

WACKER

TECTOSIL[®] PV Film the Innovative Encapsulant

WACKER HYBRID MATERIALS, SEPTEMBER 2010

CREATING TOMORROW'S SOLUTIONS

Encapsulation Material

Property Profile Requirements

SECURING HIGH MODULE QUALITY AND BEST EFFICIENCY CREATES GREAT CHALLENGES FOR ENCAPSULATION MATERIALS

Encapsulation Material and its Property Profile Requirements

Optical Coupling

- Highly transparent material

Chemical Protection

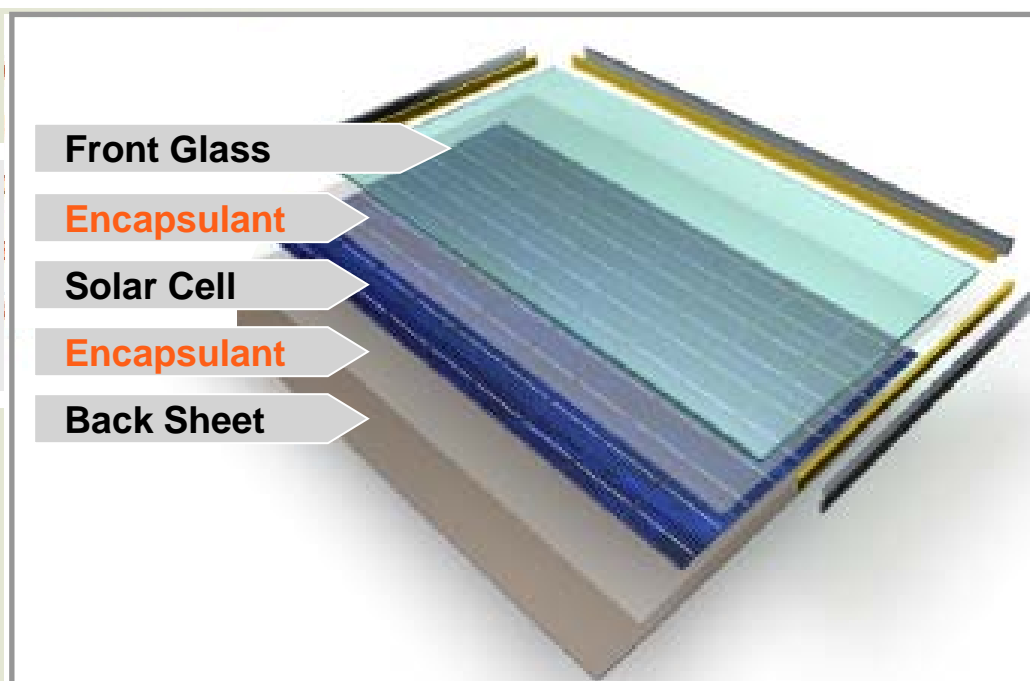
- High water-repellency
- Low water vapor permeability
- Non aggressive / inert material

Mechanical Protection

- Good adhesion to the layers
- Balance of different heat expansion coefficients
- Good electrical insulation

Processability

- Short cycle times
- Constant quality
- Easy handling and storage



TECTOSIL®

Property Portfolio, Differentiation



KEY TO IMPROVED MODULE QUALITY

TECTOSIL® Properties

Quality Benefits

Optical Performance:

Optimum transparency, UV-stable



High module efficiency, no UV-browning

Protection against chemical attack:

Highly water repellent



Reliable sealing and insulation performance

Low water-vapor uptake



No delamination

Chemically stable



No corrosive by-products

Protection against mechanical attack:

Excellent adhesion to different materials



High laminate stability and reliability

Constant properties in a very wide temperature range



Constant module properties even at low temperatures

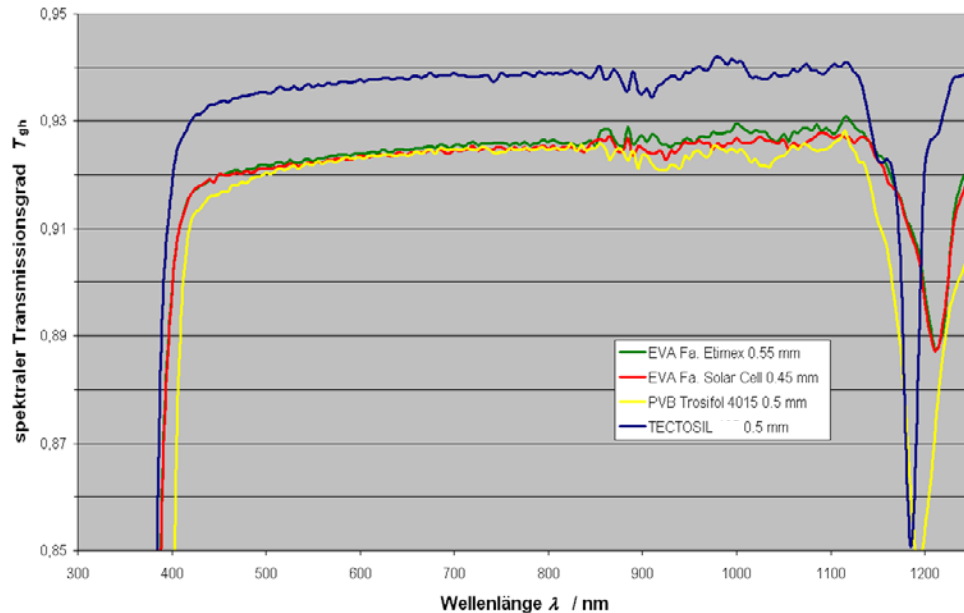
Highly flexible material, no plasticizers



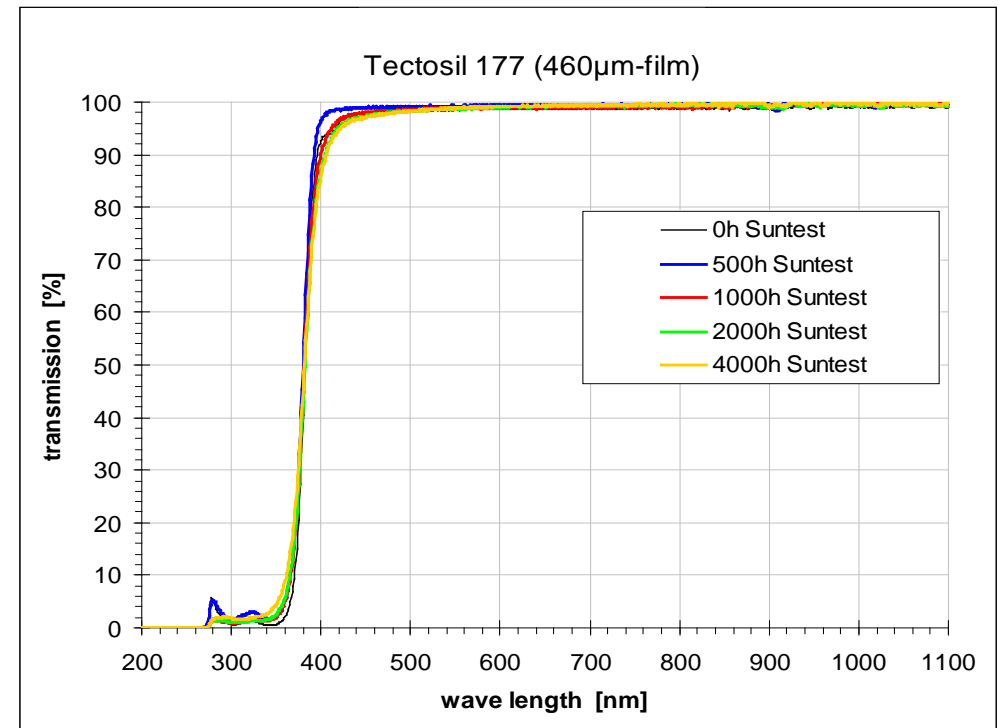
Stress-free encapsulation of the cells

HIGHER LIGHT TRANSMISSION OF TECTOSIL

Spektraler Transmissionsgrad T_{gh} der Proben EVA Fa. Etimex und EVA Fa. Solar Cell, Trosifol 4015 und Tectosil



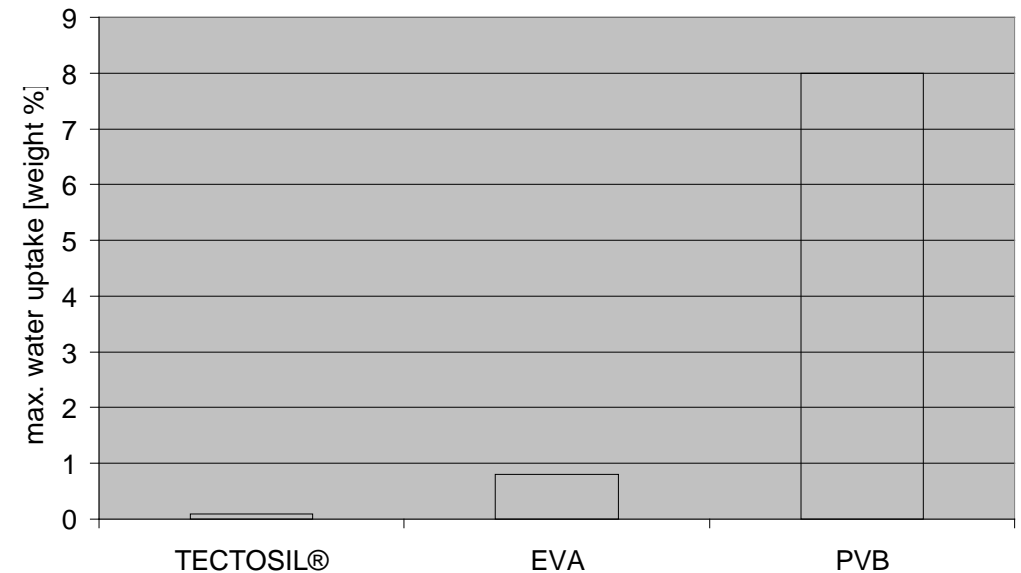
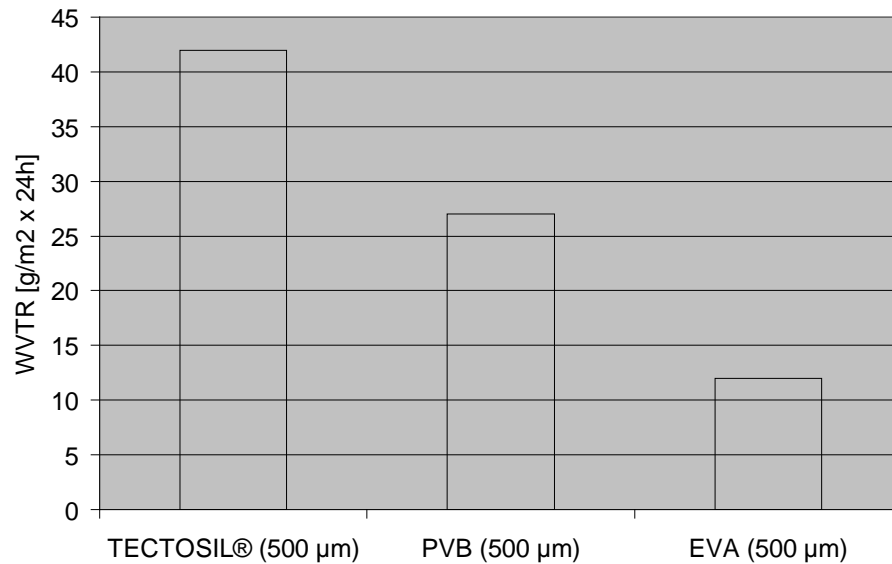
- TECTOSIL® has higher light transmission compared to EVA and PVB.
- no visible yellowing even after 4000 h irradiation
- (760 W/sqm, 60 °C)



SUPERIOR WATER REPELLENCY AND LOWEST ABSORPTION

water repellent:

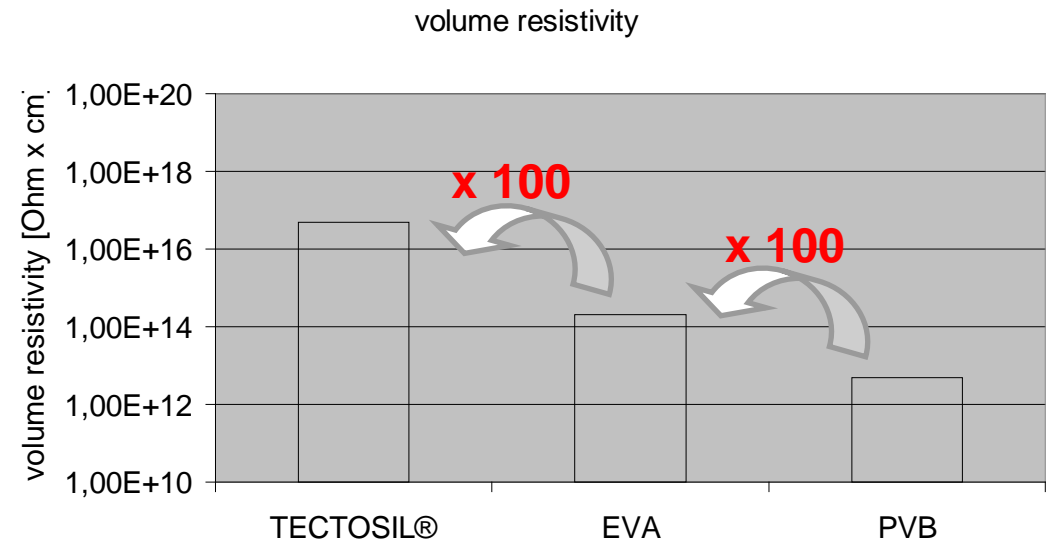
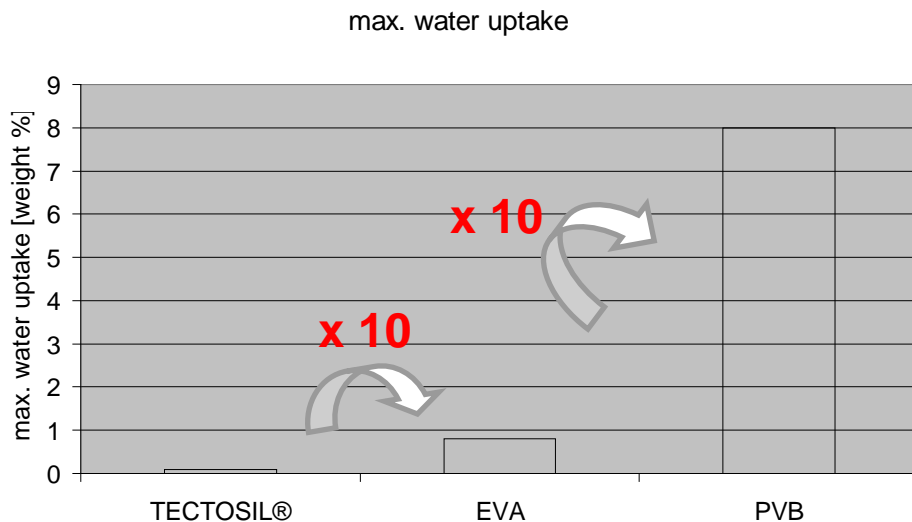
- high breathability (high WVTR)
- highly hydrophobic
- almost no water absorption / no ionic impurities



SUPERIOR RESISTANCE TO ELECTROCHEMICAL CORROSION

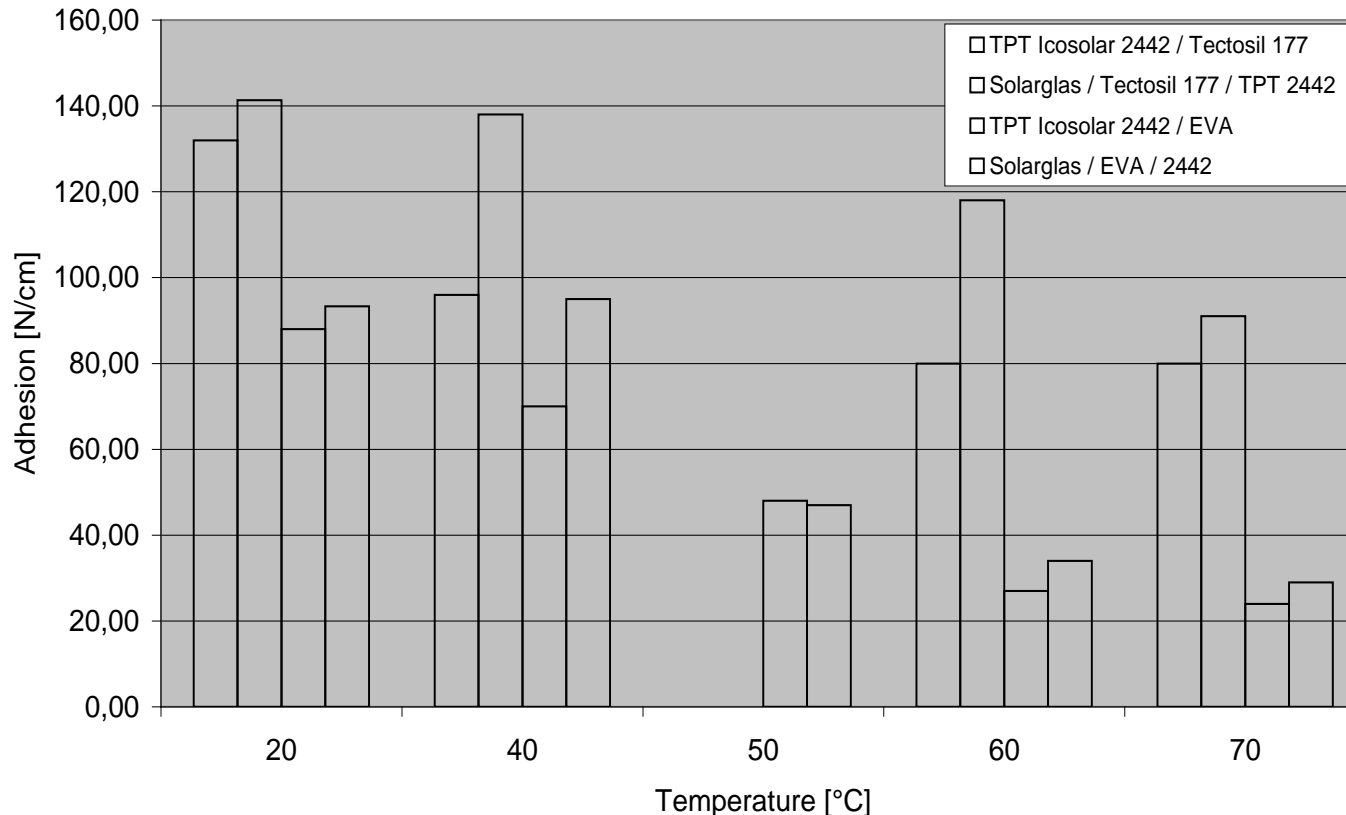
- unique combination of low water absorption combined with very high volume resistivity
- no/or less electrochemistry at interfaces
→ (electro) chemically stable

- less degradation , less increase in series resistance, higher FF over time
- higher life time expectancy
- no PIB for a-/μ-Si (1,50 €/module)
- much higher volume resistivity even after DH test (1000h) → better insulation properties (wet leakage test)



EXCELLENT ADHESION TO DIFFERENT MATERIALS EVEN AT HIGH TEMPERATURE WITH TECTOSIL

Temperature dependent adhesion



- EVA: adhesive failure (glass) from 40-45°C
- Tectosil: still cohesive failure at 70 °C

- EVA: approx. 70- 80% loss in adhesion
- Tectosil: approx. 30 % loss in adhesion

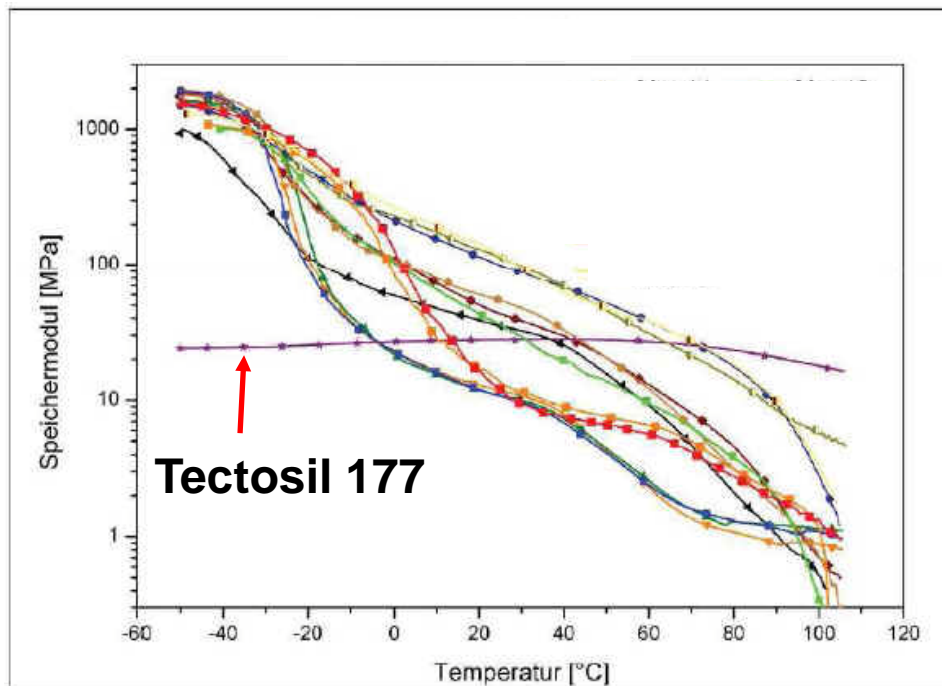
- adhesion loss:
- Tectosil: approx – 0,9 N/cm/K vs. Glas
- EVA: approx. - 2.3 N/cm/K vs Glas

test conditions:

- 180 ° peel adhesion
- EVA > 88 % gel content (US origin)

result : TECTOSIL: still cohesive failure at 70°C + excellent adhesion to glass and TPT films

CONSTANT PROPERTIES OVER WIDE TEMPERATURE RANGE



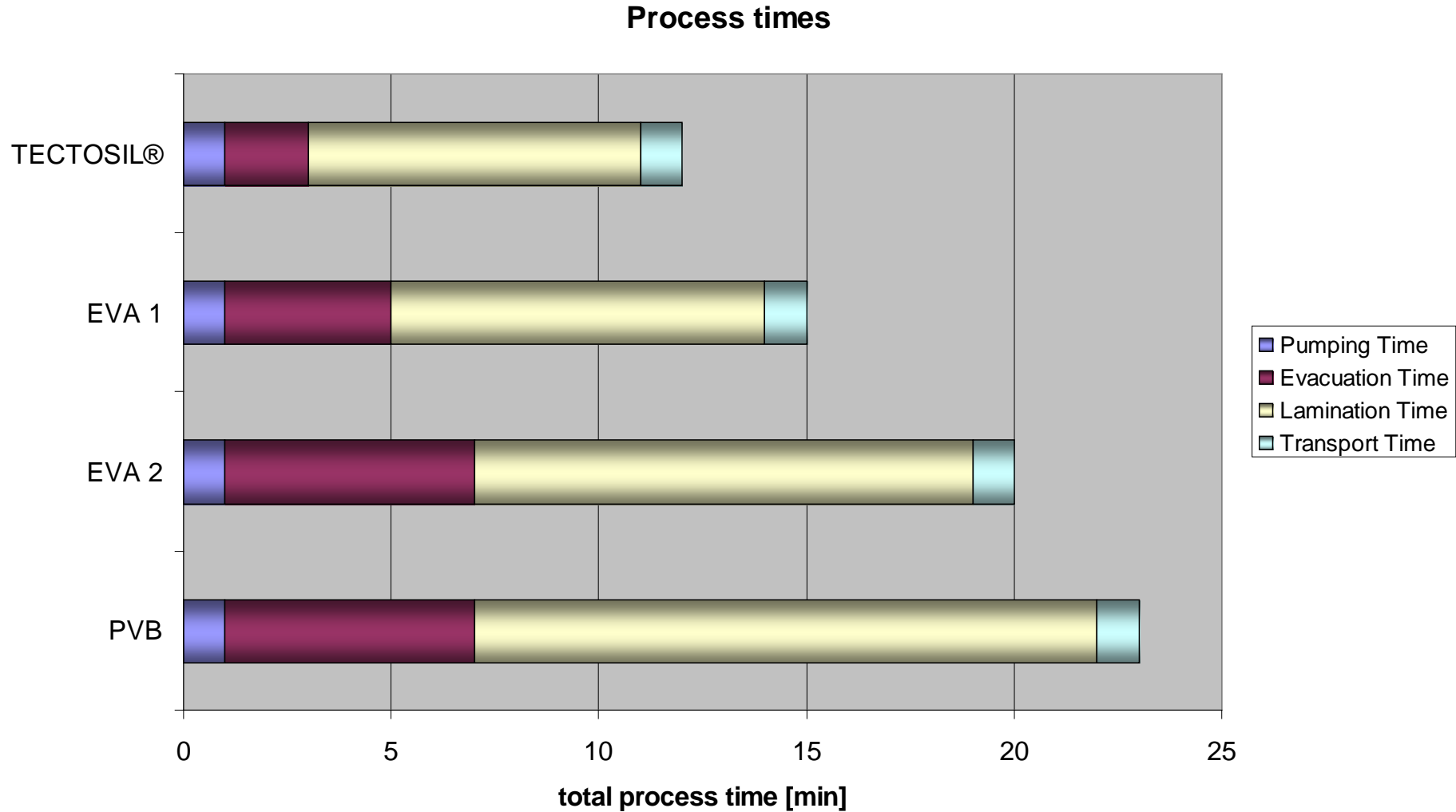
- new module concepts (glass/glass, 1.8mm, lifetime expectancy (4000 h DH, 200 HF cycles!))
- no stress on cells (thinner encapsulant, thinner cells, new stringer technology)
- thinner encapsulant (200-300 μm) possible
- suitable temperature range: -80 to + 100°C

modulus of various encapsulants vs. temperature

SHORT PROCESS, BETTER RESULTS

TECTOSIL® Properties	Process Benefits
No chemical curing	
user friendly storage conditions	→ no cold chain necessary
very fast lamination cycle	→ higher throughput
highest process reliability	→ less control measures
higher reproducibility	→ precise quality
no aggressive by-products	→ less maintenance
reprocess able	→ relamination of failed modules
Usable in roll and vacuum lamination	→ higher throughput
Usable in autoclave process	→ higher throughput
After use recycling	→ environmentally sustainable

VERY FAST LAMINATION CYCLES POSSIBLE



*Total cycle time based on glas / backsheets type module.

(standard laminator, 3 in 1 or stacked laminator much faster)

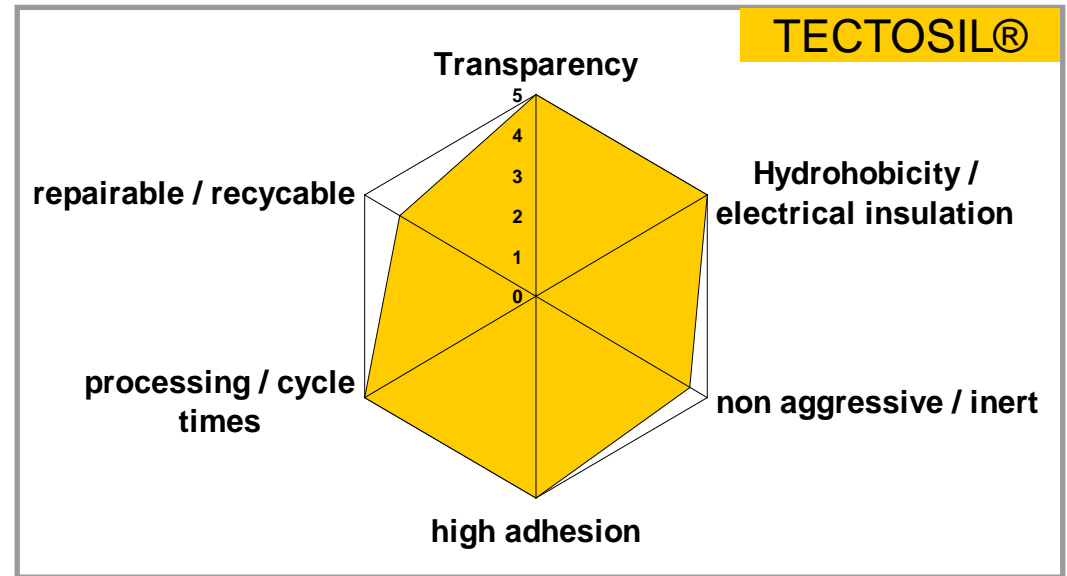
LAMINATION PROCESS

- suitable temperature range from 144-160 °C
- glass / back sheet modules and glass/glass modules
- cycle times depend on module type (heat capacity) and equipment (heat transfer rate)
- preferred back sheets based on PVF or PET (no EVA primer !)
- included aluminium sheet possible

ACHIEVEMENTS

- highest transmission
- no corrosive by products during processing / life time
- not supporting / prohibiting electrical corrosion
- best adhesion properties also at elevated temperatures
- flexibility over wide temperature range
- wide, suitable processing window from 144-160 °C
- rather short cycle times cycle times
 - depend on module type (heat capacity) and equipment (heat transfer rate)
- different module architectures possible:
 - glass / back sheet modules and glass / glass modules

TECTOSIL® THERMOPLASTIC SILICONE ENCAPSULANT FILM COMBINES BEST QUALITY AND EASY PROCESSING



TECTOSIL® is a highly transparent easy to process encapsulant film that helps to achieve high module efficiency and provides lasting protection of all module types.

THANK YOU



THANK YOU FOR YOU ATTENTION



TECTOSIL® PV Film, the innovative Encapsulant
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