Microscopic Observation of Tow Deformation for Carbon Fabric-PVC Foam Sandwich Structures During Forming

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Objectives

Verification of Deformation Patterns

- Variations of Tow Parameters

⇒ w.r.t. the Foam Density & Forming Pressure

Correlation between Tow Variation and Material Property

- Construct Database for Computational Analysis

Materials for the Sandwich Structures

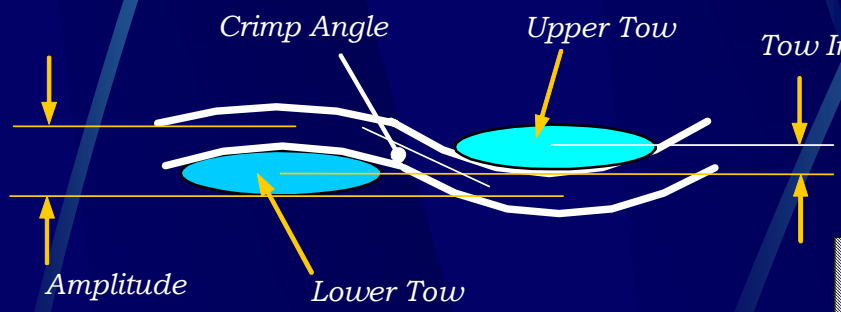
PVC Foams

- Densities: 50, 70, 90, 110
- Cell Type: Closed Cell

Fabric Composites

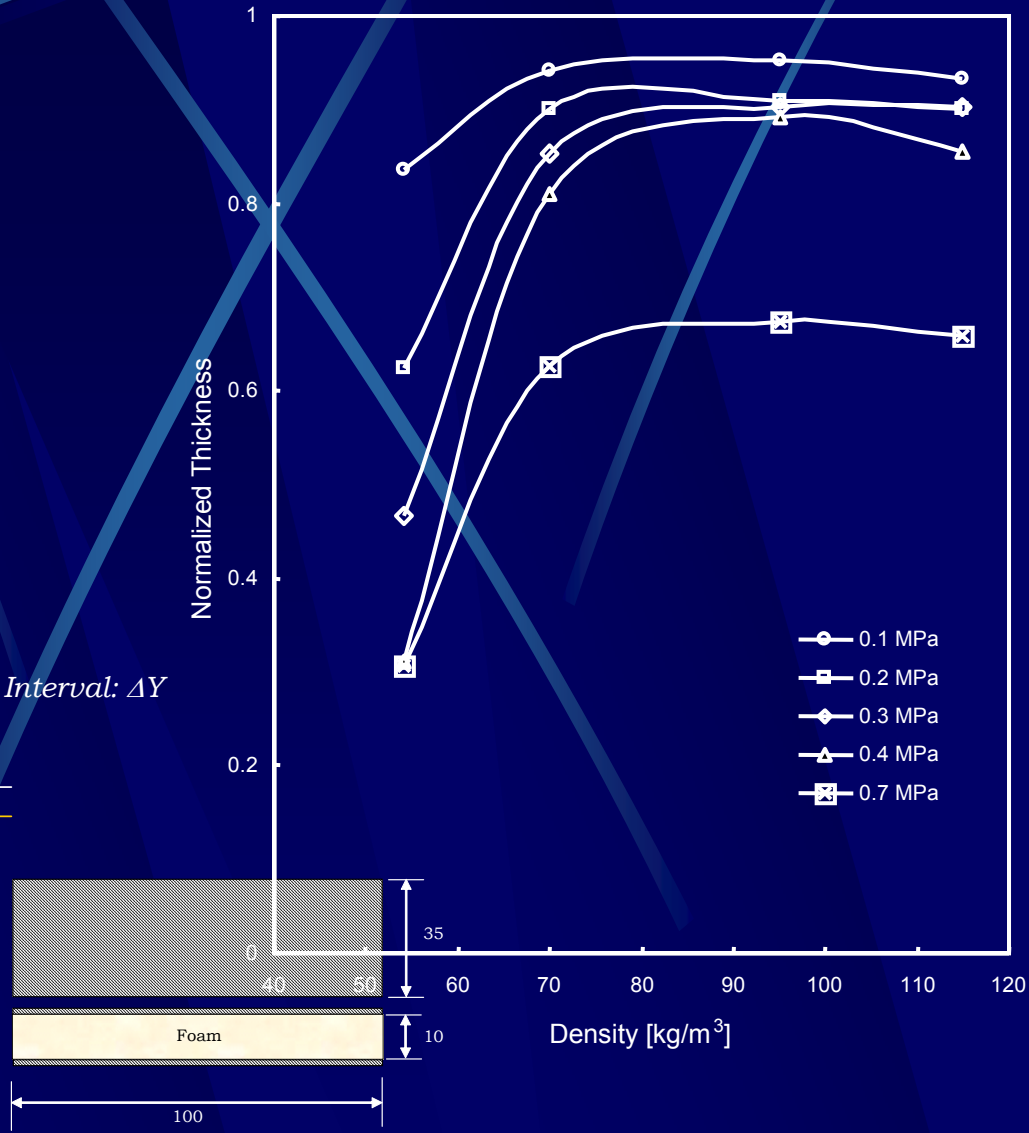
- Carbon/Epoxy
- Plain Weave (3k)

Unit Cell of the Fabric

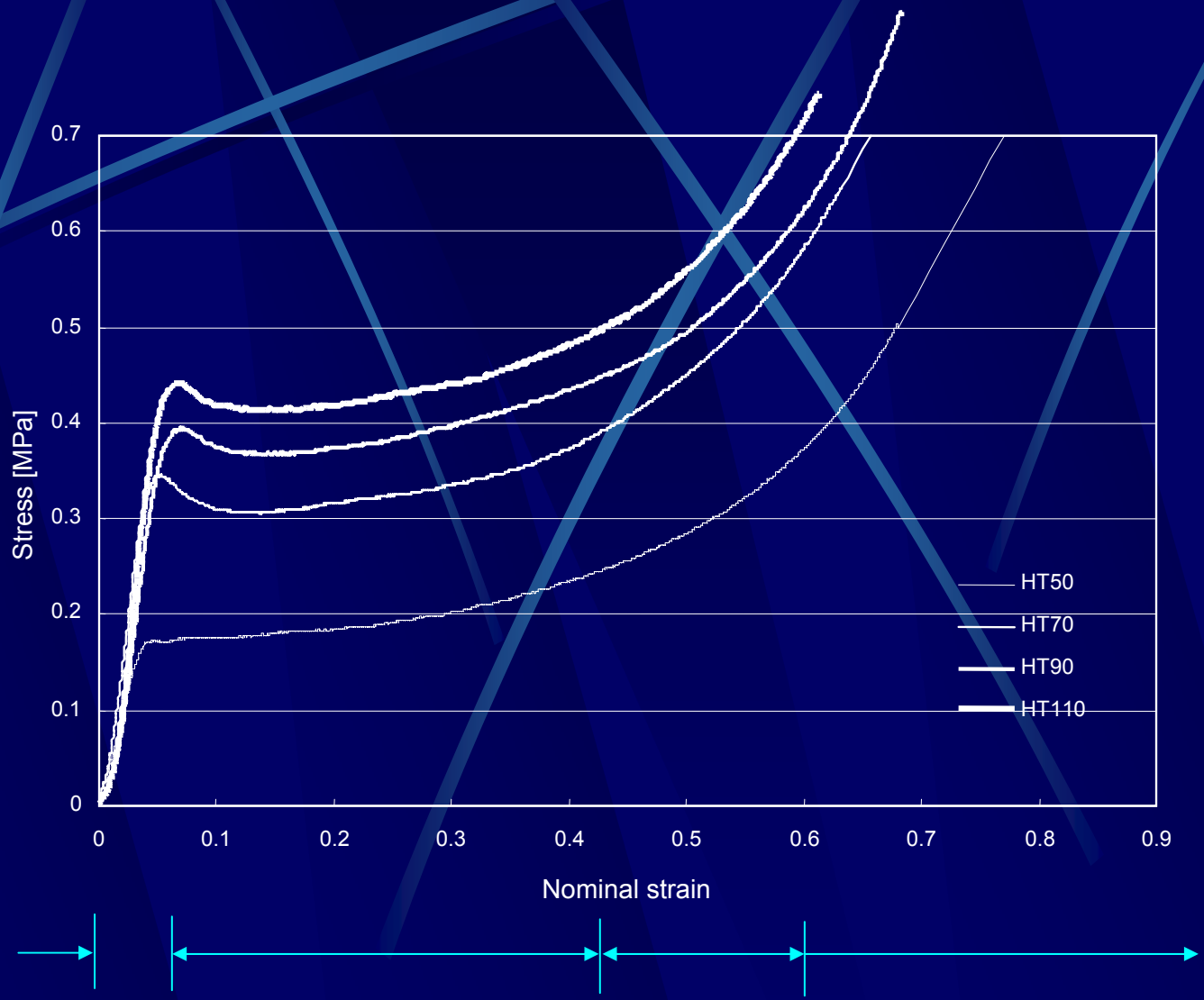


Forming Method

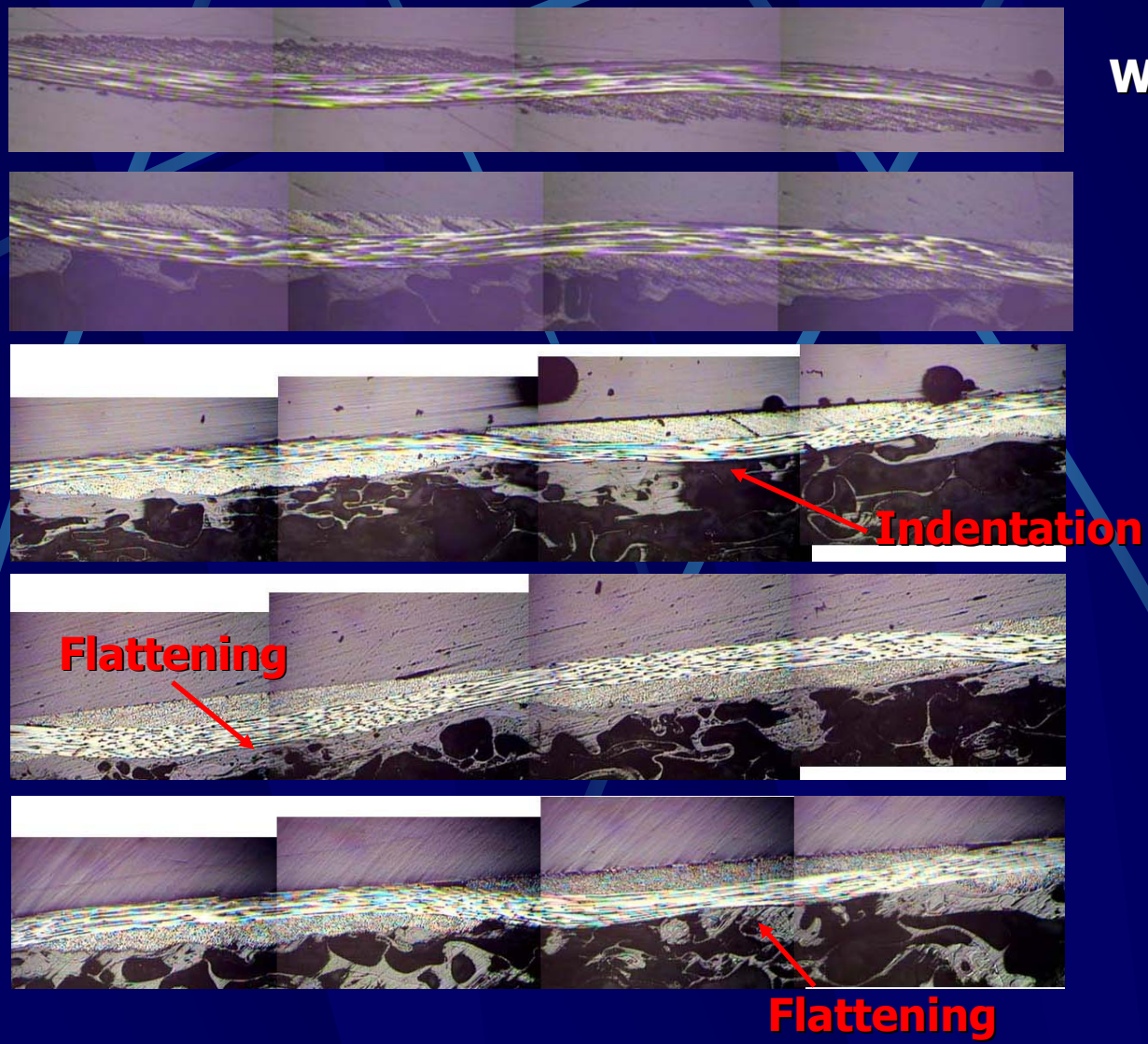
Autoclave De-gassing Moulding



Stress-Strain Relation of Foams at 125℃



Observation Results: HT50-PVC Foams



Without Pressure

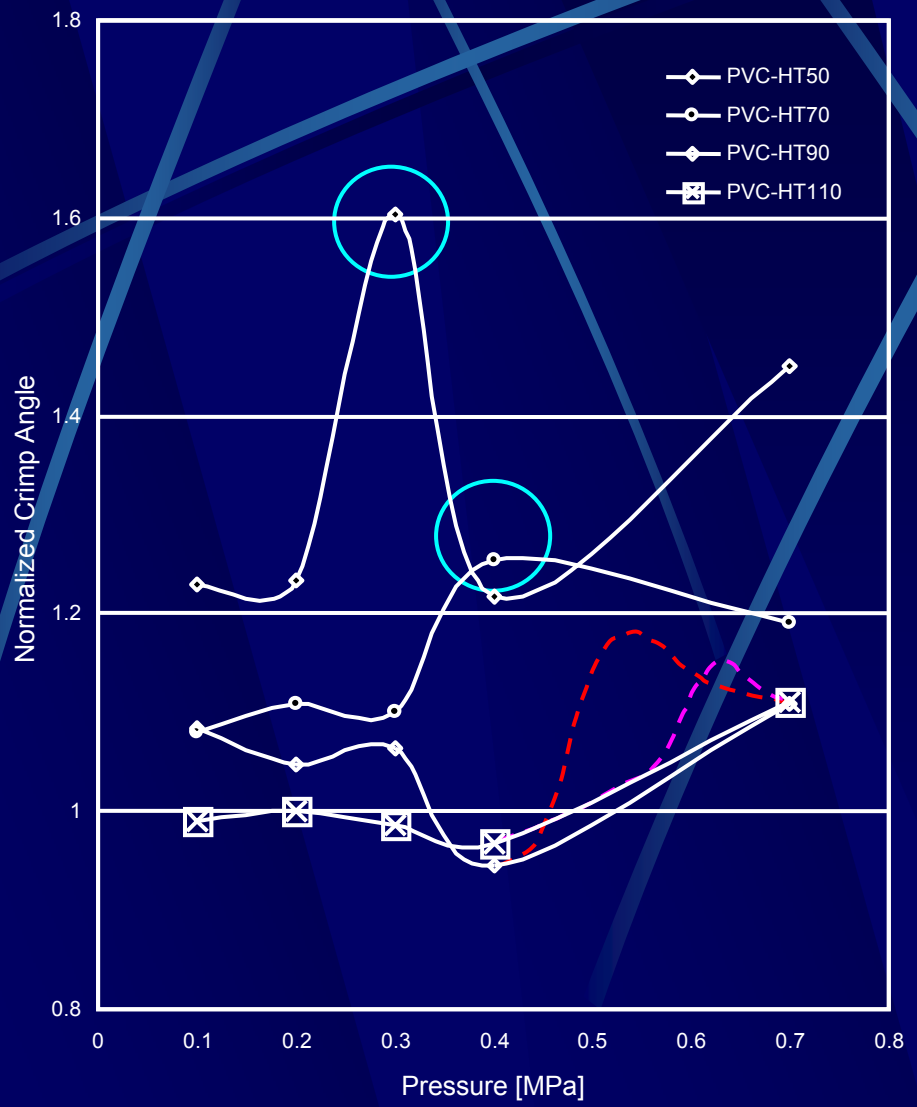
0.1MPa

0.3MPa

0.4MPa

0.7MPa

Tow Variation: Crimp Angle



Elastic Regions

⇒ Stretching Effect

⇒ Small Crimp Angle

Yielding Regions

⇒ Maintenance

⇒ Spreading of Tows

Densification Starts

⇒ Abruptly Increases

⇒ Tow Indentation

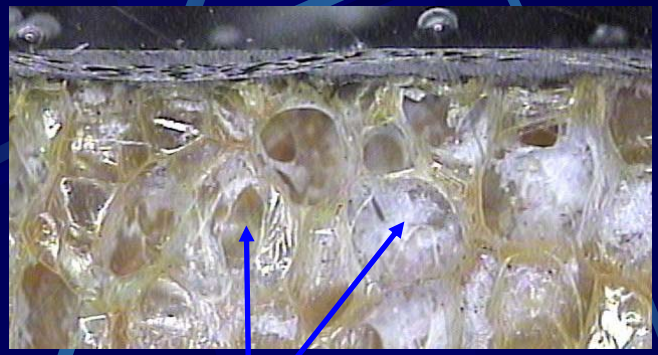
Full Densification

⇒ Decreases

Microscopic Deformation: Foam and Fabrics

HT50

0.1MPa: Elastic Region

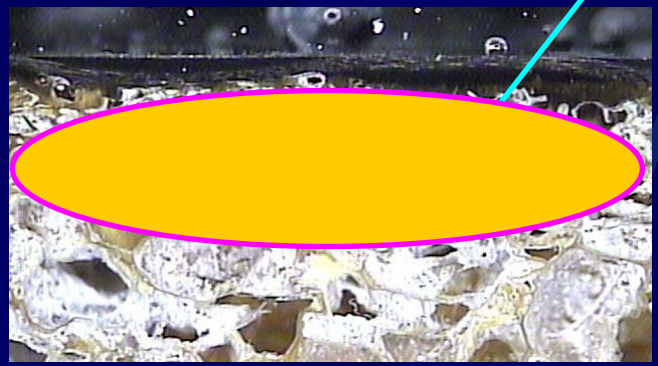


Foam Cells

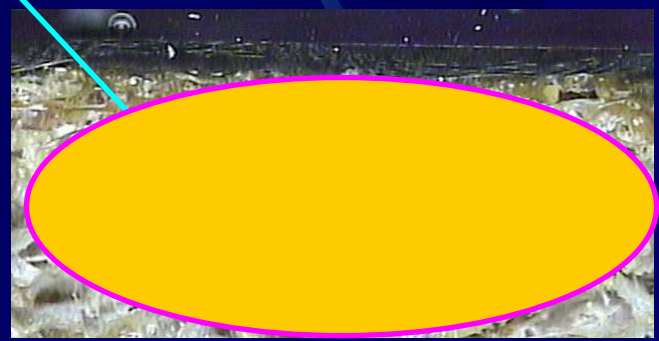
0.2MPa: Yielding

Cell Wall Crashing

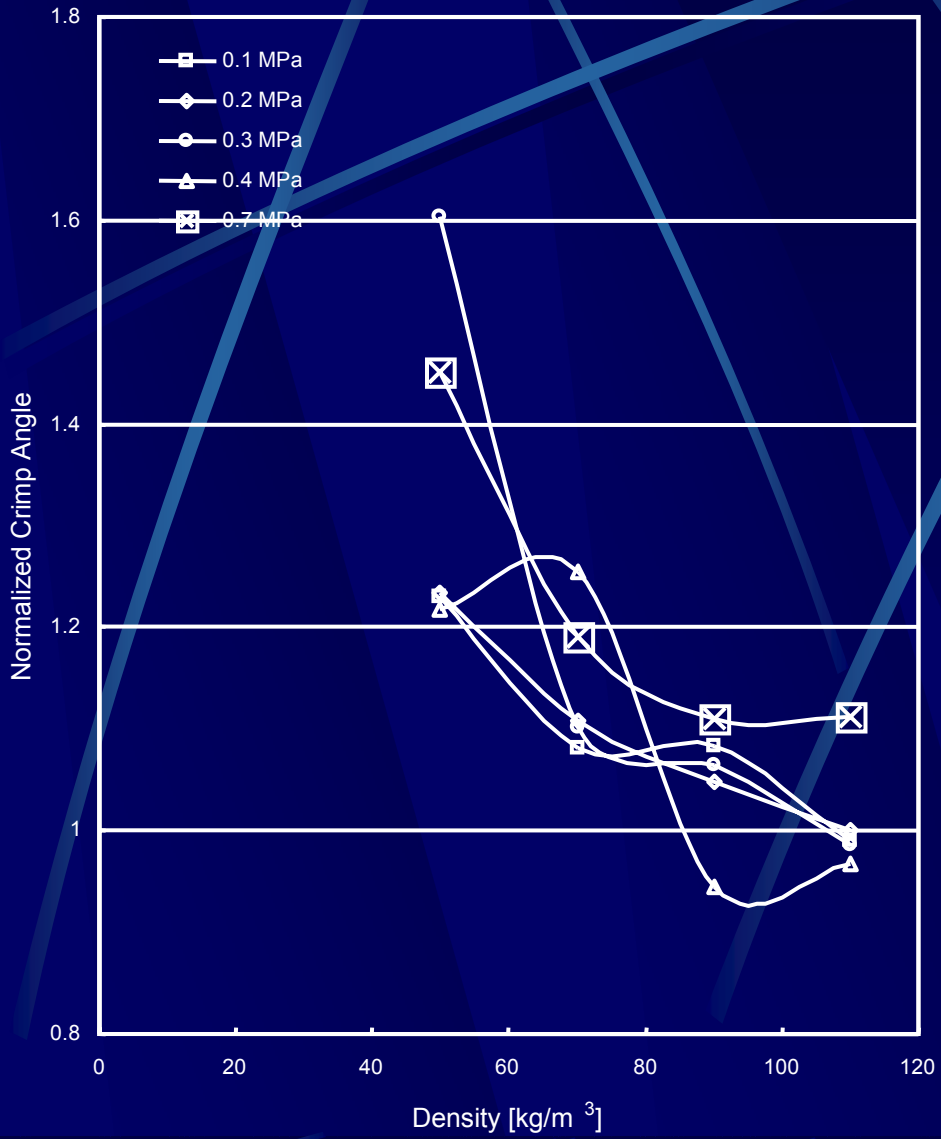
0.3MPa: Densification Starts



0.7MPa: Densification

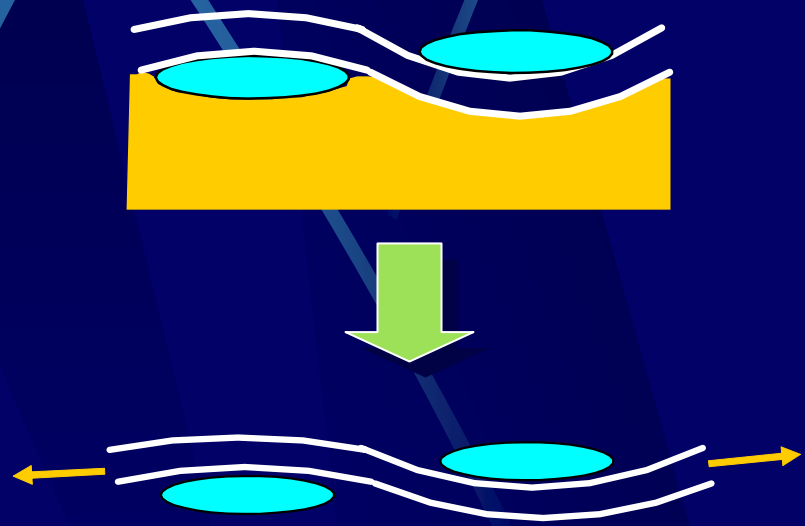


Tow Variation: Crimp Angle



As Foam Density Increases

Crimp Angle Decreases



Stretching Effects

Conclusion

Microscopic Observation

- Crimp Angle

- Micro-Deformation of Foams (Cell Wall)

⇒ Geometric Deformations of Fabrics

⇒ Correlation between Parameters and *Foam Behaviour*

(Elastic, Yielding, Densification)

w.r.t. Foam Density, Forming Pressure