



Vacuum Lamination Process with Diffusion Tight Edge Sealing for Smart Glass Applications

Markus Jandl / LiSEC Austria GmbH / Function meets Glass 2016

Program

Smart Glass Concept

Target

Tempered Thin Glass

Process description, Appearance of glass

Diffusion Tight Edge Sealing & Vacuum Lamination

Process description, Layout

Production of quadruple I.G.-Unit with Smart Glass

Parameter & photos of production

Result

Product features

best in glass processing

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Targets

- Optical appearance
- Improved insulating value
- Carbon Footprint
- Less weight
- Long time durability



AEROFLAT tempering



Quadruple IG-Unit



Less material & efficient process



Tempered thin glass



Diffusion tight encapsulation

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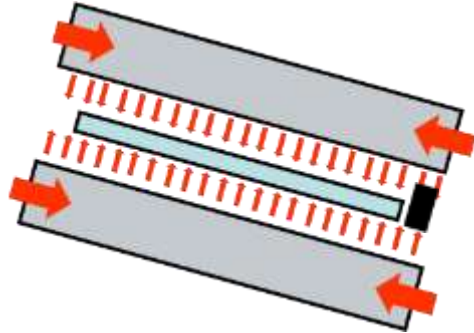
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Tempered Thin Glass

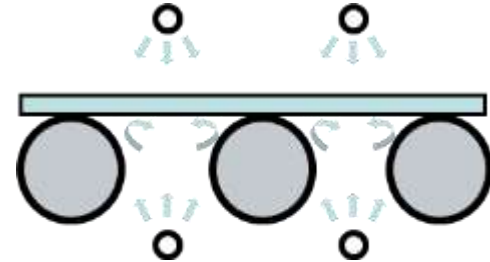
Tempering Technology



AEROFLAT air cushion technology



Conventional roller technology



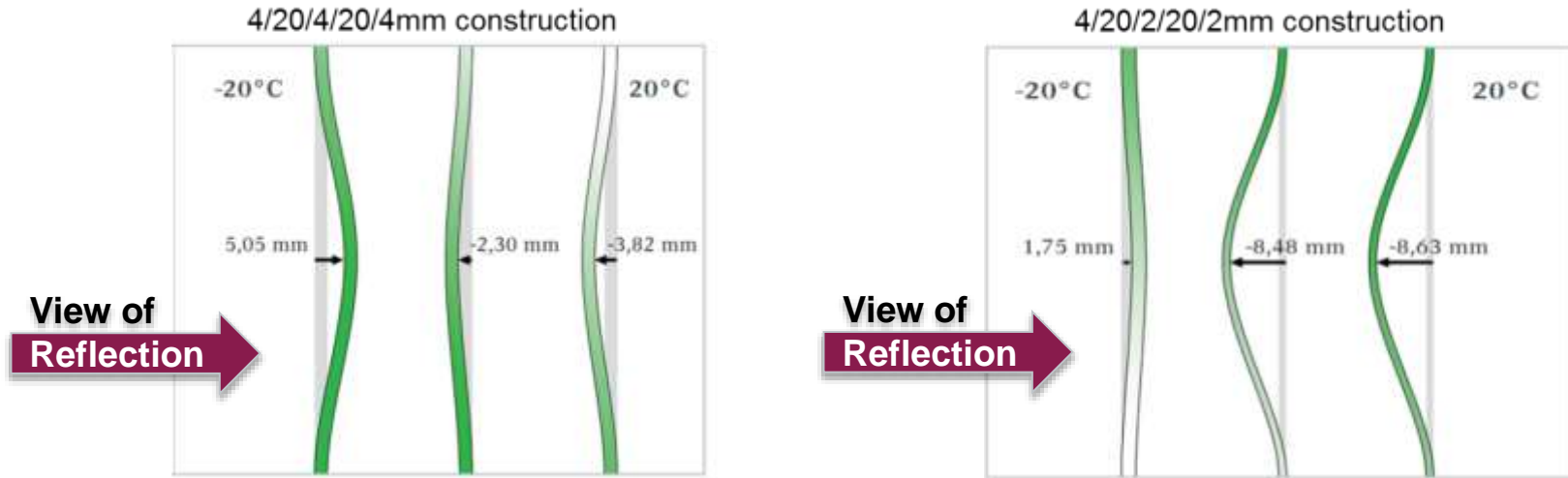
The differences between air cushion technology and conventional roller furnaces include:

- The glass surface is not touched
- Air cushions are used instead of ceramic rollers
- Maximum convection in the circulation system
- Symmetrical energy input



Tempered Thin Glass

Glass Membranes

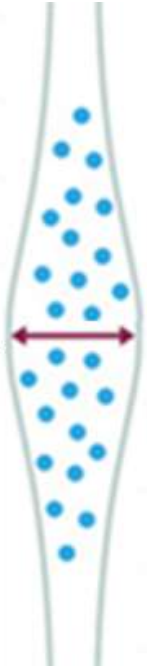


Different temperatures in the IG chambers causes different pressures. These climatic loads bends the glass. Through an asymmetric construction, thick glass for wind loads on the outside of the IG unit and thin tempered glass as a membrane on the inside of the building enables a better appearance of the glass facade.

Tempered Thin Glass

Appearance resulting climatic loads

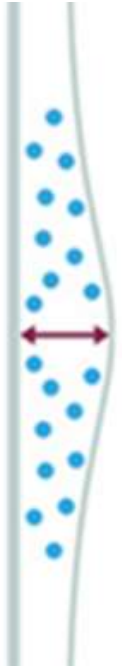
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Symmetric Design

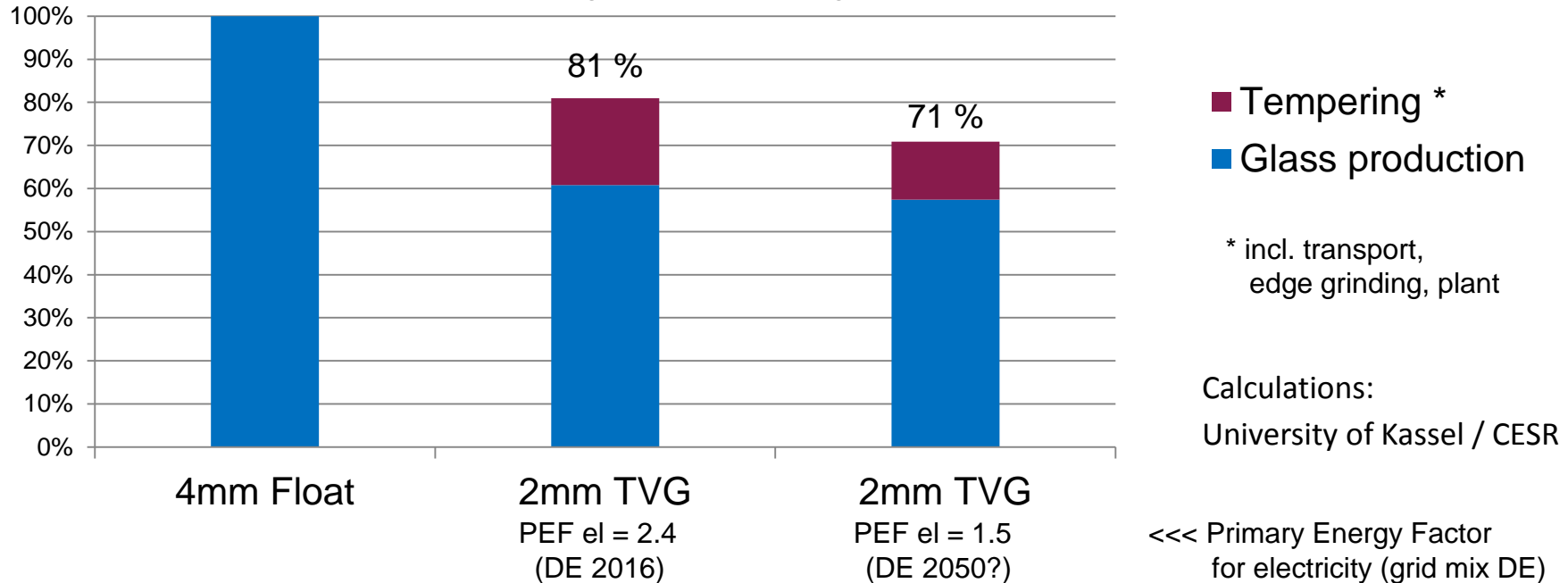


Asymmetric Design



Cumulated Energy Demand (CED) for the Production of 4mm Float Glass vs. 2mm Thin Glass

CED = Cumulated Primary Energy Input [MJ/m² glass pane]



Tempered Thin Glass

Neutral Bending Phase



Advantages thin glass in a solar module or glass-glass laminate

- Higher flexibility
- Cells or functional layers are in the neutral bending phase

Tempered Thin Glass

Neutral Bending Phase

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Bending Test Solar Panel
2x 2 mm Glass + Lamination



Biege Belastungstest Solar Modul
2x 2 mm Glas + Laminat



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Diffusion Tight Edge Sealing

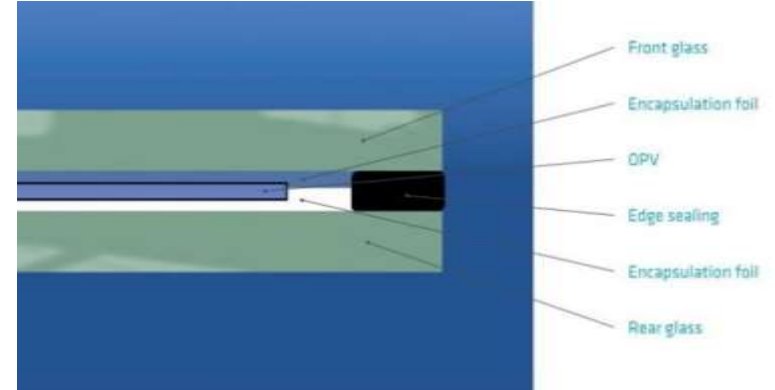
Process description



VHA edge sealing applicator



Edge Sealing = Reactive Butyl

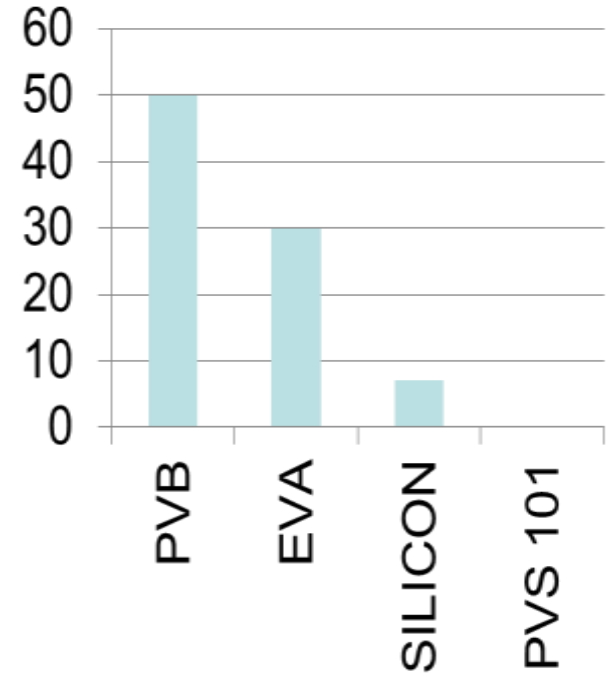


Diffusion Tight Edge Sealing

Water vapor diffusion



▪ PVB	Encapsulation foil	~ 50 g/m²day
▪ EVA	Encapsulation foil	~ 30 g/m²day
▪ Tectosil / Silicon	Encapsulation foil	~ 7 g/m²day
▪ PVS 101	Edge sealing	0,01 g/m²day



Due to the additional edge sealing, the module is 700 times more water vapor diffusion tight as the best encapsulation foil.

The cells or functional layers are best protected against moisture and environmental influences.

Vacuum Lamination Technology

Process description

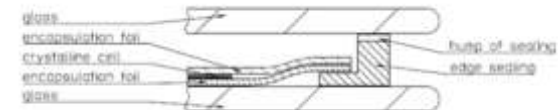
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- **Air evacuation of the chamber** <1mbar 120 seconds
- **Preheating time** 60 seconds
electric heated metal plate (e.g. 110°C for PVB interlayers)
lifts the laminate from the transport rollers for a fast heat transfer
- **Press time** 5 seconds
laminate is pressed between two heated metal plates to a defined gap, that the edge sealing tight both glasses. A rest gap of roughly 1mm between the glasses ensures, that e.g. crystalline cells does not break
- **Deairing time to atmospheric pressure** 45 seconds
Vacuum inside and atmospheric pressure outside the laminate
press both glasses smooth to the end thickness without mechanical force

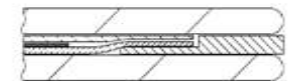
total time ~ 4 minutes



before Vacuum Lamination



after Vacuum Lamination



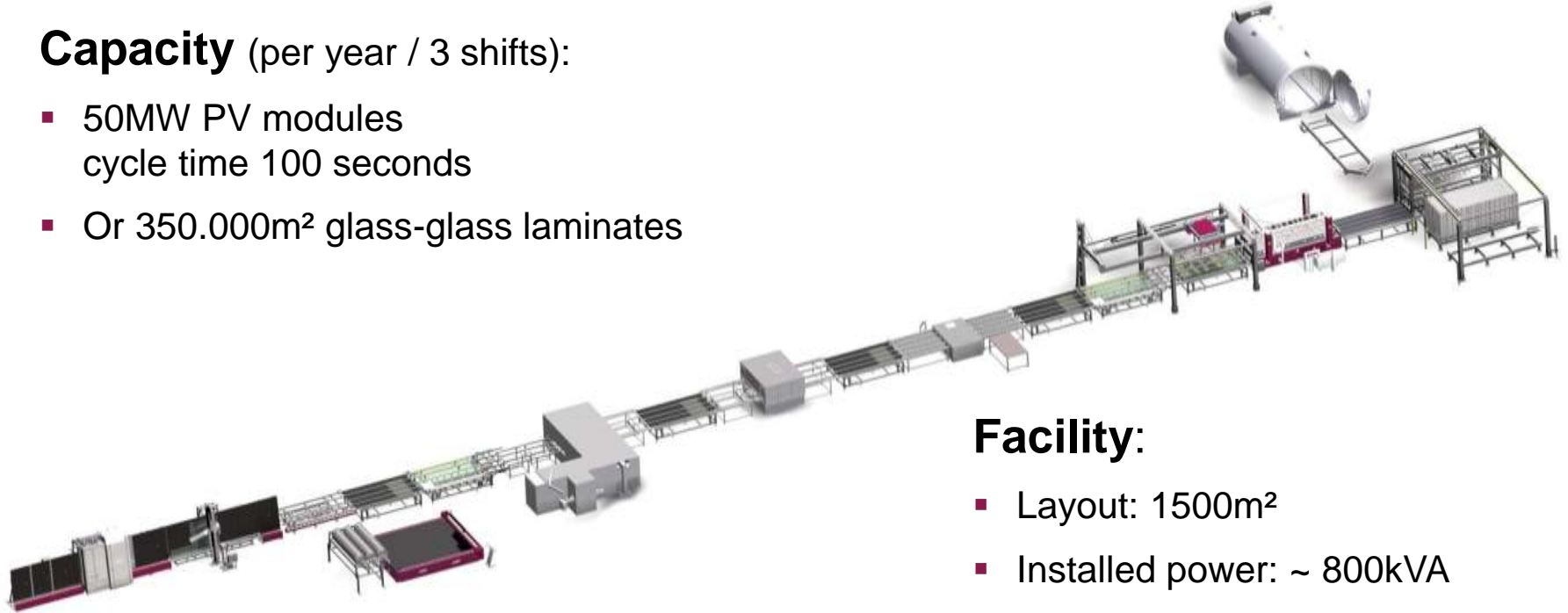
Vacuum Lamination Technology

Capacity / Layout



Capacity (per year / 3 shifts):

- 50MW PV modules
cycle time 100 seconds
- Or 350.000m² glass-glass laminates



Facility:

- Layout: 1500m²
- Installed power: ~ 800kVA
- Power consumption: ~ 400kW/h

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Production of Quadruple I.G.-Unit with Smart Glass Assembling

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Production of Quadruple I.G.-Unit with Smart Glass Lamination



Before Vacuum Lamination
110°C / 4 minutes / <1mbar



Before Autoclave
130°C / 90 minutes / 3bar



Production of Quadruple I.G.-Unit with Smart Glass

Insulating glass production



Fully automatic TPA line
for quadruple I.G.-Units

Manual connecting of cables
and secondary sealing



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Result of Quadruple I.G.-Unit with Smart Glass

Product features



LiSEC exhibition mock-up at glass technology live in hall 11 / D24

- Quadruple I.G.-Unit
- Ug-value 0.3 W/m²K with Argon filling
- 2mm heat strengthened glass membranes
- TPA flexible spacer
- Functional laminate with edge sealing
- Integrated transparent OPV for energy harvesting
- Integrates switchable PDLC layer (privacy glass)
- Size 1000x1900mm
- Weight only 60kg



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Thank you for your attention.