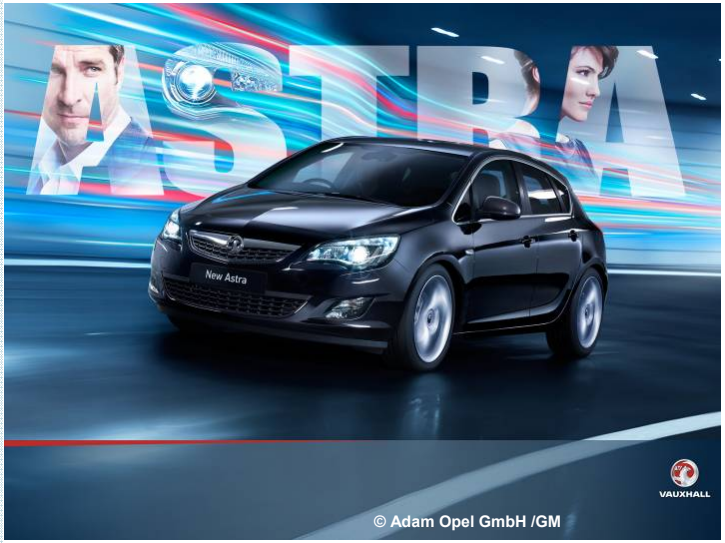
Upper door panel
with Alveolit



- Application
  - TPO and PVC foils laminated to cross linked polyolefin foams
- Main function of PO foams
  - support and protection during vacuum forming and low pressure moulding of the laminate
  - provide soft touch

haptic and visual appearance

Upper door panel
with Alveolit



Example
Opel Astra

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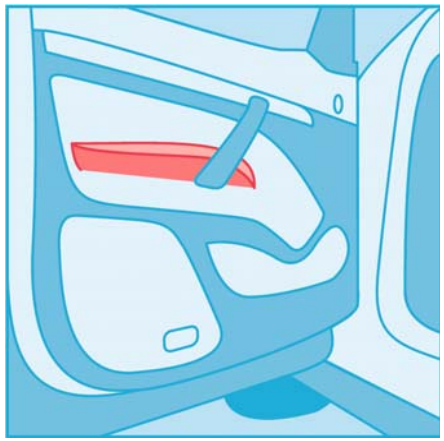
comfort and cost savings

Arm Rest
with Alveolit and Alveolen

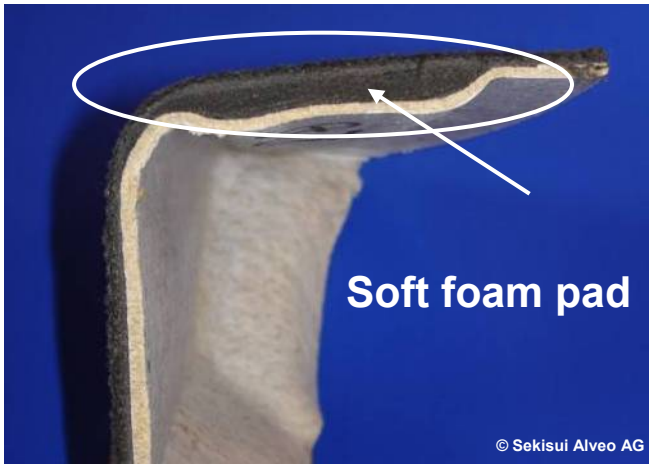


- Application:
  - foam can be pre-laminated to textiles, vinyl, leather and foils
  - or die-cut and used as a foam pad for local soft touch improvement

- Main function of PO foam
  - provide comfort to the passenger
  - cost saving potential compared to other solutions

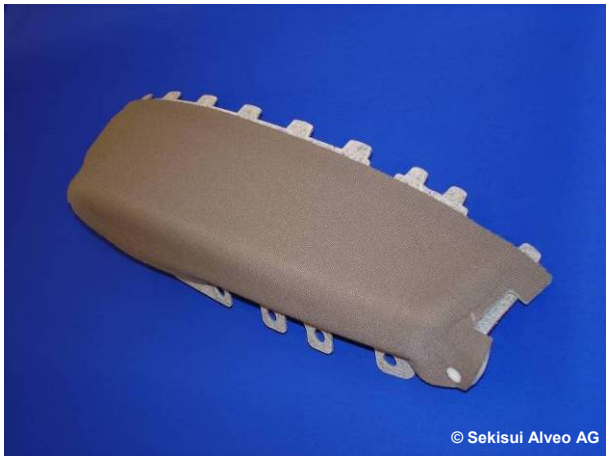
comfort and cost savings

- Soft foam pad solution:
  - provides soft touch only in areas where needed
  - add-on solution to existing carriers possible



comfort and cost savings

Arm rest
with Alveolen PE



Example
Volkswagen Golf VI

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comfort and cost savings

Arm rest
with Alveolen PE

Example
Volkswagen Sharan

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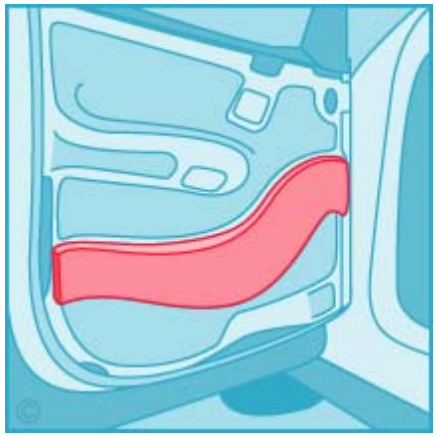
light weight air ducts

Air Duct
with Alveolen and Alveocel



- Application:
  - Simple vacuum forming, conventional or twin-sheet
- Main function of PO foam
  - Light weight parts with up to 65 % savings potential
  - Improved thermal insulation w/o condensation of humidity
  - Air flow noise reduction
  - High product flexibility for easy assembly

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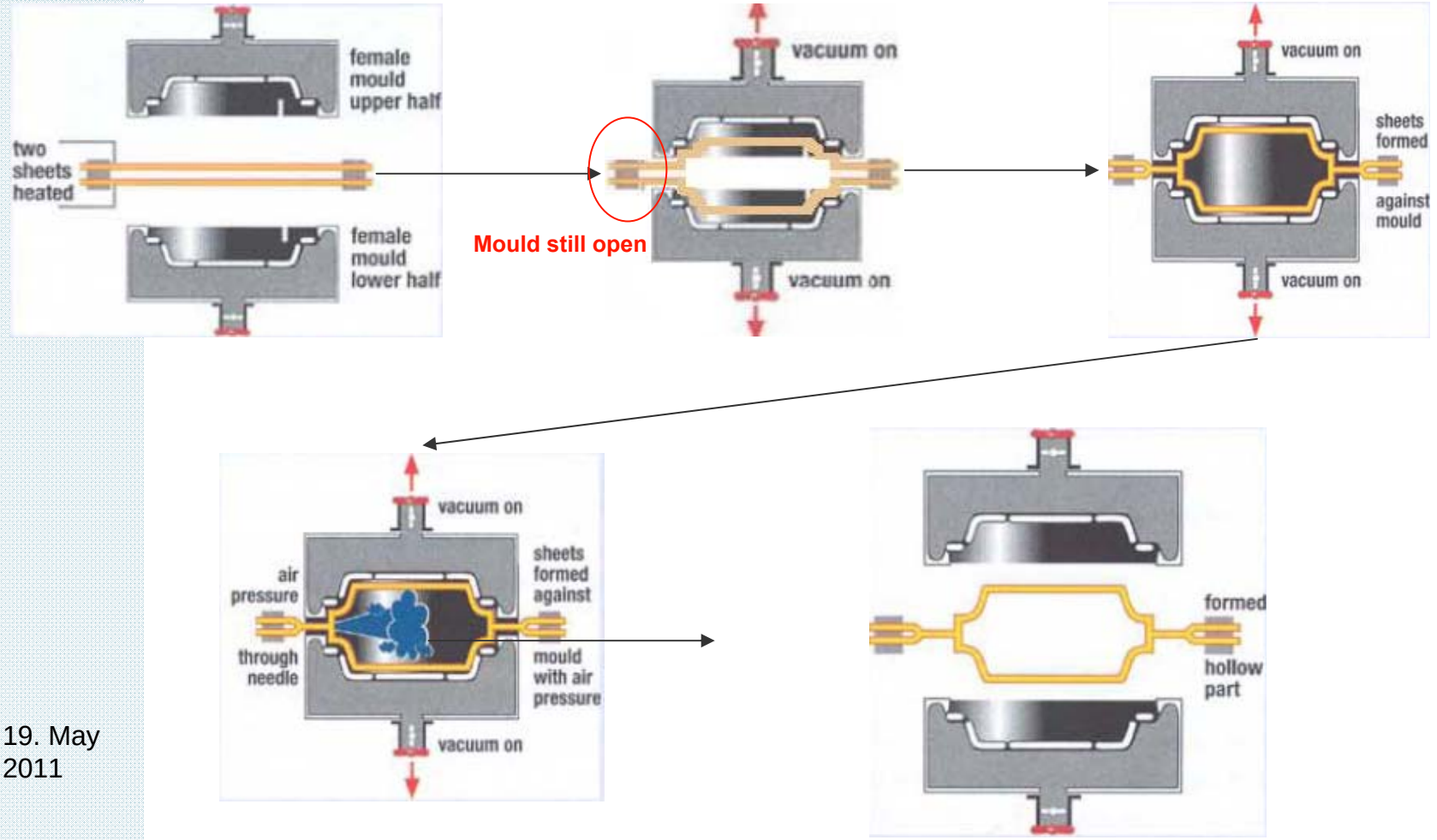
light weight air ducts



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Feature 4: light weight air ducts

Light weight air ducts
with Alveolen

Example
Peugeot 807

Acoustics

Acoustics have always been a weak side of closed cell PO-foams

The noise is reflected by the closed foam surface, leading to almost no absorption.

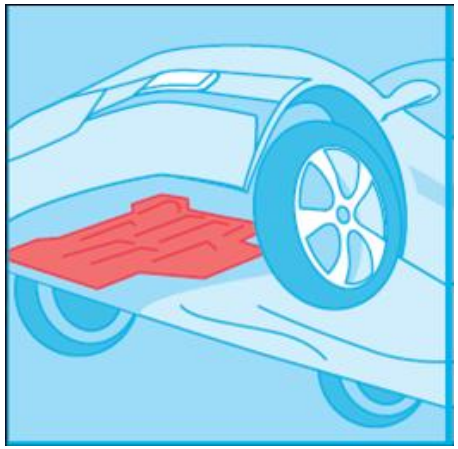
But the acoustic performance can be improved by several means:

- designing the foam part in an intelligent way
- modifying the foam surface in an intelligent way
- adding an acoustically performing material

All 3 possibilities are used today in cars to reduce acoustic emission.

Acoustics - applications

Engine under shield
with Alveocel



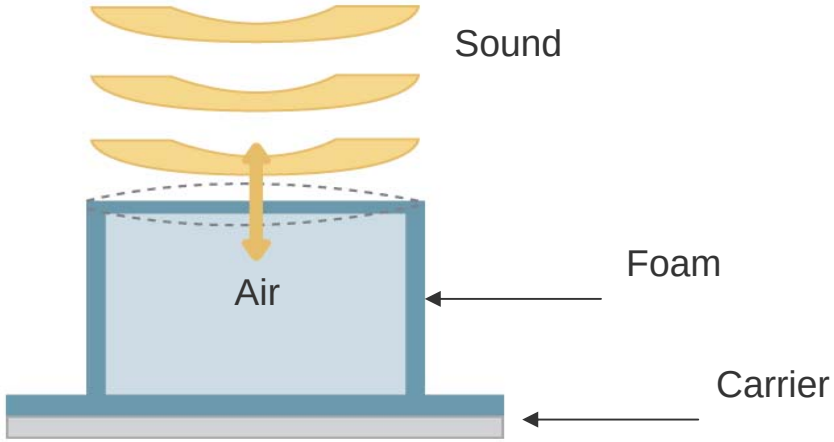
- Application:
  - vacuum formed box absorbers
  - or micro-perforated flat absorbers
  - multi-layer solutions possible for flat absorbers

- Main function of PO foam
  - excellent acoustic absorption through physical effects
  - good chemical resistance against fuel, oil, diesel
  - no water absorption → hydrolysis resistance

Acoustics – the box absorber

- Absorption Principle of the box absorber is related to the „Helmholtz resonance effect
- A „spring–mass-system“ where the foam box is the mass and the air behind the spring
- The sound energy is converted into kinetic energy
- The box shape is tuned to the problem frequencies, thereby eliminating them

- Cross linked or extruded PP-foam is heated up and vacuum formed into the desired shape
- The shape is engineered to achieve the maximum absorption in relation to the noise emitted by the engine in various areas
- PP foam is needed due to it’s high temperature stability of ~ 140°C



Acoustic Measurement Methods

Impedance Tube

ISO 10534-2

+ Small Samples

- Only Normal Sound Incidence

Alpha Cabin

D49 1977

+ Closer to reality

- larger samples needed

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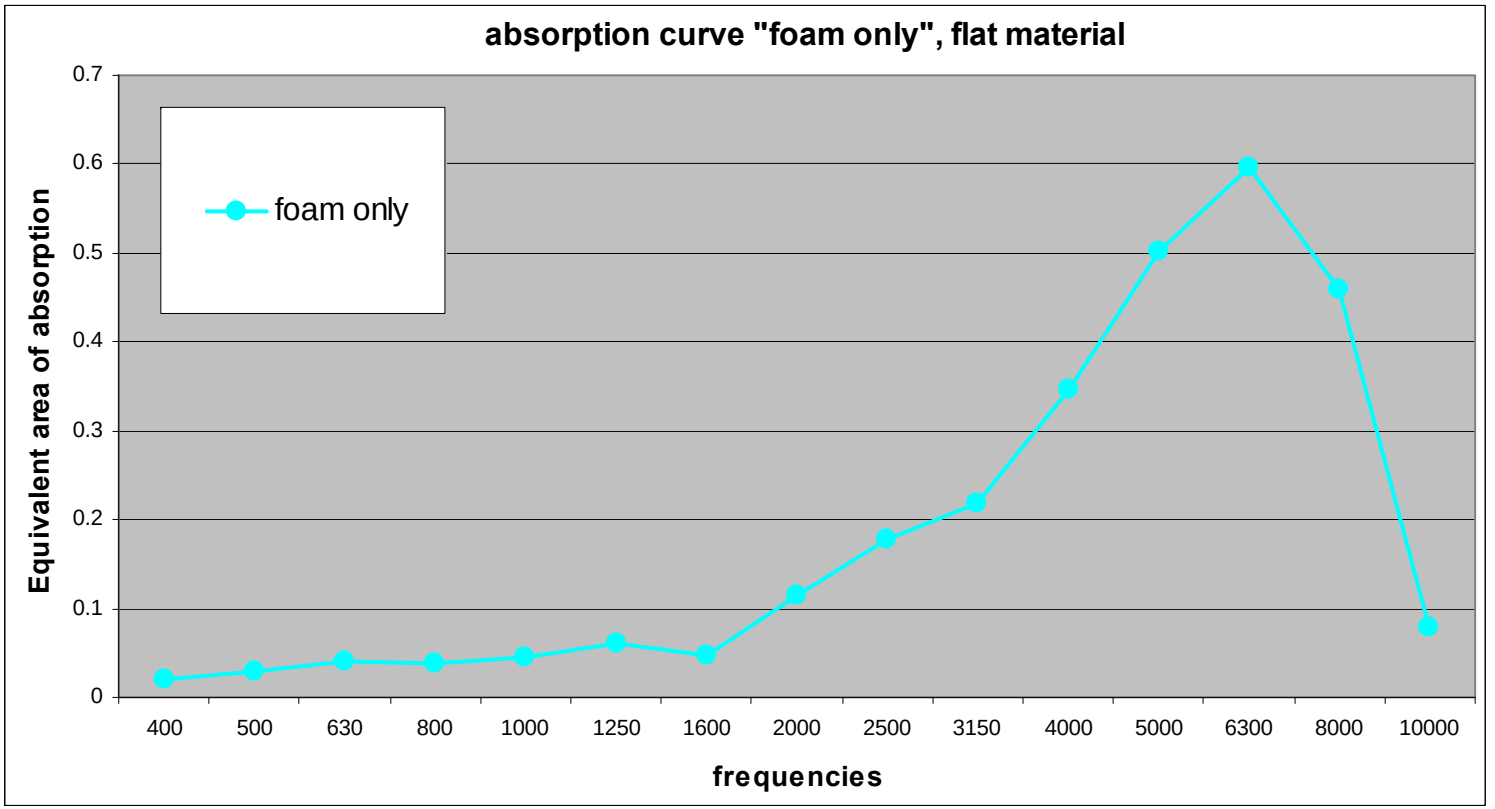
Acoustics - Alpha cabin results

Example 1

Example 2

Example 3

Serial application box absorbers



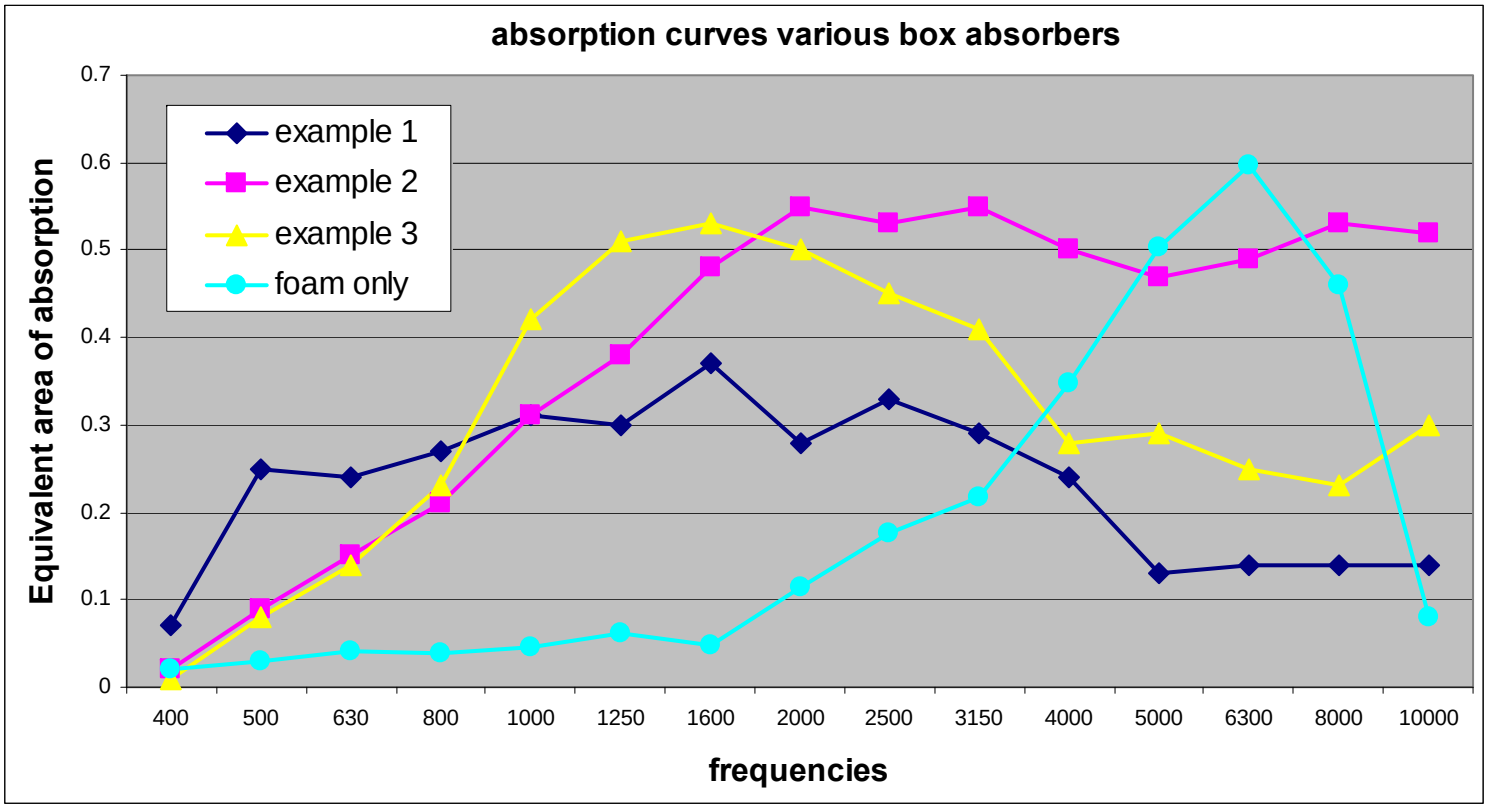
Acoustics - Alpha cabin results

Example 1

Example 2

Example 3

Serial application box absorbers



Acoustics - example

vacuum formed box absorbers
with Alveocel

©Sekisui Alveo AG

Example
Mercedes A-Class / C-Class

© Daimler AG

© Daimler AG

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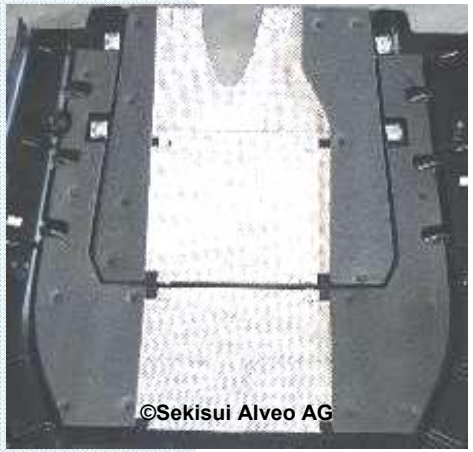
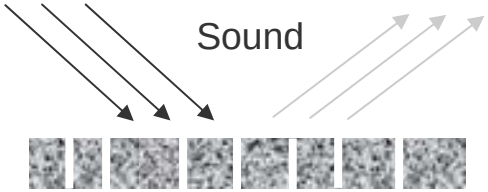
Acoustics – micro perforated flat absorber



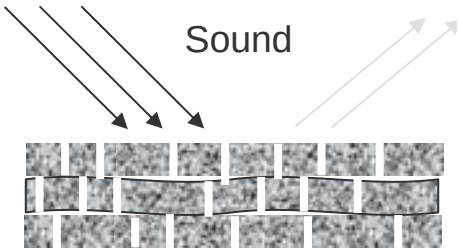
- **PP-foam is micro perforated and die cut to size**
- **Hole size, hole distribution and the shape of the die cut part are designed to achieve the maximum absorption**
- **PP foam is needed due to it's high temperature stability of ~ 140°C**

- **Absorption Principle of micro perforated flat absorbers is a combination of resonance and dissipation**
- **The sound energy is converted into kinetic energy (absorption) and into thermal energy (dissipation)**

Single layer



Multi layer



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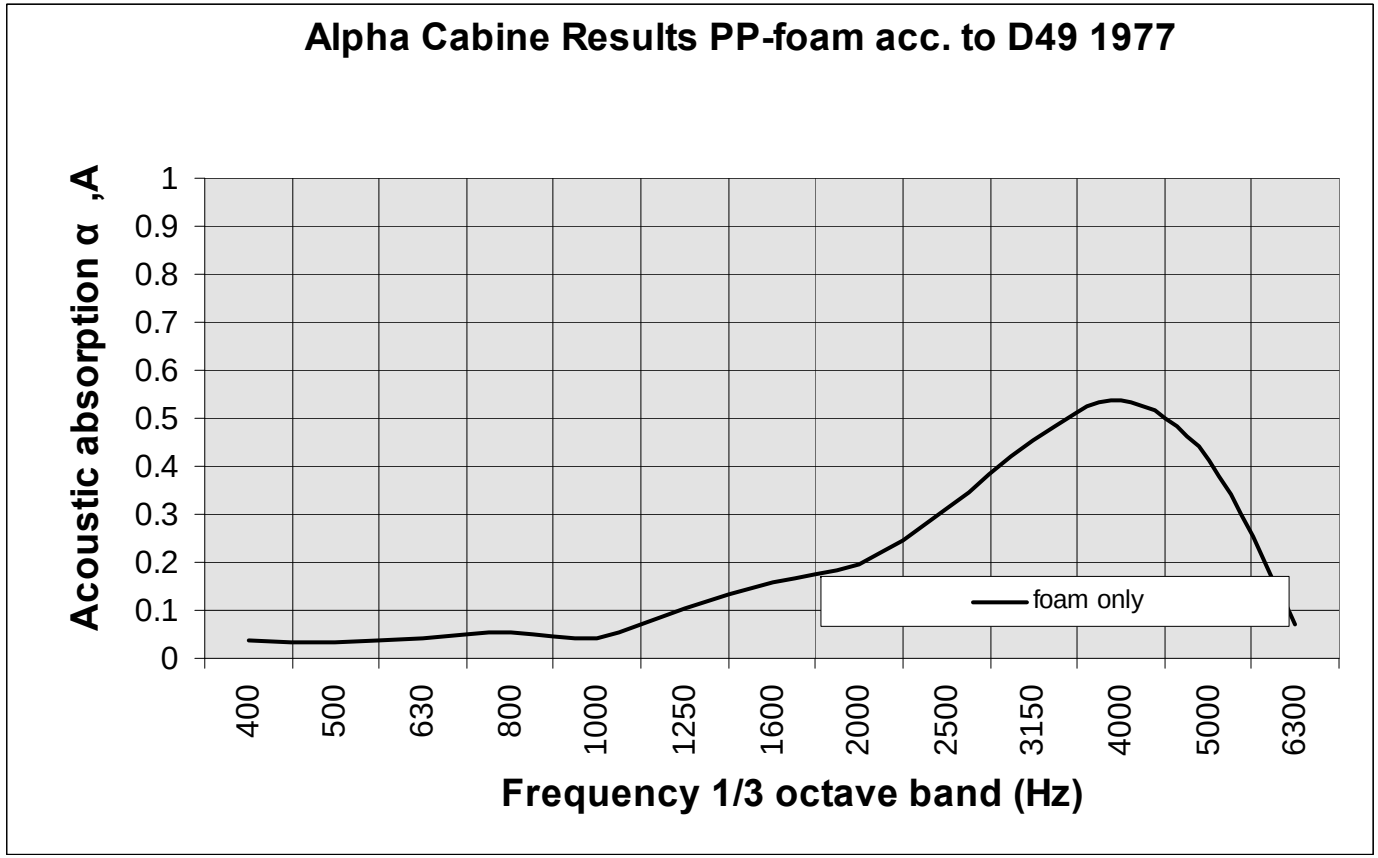
Acoustics - Alpha cabin results

Serial application micro perforated flat absorbers



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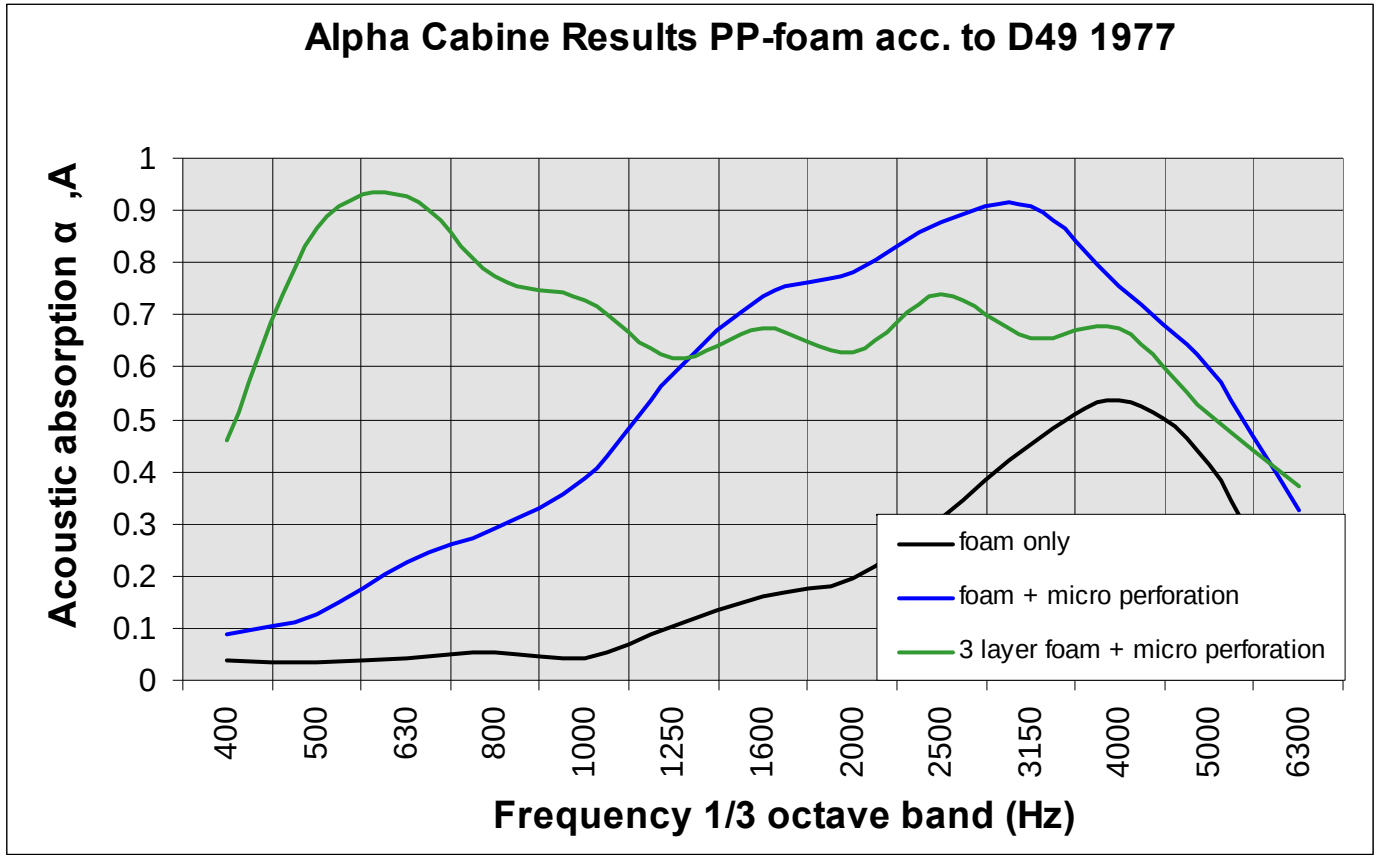
Acoustics - Alpha cabin results

Serial application micro perforated flat absorbers



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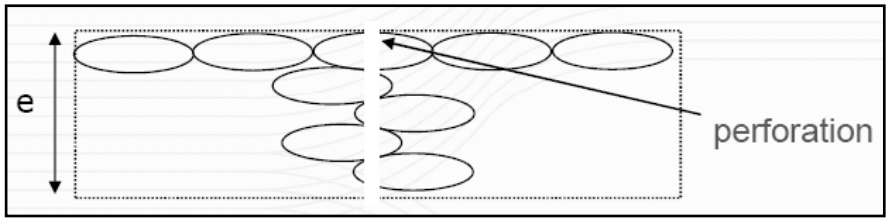
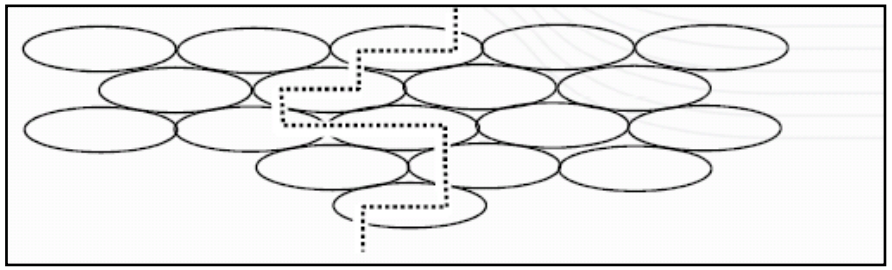
Acoustics – micro perforated flat absorber

- Absorption Principle (1) of micro perforated flat absorbers is resonance → Helmholtz
- The sound energy is converted into kinetic energy
- Ideal for lower frequencies



Result = broad band absorber

- Absorption Principle of micro perforated flat absorbers is (2) dissipation
- The sound energy is converted into thermal energy
- Ideal for midrange- and high frequencies



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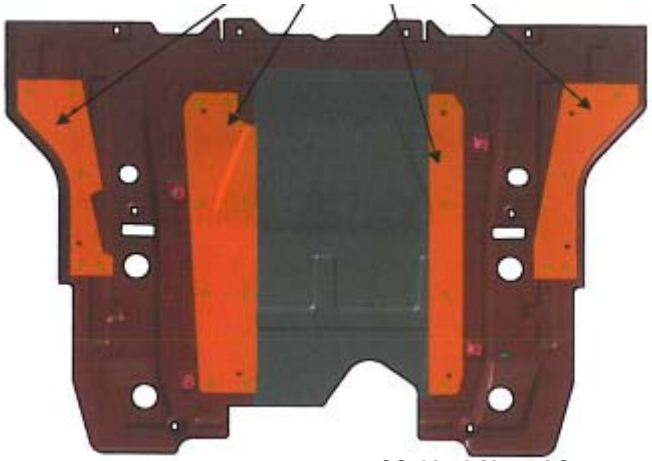
Acoustics - example

Micro-perforated flat absorbers
with Alveocel

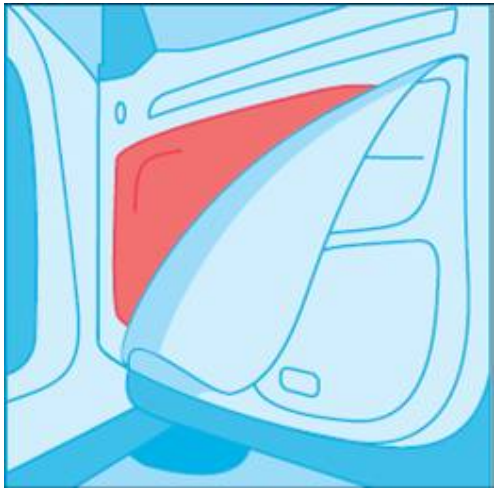
Example
Opel Astra

Die cut foam parts



Acoustics - applications

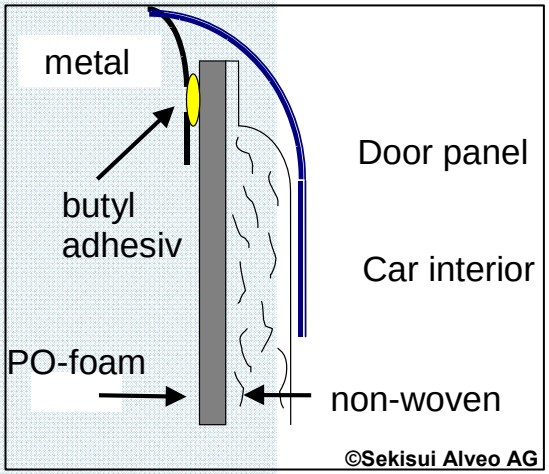
Acoustic water shield
with Alveolit / Alveolen / Alveocel



- Application:
  - vacuum forming or die-cutting of PO foam plus non-woven

- Main functions
  - Sealing against water, humidity, dust → PO-foam
  - Improved acoustic absorption → non-woven
  - easy assembly – less waste

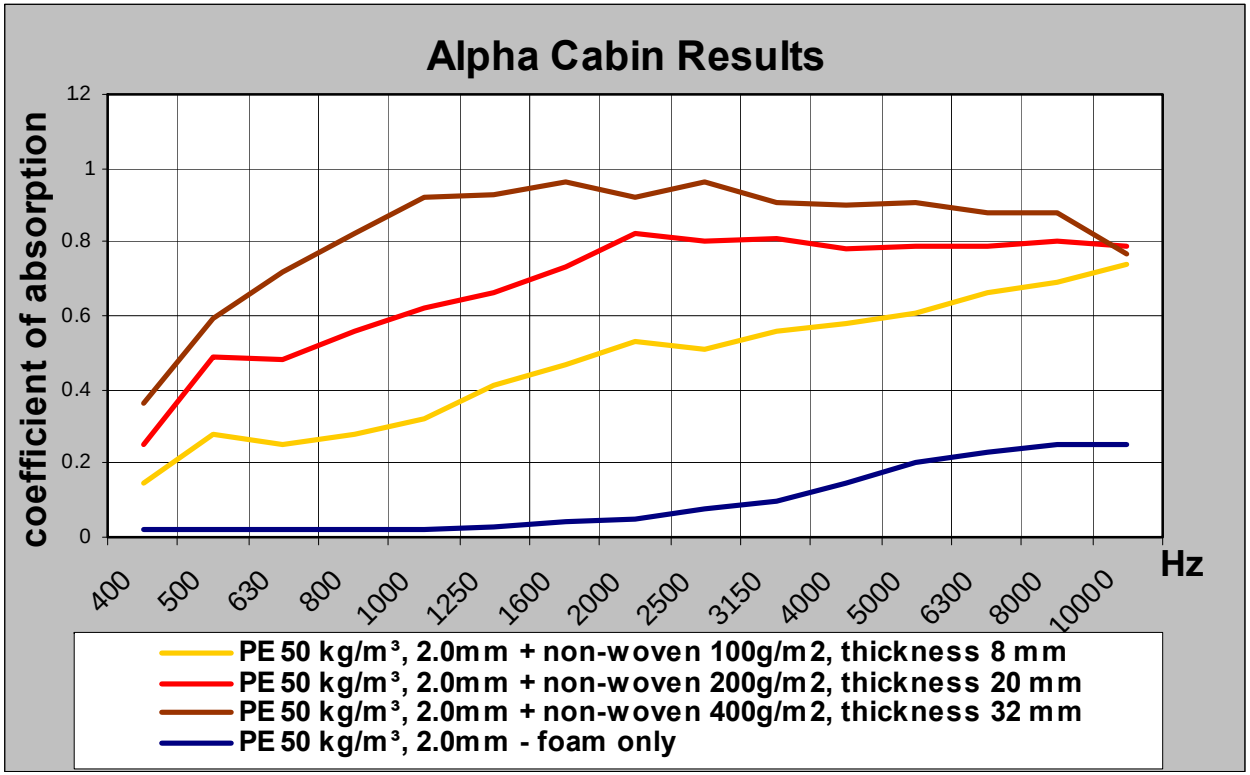
Acoustic water shield



- Cross linked or extruded PO-foam is laminated with PET-non-woven
- Vacuum forming of both material in one step

- Absorption Principle of acoustic water shield is dissipation
- The sound energy is converted into thermal energy
- Ideal for midrange- and high frequencies

Acoustic water shield



Acoustics - example

Acoustic water shield
with Alveolen / non-woven

Example
Peugeot 307

Summary and outlook for acoustics

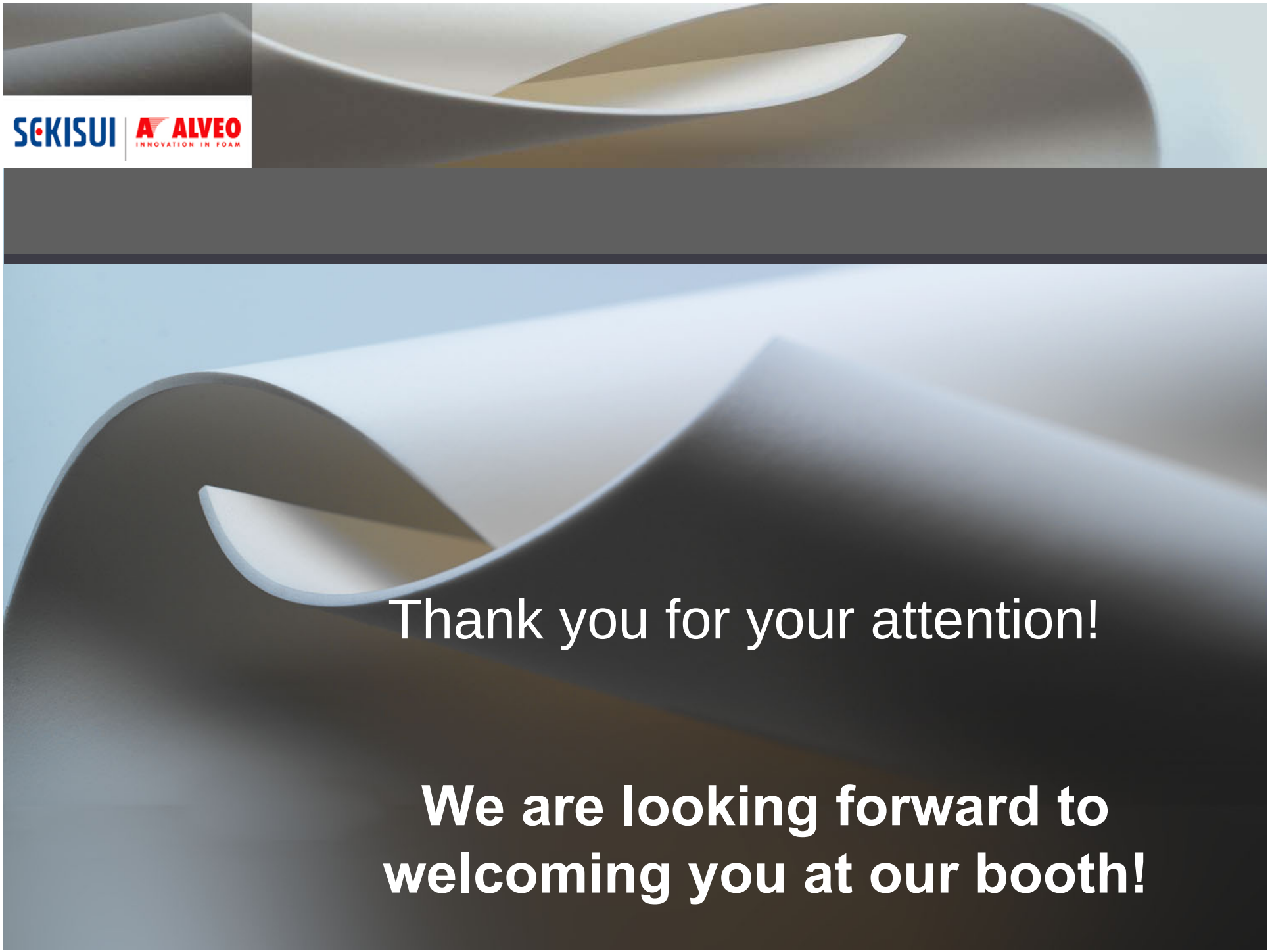
What PO foams are and in what applications they are used in modern cars

That acoustic performance with closed cell PO-foams is not a contradiction:

- box absorbers using the resonance effect
- micro perforated flat absorber using resonance and dissipation
- acoustic water shields using dissipation

What will the future bring for PO foams and acoustics?

- micro perforated absorber with 3-D geometry
- absorbers for under body panels in general
- on ongoing trend to reduce the noise emission of cars in the interior and exterior
- new challenges with electric cars & drive trains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Thank you for your attention!
We are looking forward to welcoming you at our booth!

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