



GPB
GLASS
PERFORMANCE
DAYS TAMPERE
FINLAND

ALL EYES ON SMARTER GLASS
GLASS PERFORMANCE DAYS 2019
JUNE 26-28, 2019, TAMPERE, FINLAND

WORKSHOPS JUNE 25-26
CONFERENCE SESSIONS, EXHIBITION
AND STEP CHANGE JUNE 26-28

GPD.FI
#GPD2019

GLASS PERFORMANCE DAYS 2019, JUNE 26-28, 2019, TAMPERE, FINLAND



A PLACE OF PIONEERING SPIRIT  **folienwerk**
wolfen®

Controlling lamination result
of EVA laminating films for several lamination processes

Steffen Bornemann, Nishanth Thavayogarah, Kristin Riedel, Jasmin Weiss

Bornemann, Steffen. Folienwerk Wolfen GmbH

GLASS PERFORMANCE DAYS 2019, JUNE 26-28, 2019, TAMPERE, FINLAND 

Overview

- Company introduction
- Motivation
- Use of EVA laminating films in vacuum lamination processes
- Use of EVA laminating films in nip roll / autoclave processes
- Summary







Glass performance days, tampere, finland, june 27th, 2019 Folienwerk Wolfen GmbH 2

Bornemann, Steffen. Folienwerk Wolfen GmbH



GLASS PERFORMANCE DAYS 2019, JUNE 26-28, 2019, TAMPERE, FINLAND 



Folienwerk Wolfen GmbH - Facts


-  Family owned company
-  40 Mio Euro annual turnover
-  160 employees in 4 shift continuous production
-  8 extrusion lines with 20.000 to capacity
-  In-house R&D department and Quality Control
-  Traceability back to a single vendor batch
-  Customized solutions for niche markets



Thalheim
Standort Folienwerk Wolfen










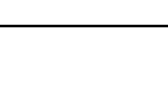





Packaging films Nip films Forming films Medical device films Gold laminated films Glass laminated films Special films 3


Bornemann, Steffen. Folienwerk Wolfen GmbH


GLASS PERFORMANCE DAYS 2019, JUNE 26–28, 2019, TAMPERE, FINLAND 

Products

PET-A	(150 – 800 µm)
PET-G	(200 – 1200 µm)
PET-GAG	(150 – 800 µm)
PC	(300 – 1000 µm)
PET-MPE	(100 – 800 µm)
PLA	(200 – 800 µm)
BIO-PET	(150 – 800 µm)
evguard®	(200 – 1140 µm)
evguard® MPE	(200 – 600 µm)


**folienwerk
wolfen®**



> Smart multi-layer solution
> Up to 9 single layers
> Customized & sustainable

Glass performance days, tampere, finland, june 27th, 2019 Folienwerk Wolfen GmbH 4

Bornemann, Steffen. Folienwerk Wolfen GmbH

GLASS PERFORMANCE DAYS 2019, JUNE 26–28, 2019, TAMPERE, FINLAND 

Overview


- Company introduction
- **Motivation**
- Use of EVA laminating films in vacuum lamination processes
- Use of EVA laminating films in nip roll / autoclave processes
- Summary


**folienwerk
wolfen®**




Glass performance days, tampere, finland, june 27th, 2019 Folienwerk Wolfen GmbH 5

Bornemann, Steffen. Folienwerk Wolfen GmbH

GLASS PERFORMANCE DAYS 2019, JUNE 26–28, 2019, TAMPERE, FINLAND 

Manufacture of laminated glasses

 **folienwerk**
wolfen®

- Status quo: polymeric laminating films

	Nip roll / Autoclave	Vacuum technology
PVB	standard	possible, but seldom
Ionomer	usable for safety glasses	possible, but seldom
EVA	low experience	standard

Glass performance days, tampere, finland, june 27th, 2019 Folienwerk Wolfen GmbH 6

Bornemann, Steffen. Folienwerk Wolfen GmbH

GLASS PERFORMANCE DAYS 2019, JUNE 26–28, 2019, TAMPERE, FINLAND 

Overview


 **folienwerk**
wolfen®

- Company introduction
- Motivation
- Use of EVA laminating films in vacuum lamination processes
- Use of EVA laminating films in nip roll / autoclave processes
- Summary




Glass performance days, tampere, finland, june 27th, 2019 Folienwerk Wolfen GmbH 7




Bornemann, Steffen. Folienwerk Wolfen GmbH

GLASS PERFORMANCE DAYS 2019, JUNE 26–28, 2019, TAMPERE, FINLAND 

EVA in vacuum lamination processes

 **folienwerk wolfen®**

- Vacuum process – laminating kilns
- for smaller sizes and specialities
- typical size of glass laminates up to 2 x 4 m
- special structures (switchable films inside, smart glasses)
- state-of-the-art in solar industry

Glass performance days, tampere, finland, june 27th, 2019 Folienwerk Wolfen GmbH 8

Bornemann, Steffen. Folienwerk Wolfen GmbH

GLASS PERFORMANCE DAYS 2019, JUNE 26–28, 2019, TAMPERE, FINLAND 

EVA in vacuum lamination processes

 **folienwerk wolfen®**

- glass laminates with switchable LC films inside
- used for daily life, hotels...
- Challenge: LC film is sensitive to temperature




Glass performance days, tampere, finland, june 27th, 2019 Folienwerk Wolfen GmbH 9

Bornemann, Steffen. Folienwerk Wolfen GmbH

GLASS PERFORMANCE DAYS 2019, JUNE 26–28, 2019, TAMPERE, FINLAND

GB

EVA in vacuum lamination processes

FWG folienwerk wolfen®

- glass laminates with inserts like meshes, printed films, nonwovens etc.
- used for interior, sometime also for facades
- Challenge:
Laminate has to be free of bubbles, twisting or warping



Glass performance days, tampere, finland, june 27th, 2019

Folienwerk Wolfen GmbH

10

Bornemann, Steffen. Folienwerk Wolfen GmbH

GLASS PERFORMANCE DAYS 2019, JUNE 26–28, 2019, TAMPERE, FINLAND

GB

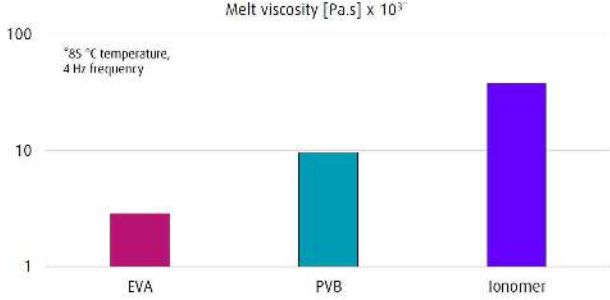
EVA in vacuum lamination processes

FWG folienwerk wolfen®

- Advantage of EVA laminating film in vacuum lamination process:
Good melt viscosity in the critical temperature region

Melt viscosity [Pa.s] x 10³

85 °C temperature, 4 Hz frequency



Material	Melt viscosity [Pa.s] x 10 ³
EVA	~3
PVB	~10
Ionomer	~40

Glass performance days, tampere, finland, june 27th, 2019

Folienwerk Wolfen GmbH

11

Bornemann, Steffen. Folienwerk Wolfen GmbH

GLASS PERFORMANCE DAYS 2019, JUNE 26–28, 2019, TAMPERE, FINLAND 


Overview

- Company introduction
- Motivation
- Use of EVA laminating films in vacuum lamination processes
- Use of EVA laminating films in nip roll / autoclave processes
- Summary



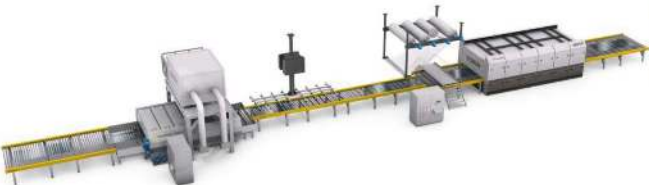

Glass performance days, tampere, finland, june 27th, 2019 Folienwerk Wolfen GmbH 12

Bornemann, Steffen. Folienwerk Wolfen GmbH

GLASS PERFORMANCE DAYS 2019, JUNE 26–28, 2019, TAMPERE, FINLAND 

EVA in nip roll / autoclave process

- Nip roll / autoclave
- for big volume and large glass sizes, mass production
- glass laminates of 3.2 x 6 m (or longer) possible
- production of safety glasses

Glass performance days, tampere, finland, june 27th, 2019 Folienwerk Wolfen GmbH 13

Bornemann, Steffen. Folienwerk Wolfen GmbH

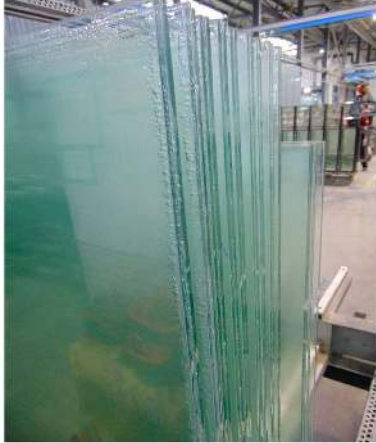
GLASS PERFORMANCE DAYS 2019, JUNE 26–28, 2019, TAMPERE, FINLAND

GB

EVA in nip roll / autoclave process

FWG folienwerk wolfen®

- Big sized glass laminates for use as architectural elements like facades, balustrades, safety glass windows
- Challenge:
Laminate has to be free of bubbles



Glass performance days, tampere, finland, june 27th, 2019

Folienwerk Wolfen GmbH

14

Bornemann, Steffen. Folienwerk Wolfen GmbH

GLASS PERFORMANCE DAYS 2019, JUNE 26–28, 2019, TAMPERE, FINLAND

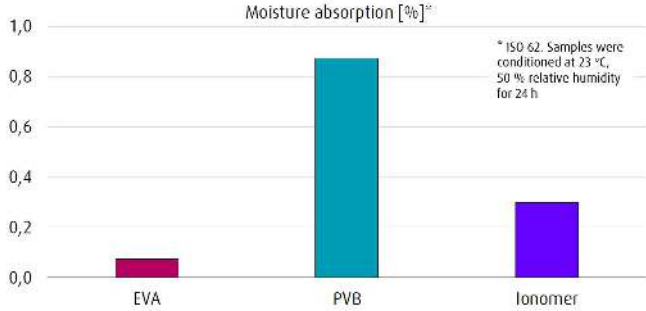
GB

EVA in nip roll / autoclave process

FWG folienwerk wolfen®


- Advantage of EVA laminating film in Nip roll / Autoclave process:
Best moisture resistance of the common polymeric materials

Moisture absorption [%]^{*)}



Material	Moisture absorption [%]
EVA	~0,08
PVB	~0,88
Ionomer	~0,32

*) ISO 62. Samples were conditioned at 23 °C, 50 % relative humidity for 24 h




Glass performance days, tampere, finland, june 27th, 2019


Folienwerk Wolfen GmbH

15

Bornemann, Steffen. Folienwerk Wolfen GmbH

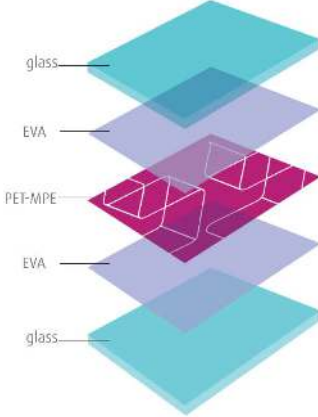
GLASS PERFORMANCE DAYS 2019, JUNE 26–28, 2019, TAMPERE, FINLAND 

EVA in nip roll / autoclave process



The combination of EVA and MPE for stronger glass laminates

- MPE = Modified PolyEster
(produced by Folienwerk Wolfen GmbH)
- withstands high thermal loads
- incorporation as a coloured or printed interlayer
- MPE is available in different dimensions
- highly improved impact resistance,
i.e. hurricane proof facades, secure balustrade



The diagram illustrates a five-layer glass laminate structure. From top to bottom, the layers are: a light blue glass layer, a light purple EVA interlayer, a central red PET-MPE interlayer with a grid pattern, another light purple EVA interlayer, and a final light blue glass layer. Labels on the left side of the diagram identify each layer: 'glass', 'EVA', 'PET-MPE', 'EVA', and 'glass'.

Glass performance days, Tampere, Finland, June 27th, 2019 Folienwerk Wolfen GmbH 16

Bornemann, Steffen. Folienwerk Wolfen GmbH

GLASS PERFORMANCE DAYS 2019, JUNE 26–28, 2019, TAMPERE, FINLAND 

Overview



- Company introduction
- Motivation
- Use of EVA laminating films in vacuum lamination processes
- Use of EVA laminating films in nip roll / autoclave processes
- Summary



The photograph shows a close-up of a glass laminating process in a factory. A large, curved glass panel is being processed on a conveyor system. The glass is partially covered with a white, translucent film. The background shows industrial machinery and a blue ceiling structure.

Glass performance days, Tampere, Finland, June 27th, 2019 Folienwerk Wolfen GmbH 17

Bornemann, Steffen. Folienwerk Wolfen GmbH

Summary

- vacuum technology and nip roll / autoclave for production of glass laminates for different applications
- several polymeric laminating films are in use
- settings need to be optimized for getting best performance
- some tests and technical support is advisable

