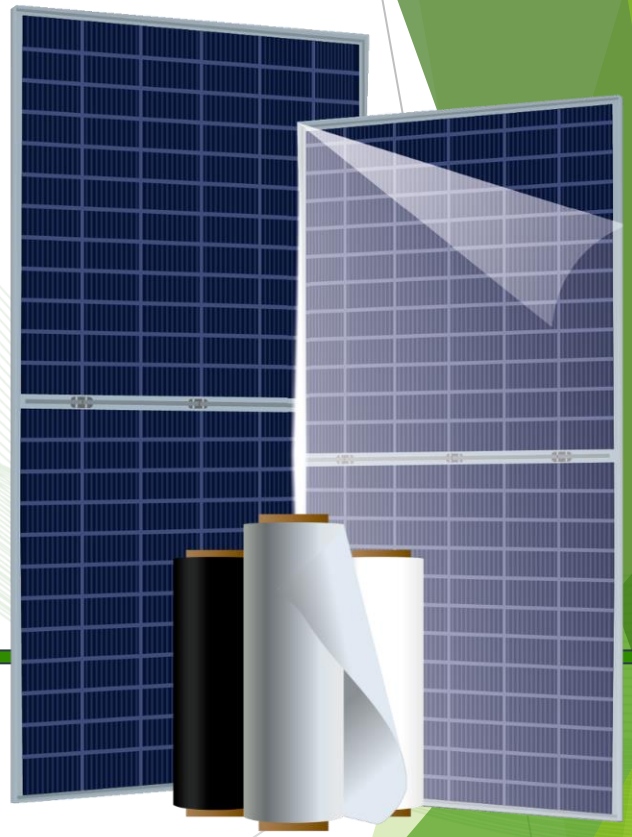
ALISHAN

ENCAPSULANTS & BACKSHEETS

Dr. Khushbu D Patel, AGM, Business Development



Encapsulation solutions for upcoming technologies and status in India

www.alishangreenenergy.com info@alishangreenenergy.com

Diversification of the Alishan Group

Mining & Refining

Graphite

Hospitality

Resort, Multiplex & Malls

Textile

Cotton Ginning

Real Estate

Housing & Residential Projects

Renewable Energy

Encapsulates & Backsheet for Solar PV Modules

FMCG

Aluminium foil & containers, Plastic containers, Garbage bags, Cling films

ALISHAN GROUP

Renewable Energy Division

One of the largest manufacturer of Encapsulants (E) & Backsheet (B)

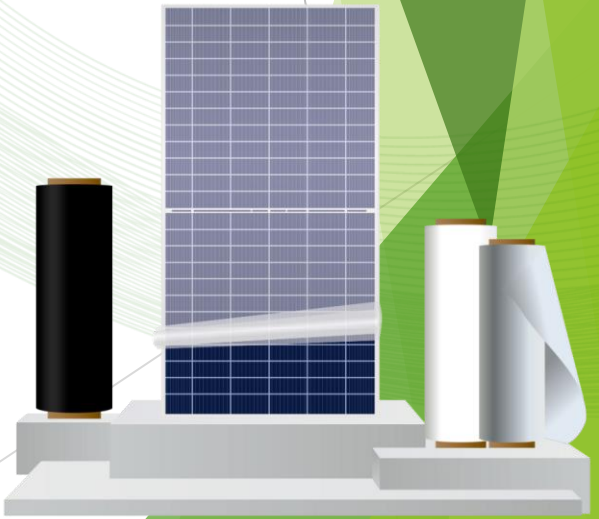
Robust Encapsulants

Capacity: 4.2 GW
Adding more 2.4 GW by Oct-25

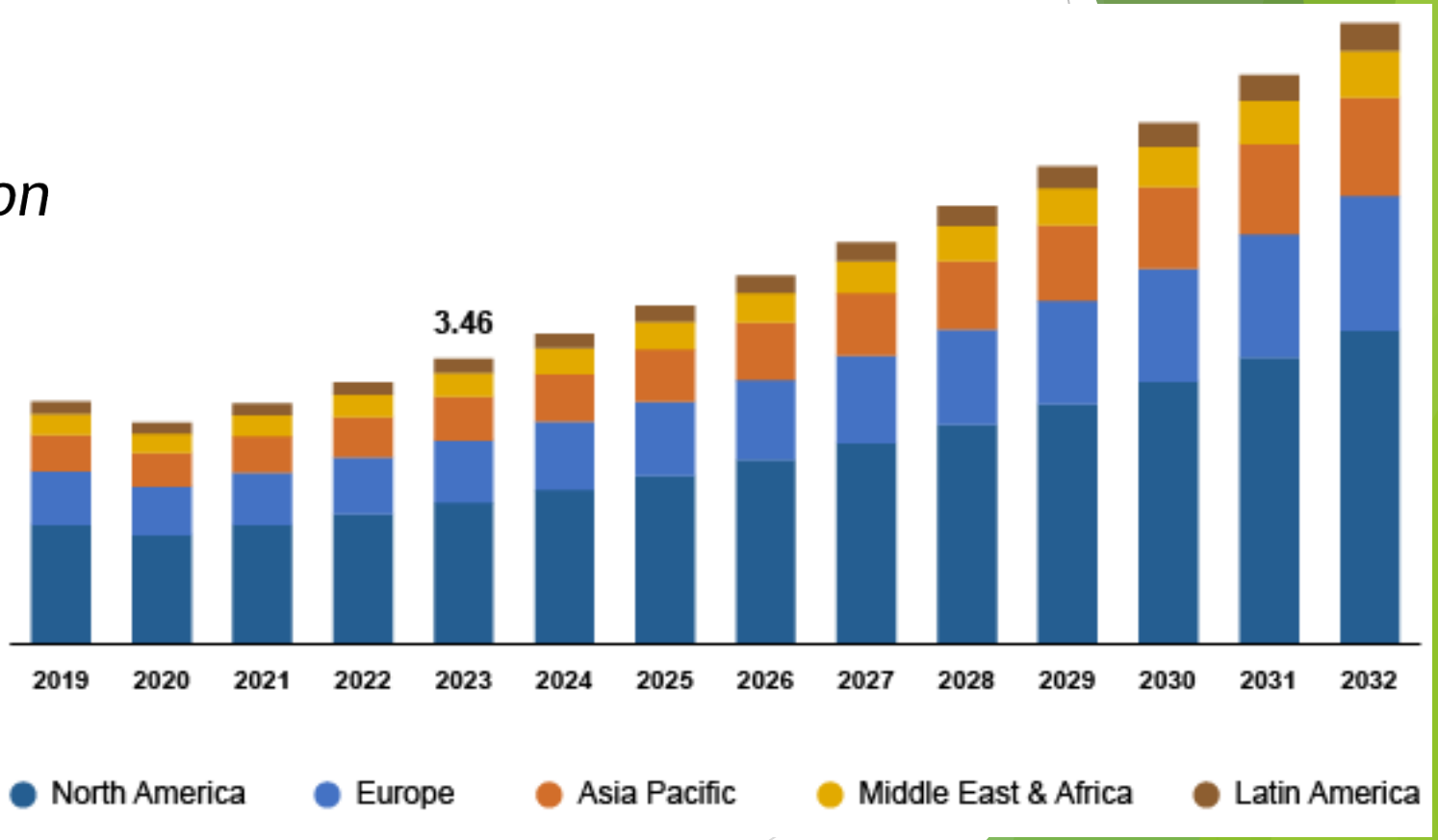
Superior Coated Backsheet

Capacity:

3 GW



Encapsulation business Worldwide In USD BN

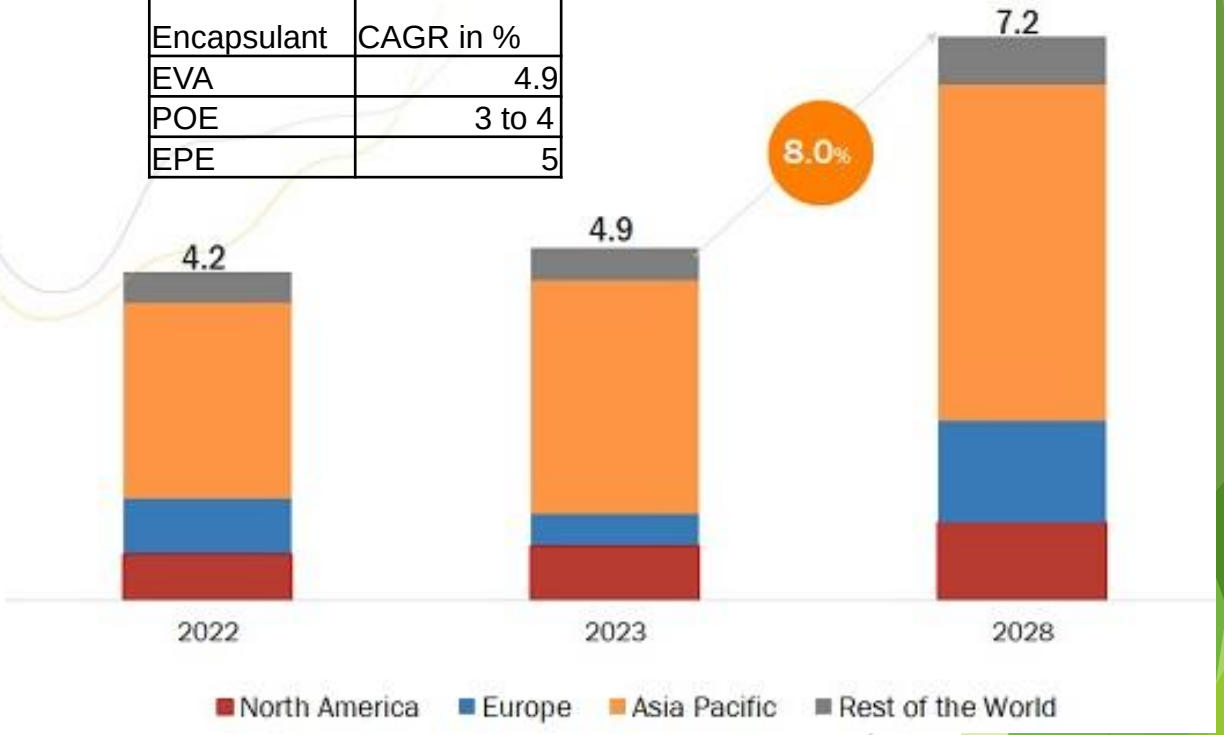


SOLAR ENCAPSULATION MARKET GLOBAL FORECAST TO 2028 (USD BN)

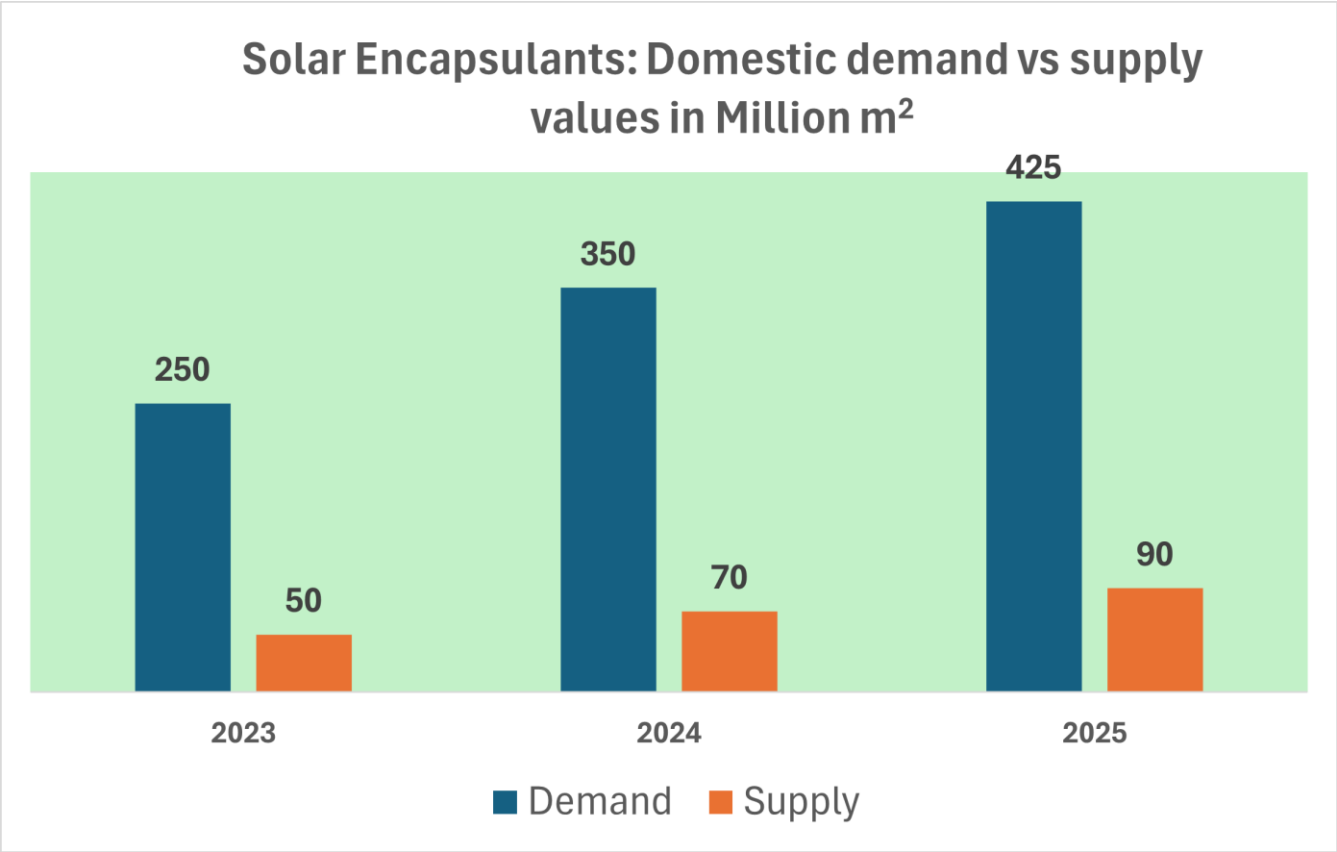
CAGR OF
8.0%

The global solar encapsulation market is expected to be worth USD 7.2 billion by 2028, growing at a CAGR of 8.0% during the forecast period.

Encapsulant	CAGR in %
EVA	4.9
POE	3 to 4
EPE	5



Indian market: Encapsulation Demand vs Domestic supply



Potential gap of 70% ~60 GW additional capacity

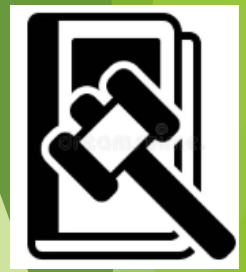
Opportunities for Alishan

Compatibility with next gen modules

Stabilized products (EVA, EPE)

Reliability duly verified at customers' end

Strong R&D team



ADD DCR (soon)

Competitive advantage

Niche Advantage
No captive consumption

Ease of adaptability at new laminators

Quality assurance

Digital media
Technical brochure
Brainstorming
Leadership meets
Magazine articles
Exhibitions
Invited conference talks

Technology transfer
Reverse engineering

Lucrative pricing models
Increased value of products

We are India's first only ancillary manufacturer to have NABL certification for Testing

National Accreditation Board for Testing and Calibration Laboratories

NABL

CERTIFICATE OF ACCREDITATION

TESTING LABORATORY, ALISHAN GREEN ENERGY PRIVATE LIMITED

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2017

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

KHASRA NO. 20, VILLAGE SEONI, RAIPUR, CHHATTISGARH, INDIA

Our Certifications

Products

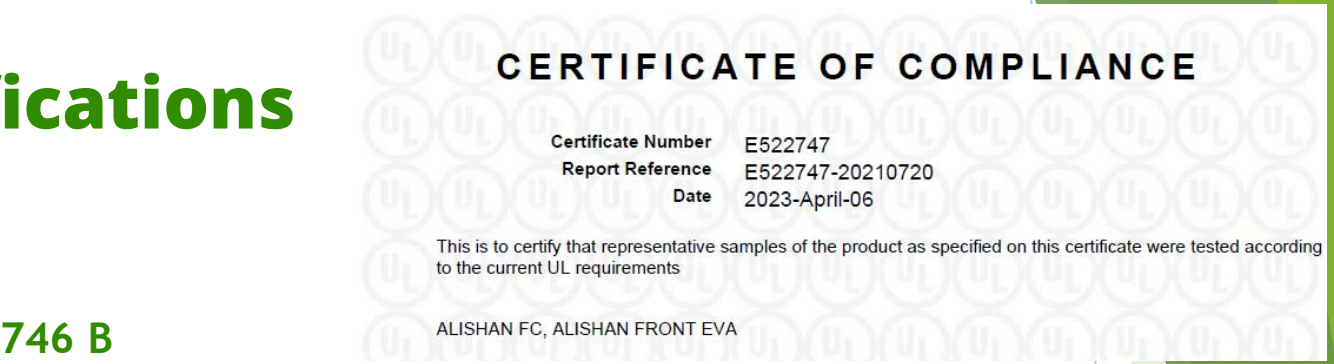
- UL 746 A and 746 B
- IEC 61730 all Mandatory tests by third party

System

- ISO 9001
- ISO 14001
- ISO 45001

Other

- NABL



CERTIFICATE OF COMPLIANCE

Certificate Number E522747
Report Reference E522747-20210720
Date 2023-April-06

This is to certify that representative samples of the product as specified on this certificate were tested according to the current UL requirements

ALISHAN FC, ALISHAN FRONT EVA

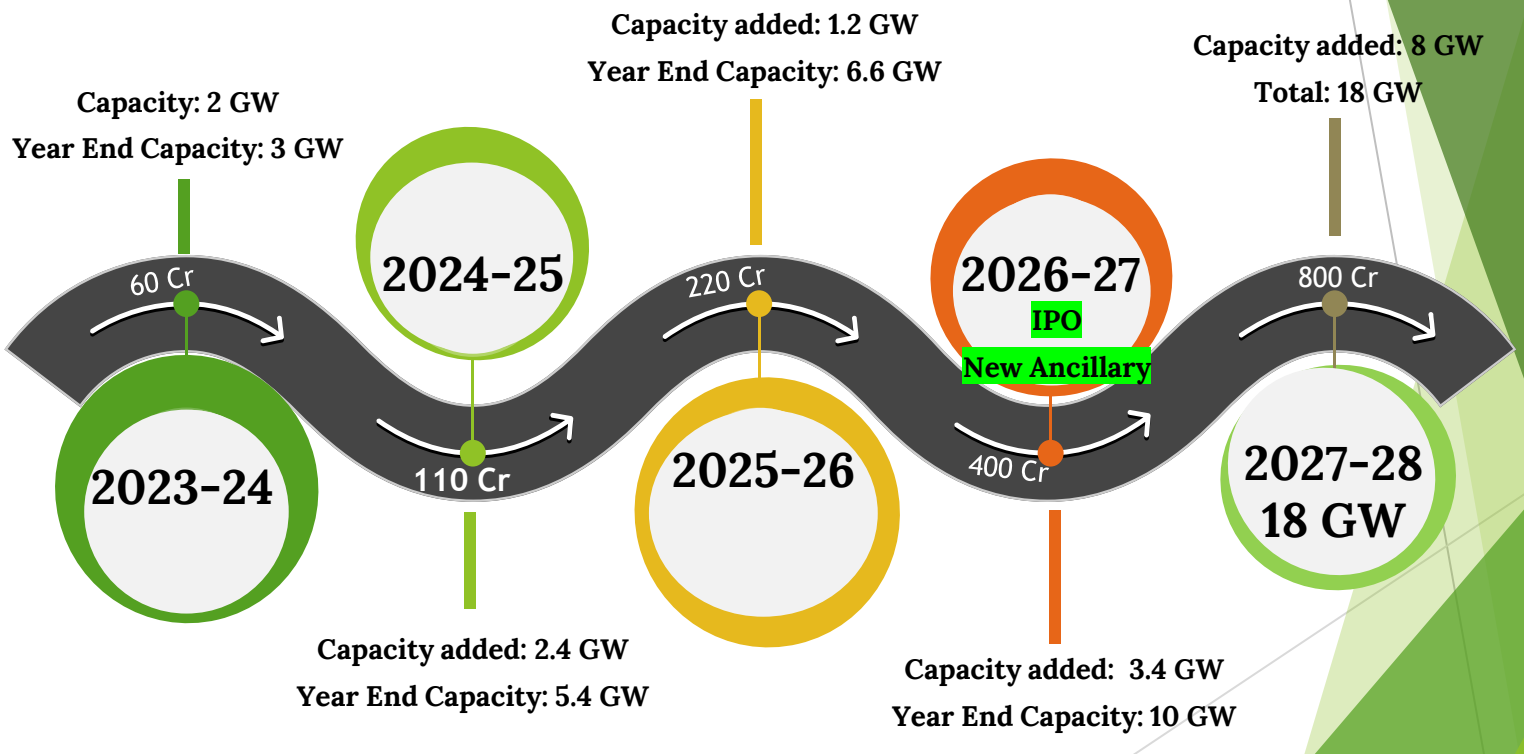
CERTIFICATE OF COMPLIANCE

Certificate Number E522747
Report Reference E522747-20230825
Date 2023-August-28

This is to certify that representative samples of the product as specified on this certificate were tested according to the current ULC requirements.

Backsheets designated “ALISHAN PVDF and ALISHAN COATING”

Expansion Plans



State of the art Manufacturing Facility

Manufacturing capacities for M10 and G12 modules
Width upto 1305 mm for Encapsulants and Backsheets

Our Products

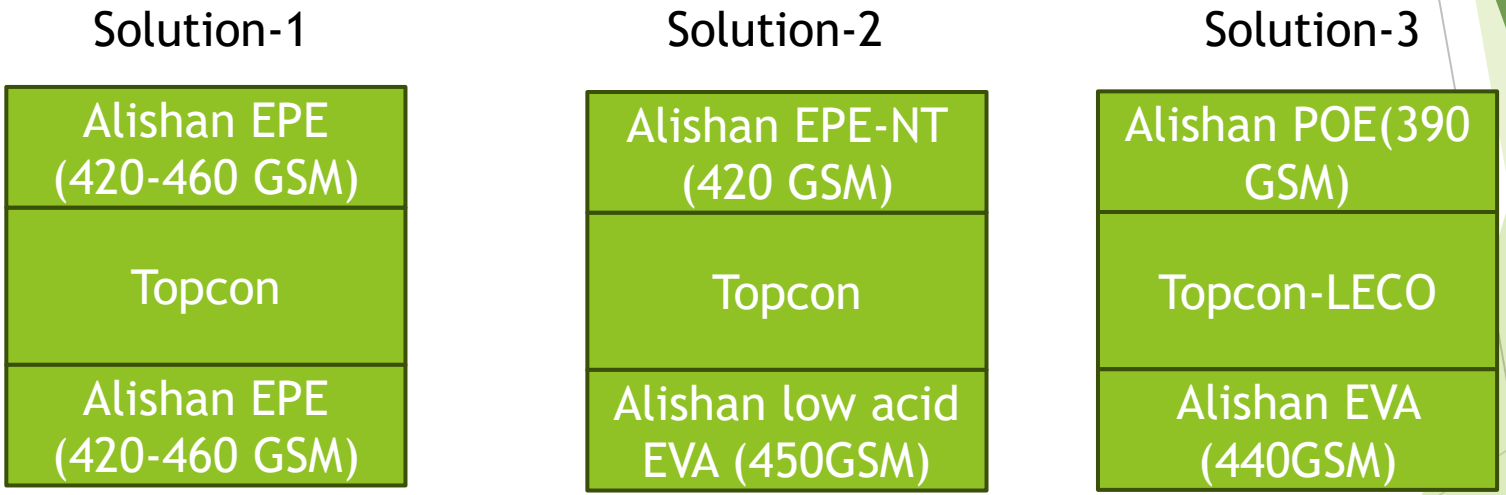
Encapsulants

Alishan Front EVA
Alishan FC
Alishan POE
Alishan EPE
Alishan EPE-NT
Alishan EPE-DC
Alishan Low acid EVA

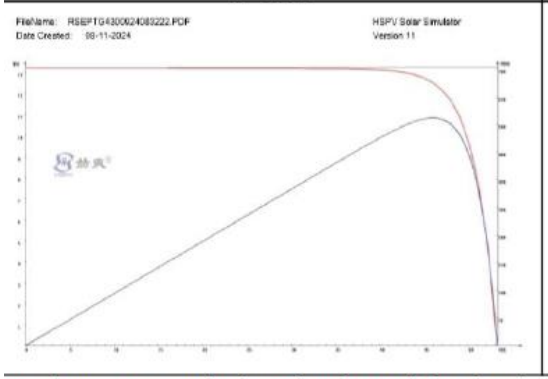
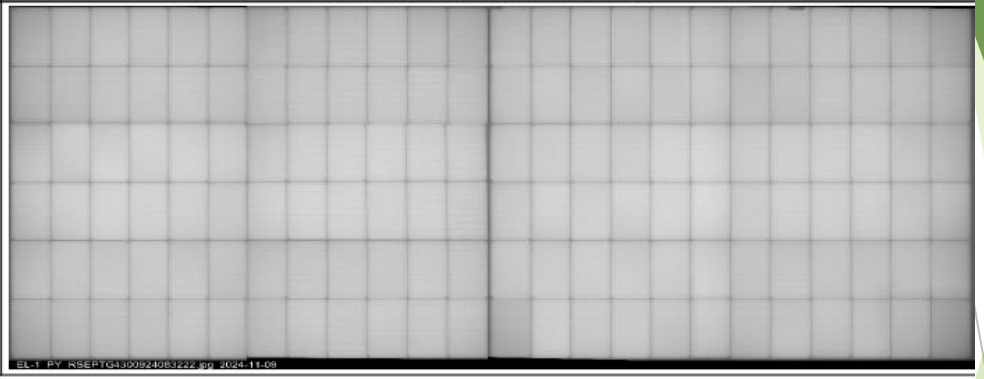
Backsheets

All range of laminated and coated backsheets in white, black and natural variants
We recommend our unique coated versions “KPC, PPC, CPC”

Our suggestive solutions for Topcon technology



Customer validation for PID288 (3cycles)

IV Curve	Electroluminescence (EL) Image
	

Visual Inspection Result after 3rd Cycle: No defects found.

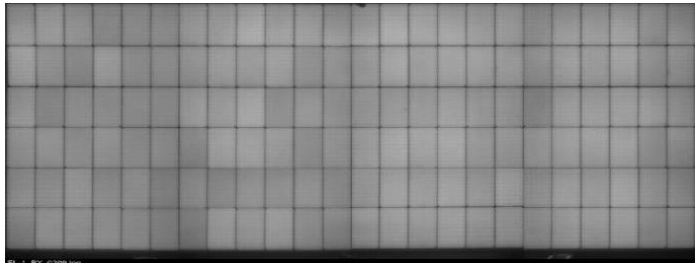
Wet Leakage Test Data - Final					
Measured Value	6033 MΩ	**Pass Criteria**	≥ 40 MΩ.m^2	**Result**	**PASS**

Power degradation after PID test		
Total Power Degradation In Watt : 3.60 Watt **in % : 0.62 %**	**Criteria**	**Result**
	≤ 5 %	**PASS**

PID<0.7%

Customer validation for DH2000

- Solution-1

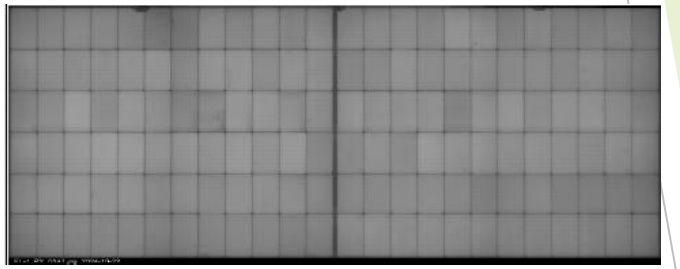


Power loss < 5%

Solution-1

Alishan EPE (420-460 GSM)
Topcon
Alishan EPE (420-460 GSM)

Solution-2



Power loss < 2%

Solution-2

Alishan EPE-NT (420 GSM)
Topcon
Alishan low acid EVA (450GSM)

Properties of Alishan EPE after DH 3000

MODEL	ALISHAN EPE		
PROPERTIES	Peel Bond N/cm AFTER 1000 HRS DAMP HEAT	Peel Bond N/cm AFTER 2000 HRS DAMP HEAT	Peel Bond N/cm AFTER 3000 HRS DAMP HEAT
Peel strength Adhesion with Backsheet N/cm	71.31 N/cm	63.16 N/cm	54.34 N/cm
Peel strength Adhesion with Glass N/cm	60.91 N/cm	53.33 N/cm	47.98 N/cm

TEST REPORT

Parameters	Test Method	RESULT	UNIT
Initial VR	IEC 61215-2-2021 & ASTM D257-14	1.83×10^{16} (500V)	Ohm.cm
VR after 3000 DH hours	IEC 61215-2-2021 & ASTM D257-14	1.47×10^{16} (1000V)	Ohm.cm

MODEL	ALISHAN EPE		
PROPERTIES	Transmittance AFTER 1000 HRS DAMP HEAT	Transmittance AFTER 2000 HRS DAMP HEAT	Transmittance AFTER 3000 HRS DAMP HEAT
Transmittance	92.13%	91.40%	90.70%

MODEL	ALISHAN EPE		
PROPERTIES	Yellowness index AFTER 1000 HRS DAMP HEAT	Yellowness index AFTER 2000 HRS DAMP HEAT	Yellowness index AFTER 3000 HRS DAMP HEAT
Yellowness Index	1.4 YI	1.9 YI	2.5 YI

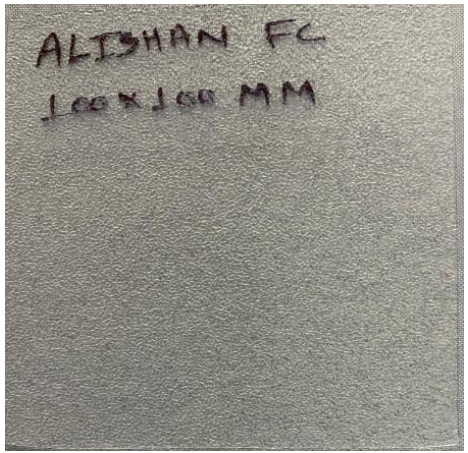
Salient Features of Alishan EPE

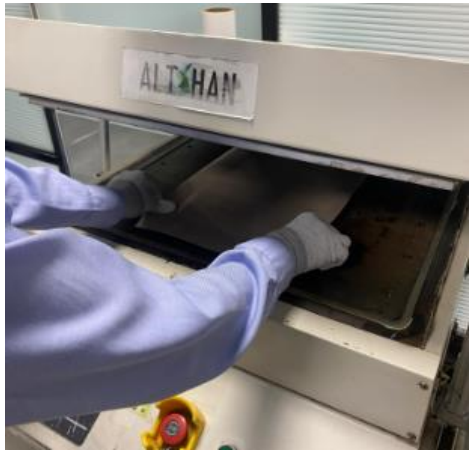
- Perfectly tuned EVA:POE ratio
- Intelligently engineered for TOPCon cells, high resistance to moisture
- Carefully chosen additive to ensure acetic acid management inside G2G modules
- Continuous improvement on process parameters to achieve zero process related challenges at customer's end

Effect of Direct Temperature treatment on VR of EVA/EPE/POE

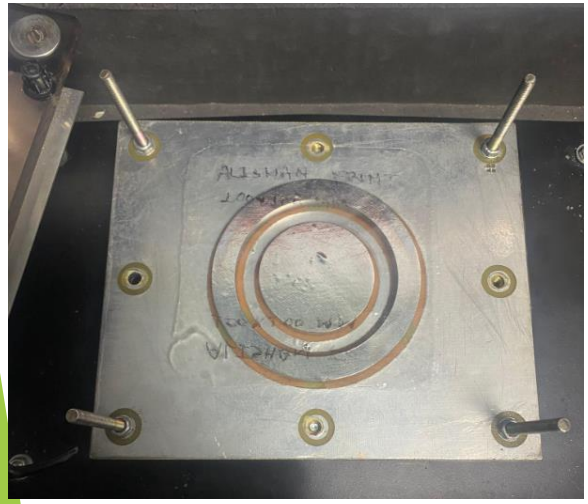
- Experimental details

Temp: 40 to 120 ^{o}C for 4 hours and measure VR





VR Measurements



Observations

- VR values does not drastically change even with a direct temperature application to the laminates, e.g. Initial VR and final VR remains in the range of 10^{15} ohm. cm
- Need to look at 2nd order phenomena!
- Known Fact!!

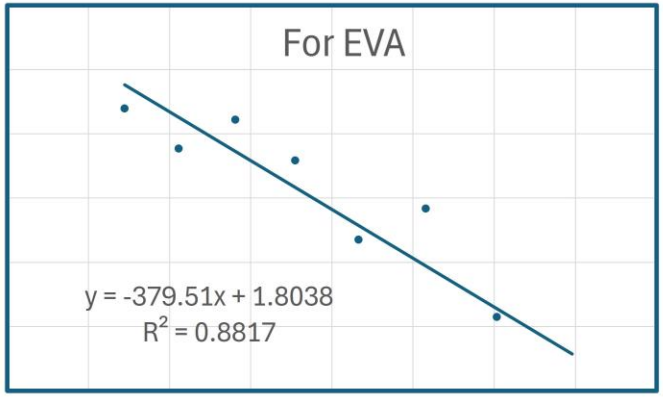
The average kinetic energy increases with increase in absolute temperature. Hence the number of molecules with energy greater than the threshold energy also increases.

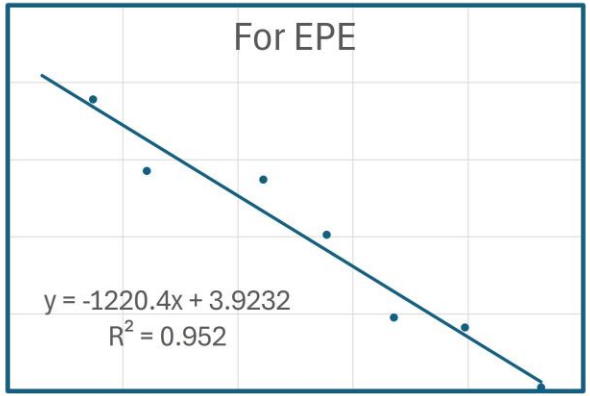
As a result, the number of effective collisions between reactant molecules also increases. Therefore, usually, it is observed that the rate of reaction increases with increase in temperature.

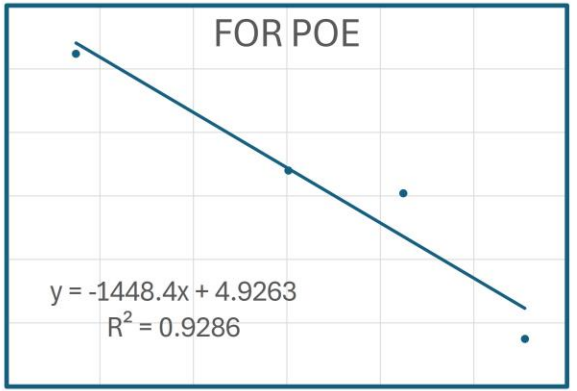
Arrhenius Equation

$$k = Ae^{-Ea/RT}$$

Arrhenius Plots for Alishan Encapsulants







$E_a = 3.1\ kJ/mol$

$E_a = 10.02\ kJ/mol$

$E_a = 12\ kJ/mol$

Observations from Plots

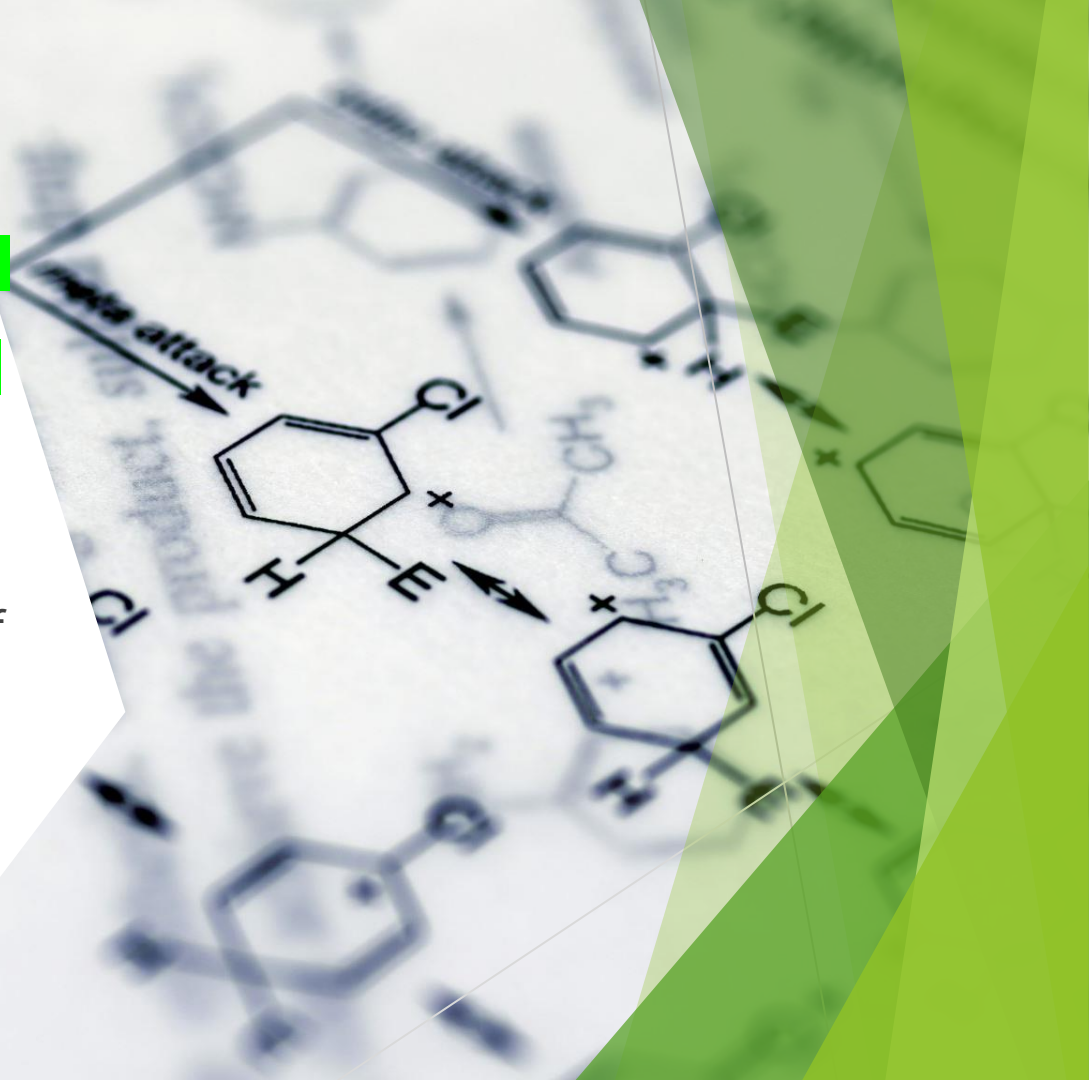
- E_a is lowest for EVA which means that the influence of temperature will be maximum on EVA encapsulants; rate of reaction will be much faster in EVA as compared to EPE or POE
- In EPE and POE, we have observed that an order of more energy is required to initiate the reactions than EVA
- Interestingly, EPE is not behaving just as an “averaged” encapsulant of EVA-POE, rather it shows similar properties as POE

Conclusion

- We believe that the Non-polar nature of POE is crucial to inhibit the thermally activated chemical processes
- Thickness of 150~200 micron Alishan POE is enough for desired VR
- Moreover, EPE which is co-extruded POE films, can be an important encapsulant in future for exhibiting low thermal degradation along with competitive prices

- EPE can be carefully formulated in blended form where it loses its “Oil-Water analogy”: Alishan EPE

- Its time to look at the 2nd and 3rd order phenomena like rate of reactions, pathways for degradation and their mitigations than just the visibly measurable entities!



Alishan EPE is a perfect encapsulant for Topcon cells, while Alishan-NT gives freedom on using EVA on back side for commercially viable modules

EPE, thanks to POE properties will sustain in the market as cost effective and easy to handle material than POE

We believe that for sensitive cell technologies like TOPCon, HJT and Tandem, POE is better material to withstand harsh weathering

Final Take away! *Discuss with your supplier and choose the Reliability Consciously!*

ALISHAN

ENCAPSULANTS | BACKSHEETS

THANK YOU

Hope you had a wonderful experience at the conference!