



The Evonik Platform of Products and Services for the Automotive Industry

Dr. Annegret Terheiden

Evonik Industries AG
Goldschmidtstr. 100
45127 Essen, Germany
annegret.terheiden@evonik.com



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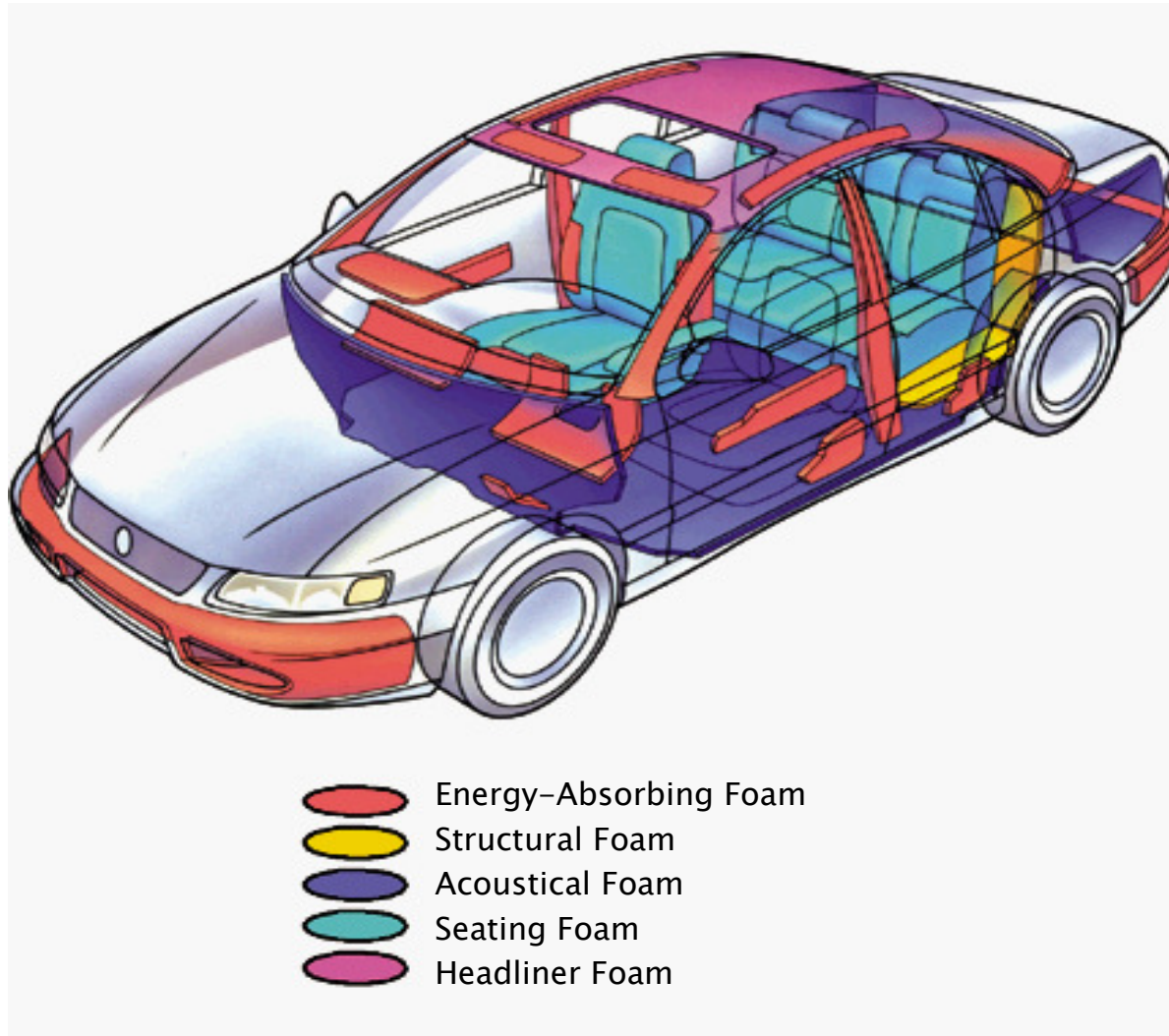
•Evonik Industries has been serving the PU foam industry with polyurethane additives and technical service for 50 years.

•We have aligned our technical activities with the industry requirements and industry trends such as:

- Wide product portfolio for different foam technologies: e.g. TDI, MDI, TM, MT
- Ecotoxicologically friendly products
- Product consistency
- Low Fogging/Low Emission (VOC)
- Improved foam comfort
- Wide processing latitude
- Use of NOPs
- ...

➤ **The following slides will illustrate some of these activities**

PU Foam in Automotive applications



~18kg of PU in a typical family car

Foam Types/Applications:

- **Flexible:**

Seating (seats, backs, armrests, headrests), NVH (foam-backed carpet, engine compartment, bulkhead cladding), etc.

- **Integral Flexible:**

Steering wheels, armrests, gearshift knobs etc.

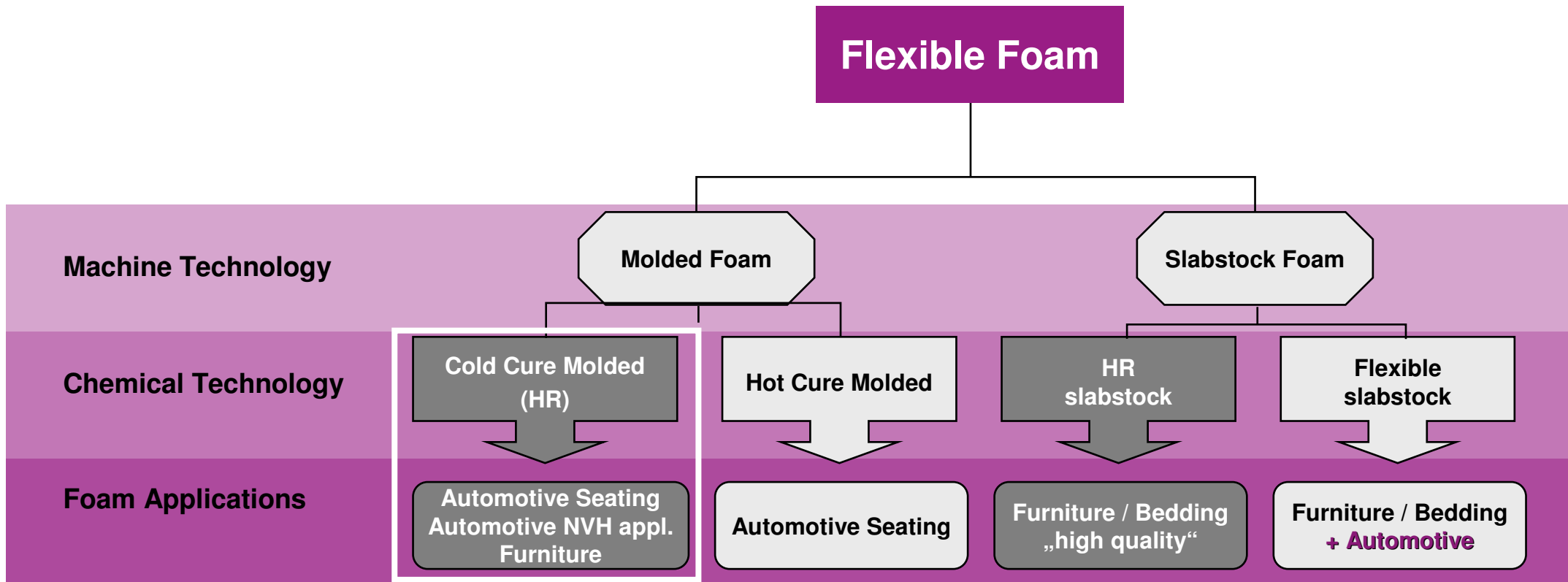
- **Semirigid:**

Headliner, instrument panels, door pillars, door panels, bumpers, etc.

- **Rigid:**

Seat pans, reinforcement in hollow space in the columns

Flexible foam segmentation

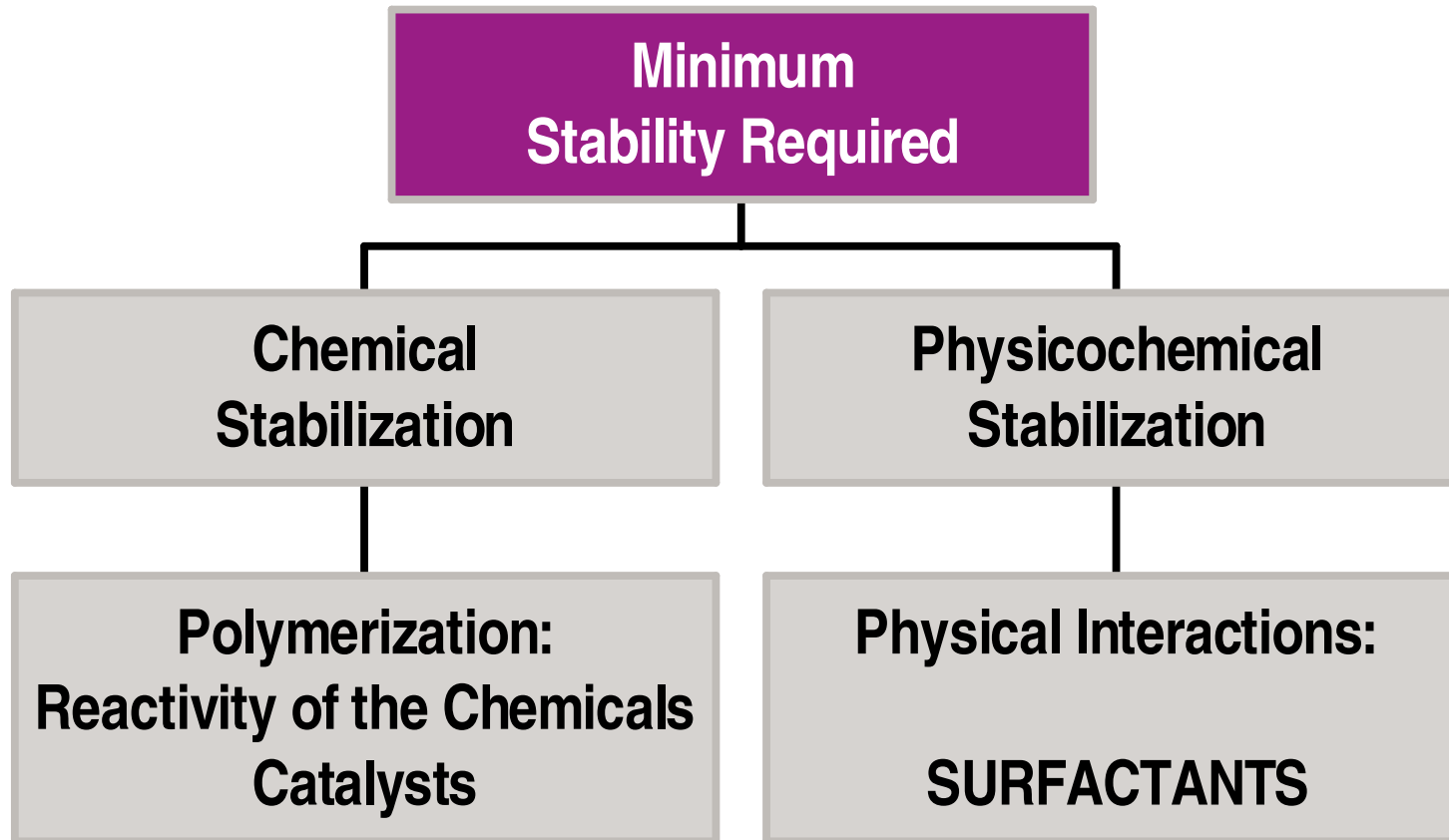


Foam properties

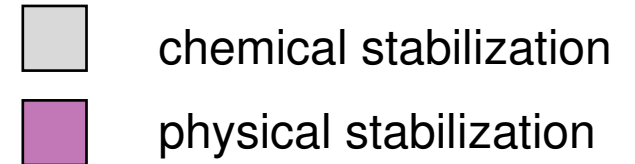


	Flexible (Hot Cure)	HR (Cold Cure)
Resilience	Typically 30-48%	>55%
Sag Factor	1.5 – 2.0	>2.5
Elongation Tensile Strength Tear Strength	+	0
Flame Resistance	0	+
Dynamic Fatigue	0	+

Stability of an expanding polyurethane foam mixture



Processing tolerance for HR molded foam



Over stability

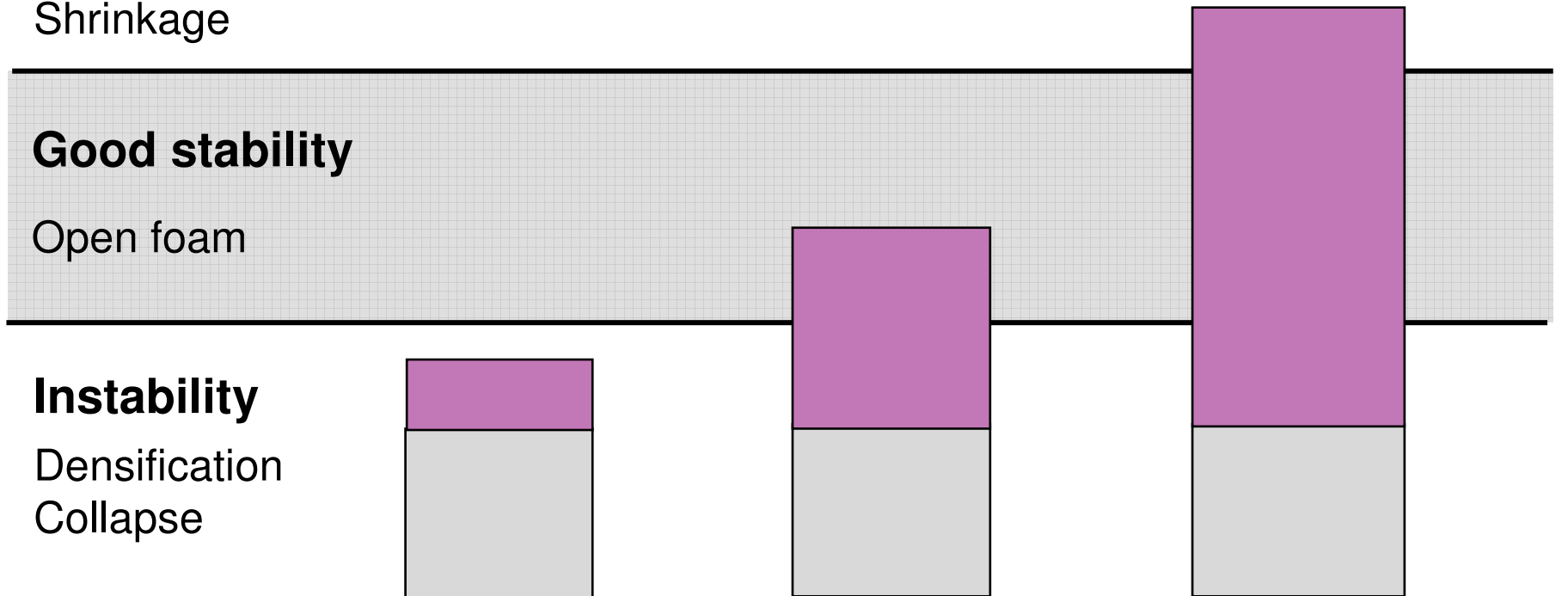
Tightness
Shrinkage

Good stability

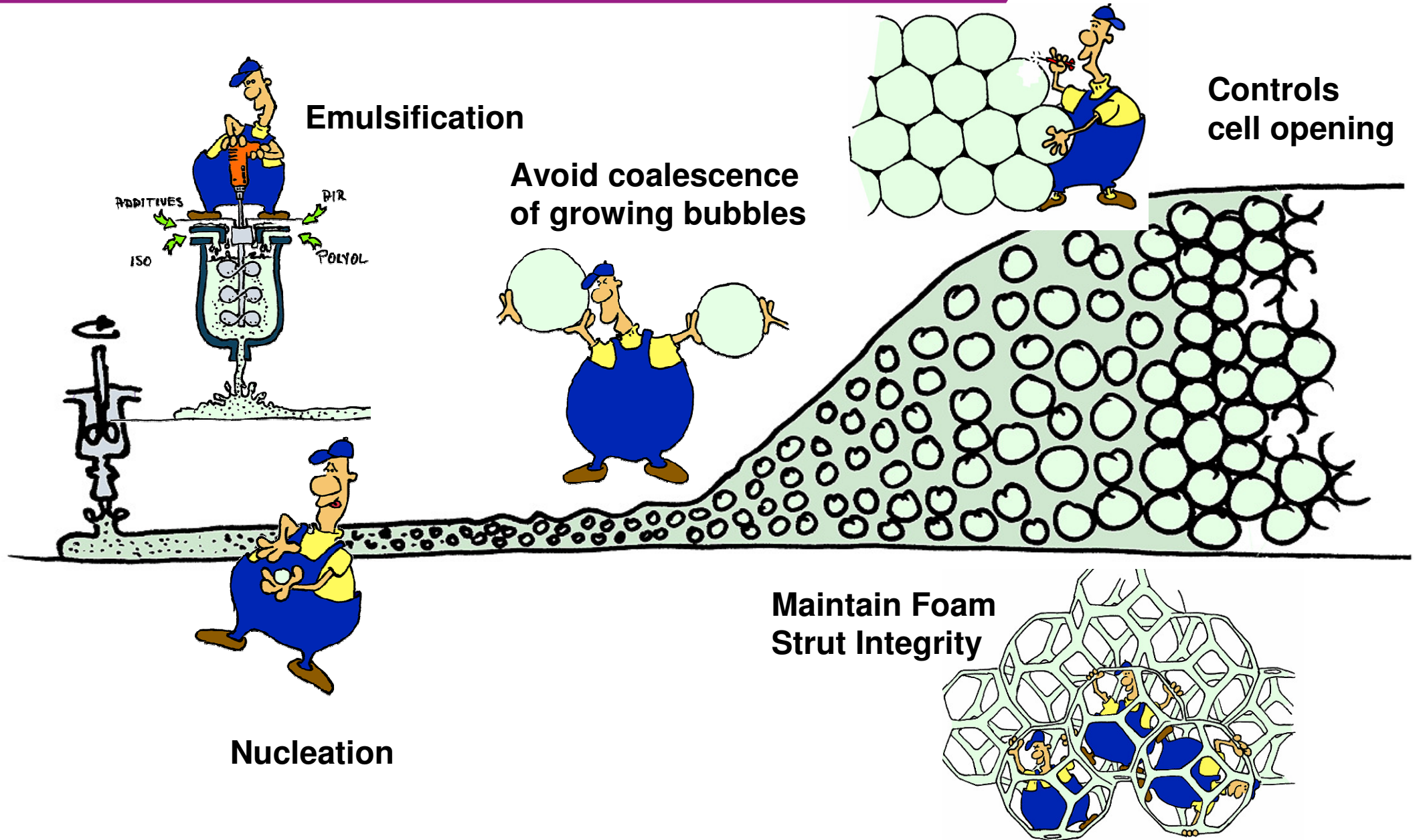
Open foam

Instability

Densification
Collapse



Functions of a silicone surfactant in PU foam



What are the functions of a HR Molded foam surfactant?



- **Emulsification (better mixing, better system stability)**
- **Nucleation (regulation of cell size and cell size distribution)**
- **Stabilisation (optimization of foam stability)**
- **Control of cell opening (control of crushability)**

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- Emulsification (better mixing, better system stability)
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- Stabilisation (optimization of foam stability)
- Control of cell opening (Control of Crushability)

In Addition:

- **Stabilization of the surface (skin) and subsurface area**
- **Improvement of shear stability**
- **Elimination of release agent effects**

Parameters Determining the Choice of HR-Foam Surfactant



- ❖ **Formulation Parameters**
(Isocyanates, Polyols, Crosslinkers, . . .)
- ❖ **Manufacturing Process and Conditions**
(Slabstock Technology, Mold Conditions, . . .)
- ❖ **Requirements on the Final Physical Foam Properties**
(Mattress, Seating, Sound and Vibration Deadening, . . .)

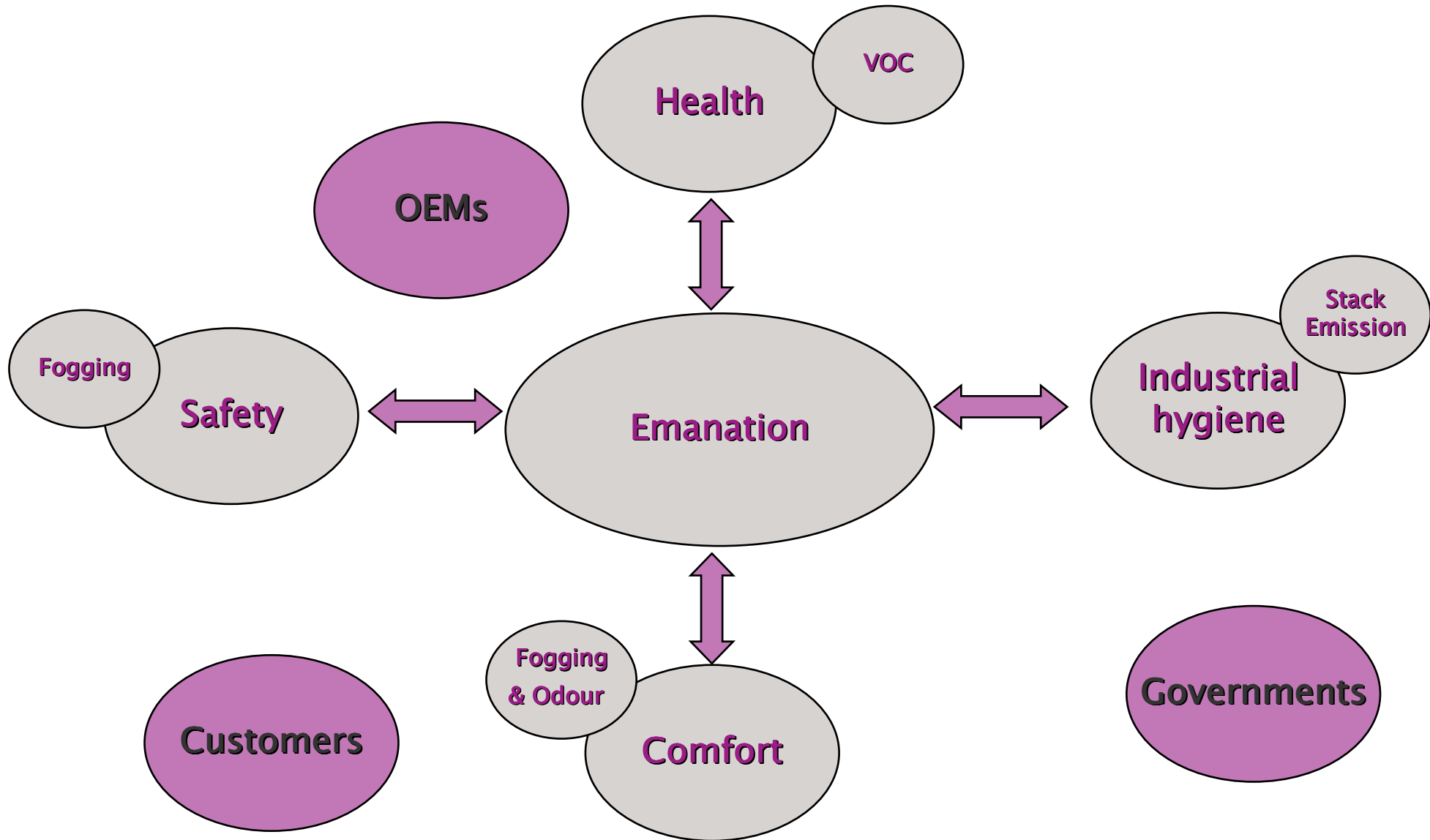
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- ❖ **Emanation Requirements**

Low fogging/low VOC

Why is it getting more important?



VOC / FOG Definition's



VVOC: < 0 ... 50-100°C

VOC : 50 - 250 °C

SVOC: 240 - 400°C

POM : >380°C



VVOC: Very Volatile Organic Compounds

VOC: Volatile Organic Compounds

SVOC: Semi Volatile Organic Compounds

POM: Particulate Organic Matter

EU definition:

Substances with a vapor pressure of > 0.01 kPa at 293.15 K

Which deficiencies can be fixed by a HR molded foam surfactant?



- ✓ Coarse cell
 - contamination or surfactant with too low cell regulating efficiency
- ✓ Collapse
 - surfactant level too low or surfactant not potent enough
- ✓ Subsurface Voids
 - surfactant not potent enough
- ✓ Vent Collapse
 - surfactant not potent enough
- ✓ Tightness
 - surfactant too potent
- ✓ High Emanations
 - change to emanation optimized surfactant

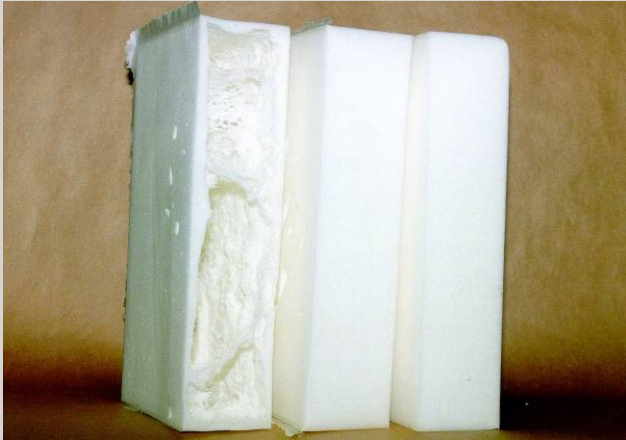
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- ✗ Defoaming
 - contamination
- ✗ Loose skin
 - mold temperature too low (cold collapse)
- ✗ Coarse Skin
 - mold temperature too high

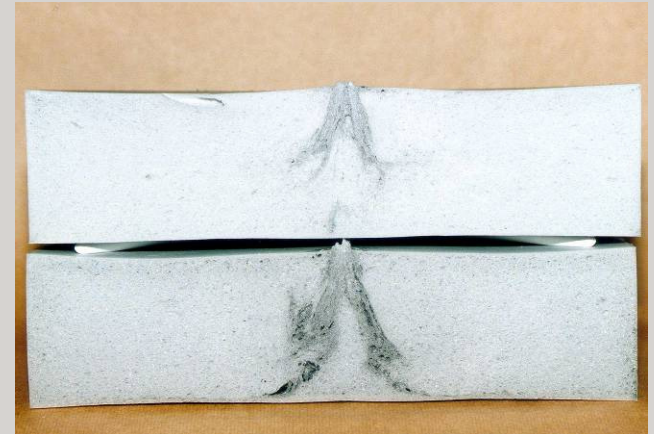
Typical HR molded foam defects



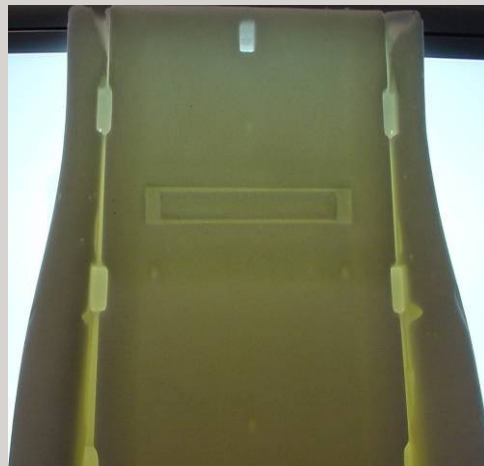
Collapse



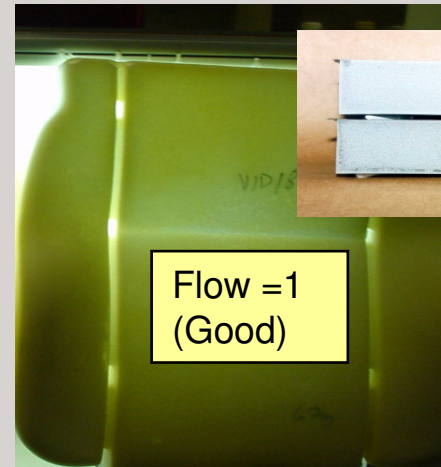
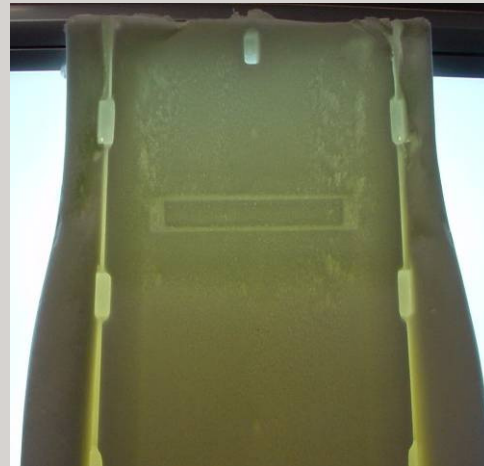
Shrinkage



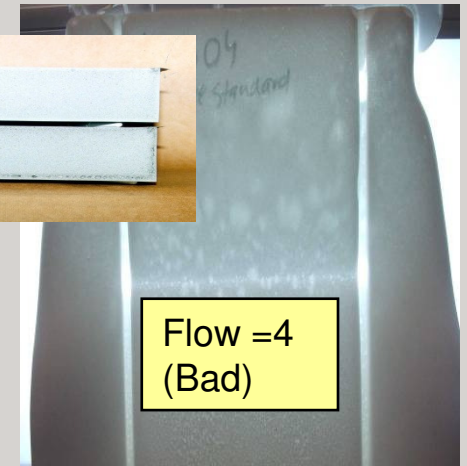
Vent Collapse



Surface Defects

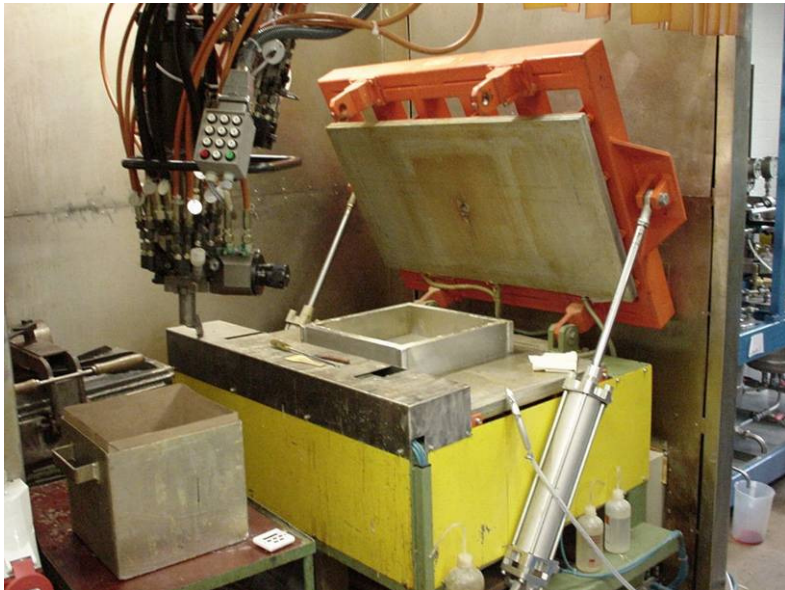


Subsurface Defects (Perl strings)



Capability of Technical Service Group

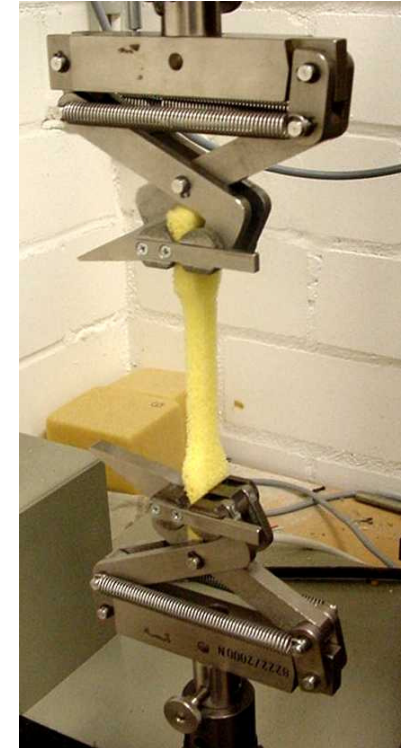
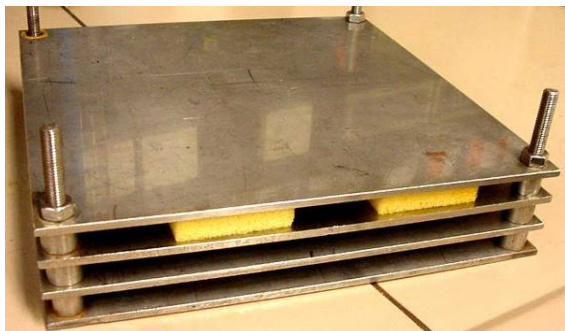
Various temperature controlled molds



Capability of Technical Service Group

Physical testing equipment:

- **Crushability**
- **Tensile strength / Elongation / Tear strength**
- **CLD / ILD-Hardness**
- **Compression Set/Wet set**
- **Density**
- **Elasticity**
- **DIN75201B fogging**
- **2D-cell analysis**





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