Effect of QUV A with Thermal Cycling Exposure on PV Backsheets

Amy Lefebvre, Greg O'Brien, Ron Partridge, James D. Knapp, Bryan Douglas, Gunter Moeller, Dana Garcia
Arkema Inc. King of Prussia, PA

Introduction

- PV backsheets are the only insulation that can be "relied upon" on the backside of a module per the new IEC standard working group.
- Backsheets must be shown to be weatherable over the expected module lifetime.
- Current test standards, including IEC 61215, require only a minimal amount of UV exposure.
  - Less than three months of direct exposure in Miami, Florida.
- Constant temperature QUV A accelerated testing on backsheets has resulted in degradation of the polymer matrix, pitting, microcracking, and accumulation of pigment on the outer surface.
- Larger scale cracking and delamination has not been observed in the accelerated testing - but has been observed in fielded modules.
  - This could be due to the thermal cycling seen in the field that is not present in constant temperature accelerated QUV A conditions.
- **The objective of this poster is to report on preliminary results from QUV A exposure testing conducted with thermal cycling on PV backsheets.**

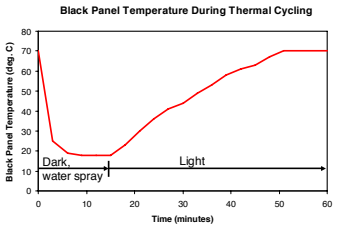
Accelerated Weathering Conditions

Accelerated Testing Conditions:

QUV A with Thermal Cycling	Irradiance at 340 nm	Temperature (black panel)	Duration	Water
Light Period	1.55	70 deg. C	3.25 hrs.	none
Dark Period	none	see figure	0.25 hrs.	water spray
		50 deg. C	3 hrs.	condensation
Total Cycle Time			24 hrs.	

Repeat 6 times before condensation period.

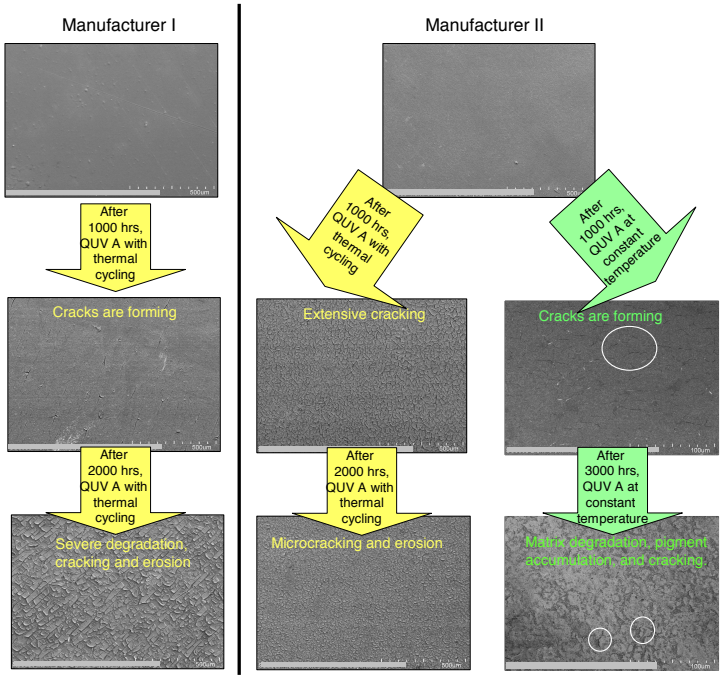
QUV A at Constant Temperature	Irradiance at 340 nm	Temperature (black panel)	Duration	Water
Light Period	1.55	60 deg. C	8 hrs.	none
Dark Period	none	50 deg. C	4 hrs.	condensation
Total Cycle Time			12 hrs.	



Backsheet Materials Tested:

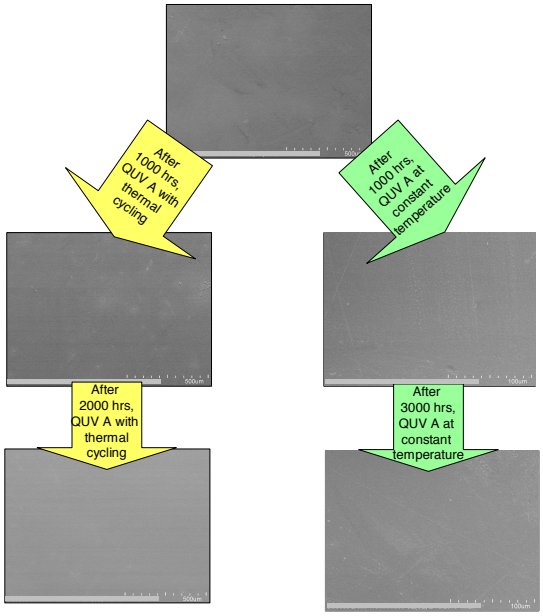
- KPE® Backsheet – Kynar® film/PET/EVA backsheet
- PPE Backsheet – PET/PET/EVA backsheet from two different manufacturers
- Outer weatherable surface of backsheets are facing the lamp.

PPE Backsheets- SEM images before and after QUV A exposures



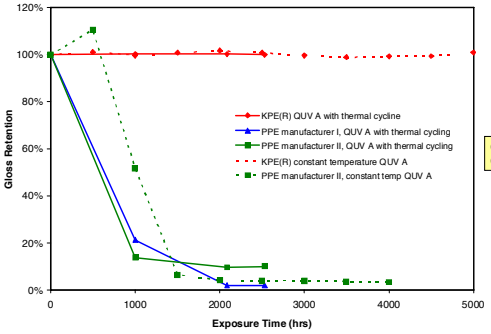
- Regardless of manufacturer, PPE backsheets are cracking and degrading after accelerated weathering exposure.
- QUV A with thermal cycling accelerates crack formation in PPE backsheets vs. constant temperature QUV A conditions.
- After only 2000 hrs of exposure, degradation of the polymer matrix and cracking of the PPE backsheet is occurring.

KPE® Backsheets- SEM images before and after QUV A exposures



- No changes in KPE® backsheets are observed in either constant temperature QUV A or QUV A with thermal cycling exposures.

Gloss Retention



- Gloss retention monitors surface changes (erosion, cracking) of the backsheet outer surface.
- The PPE gloss retention drops quickly under all conditions, but with thermal cycling the loss is more rapid than with constant temperature.
- The KPE® shows extreme stability and no surface degradation – under any testing condition (constant temperature or thermal cycling).

Conclusions

- Running QUV A with thermal cycling reliably and consistently is possible in commercial QUV cabinets.
- Crack formation is accelerated in QUV A with thermal cycling conditions vs. QUV A at constant temperature conditions in PPE backsheets is observed.
  - Mechanical stresses induced by thermal cycling accelerated microcracking of the backsheet.
- KPE® backsheets were not observed to crack or degrade when exposed to either QUV A with thermal cycling or QUV A at constant temperature conditions.
- Gloss retention of PPE backsheet decreased more rapidly for samples exposed to QUV A with thermal cycling versus constant temperature conditions due to accelerated crack formation.
- In the absence of SEM imaging, gloss retention can also be used to monitor changes in the outer weatherable layer of backsheets.

This presentation contains no confidential information.