Mitsui Chemicals Group

Solar PV Laboratory

212208017026

Final Report

Determination of Yellowness Index wavelength of Encapsulant as per IEC 62788-1-4:2016

MCIND SPVL Report Number: MCIND/21-22/LB/xxxx.V1

Issue Date: 29.09.2021

Customer

Navitas Alpha Renewables Private Limited

Address: Plot No. B-20/21, Road No. 14, Palsana-Baleshwar Rd, Hoziwala Industrial Estate, Sachin, Surat, Gujarat 394230.

Contact Person

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Laboratory

Solar PV Laboratory

Mitsui Chemicals India Private Limited

Lab Address: Plot no. 5 & 6, Swastik Industrial Estate, Sarkhej-Bavla Highway,Village: Sari,Tal: Sanand, Ahmedabad

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Contact Person

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BERLIN PI

Technical Licensing partner

Mitsui Chemicals Group
Solar PV Laboratory

Report details

Report number	MCIND/21-22/LB/xxxx.V1	Order date	24-08-2021
Order number	MCIND/20-21/017.V1	Sample Receive Date	20-08-2021
Test start Date:	06-09-2021	Test end date:	25-09-2021

Customer Information

Customer	Navitas Alpha Renewables Private Limited	Street address	Plot No. B-20/21, Road No. 14, Palsana-Baleshwar Rd, Hoziwala Industrial Estate, Sachin, Surat, Gujarat 394230
Responsible person	Anil Deshmukh	City / State	Gujarat
Phone number	+91-8108851973	Pin code	394230
E-Mail	anil.deshmukh@navitasalpha.com	Country	INDIA

Lab information

Lab	Mitsui Chemicals India Pvt Ltd	Street address	Plot no. 5 & 6, Swastik Industrial Estate, Sarkhej-Bavla Highway, Village:Sari, Tal: Sanand, Ahmedabad
Responsible engineer	Shubham Kumar	City / State	Ahmedabad, Gujarat
Phone number	+91-9650079706	Pin code	382220
E-mail	Shubham.kumar@ mitsuichemicals.com	Country	INDIA

Signatures

Prepared By	**Mr. Shubham Kumar**	**Authorized and Issued by**	**Mr. Gowri Ganesh**
Checked by	**Mr. Mayur Nakarani**		

DISCLAIMER: The data reported in this report are valid at the time of and under the stipulated conditions of measurement and the test results are only applicable to those items which have been tested. The sampling was done by the client. The data contents in this report do not constitute a qualification certificate under any set of specifications. MCIND does not accept any liability for any consequences including commercial or otherwise arising out of the utilization of the information contained in this report. MCIND reserves the right to utilize the information contained in this report in the interest of scientific progress without disclosing the identity of the customer. The duplication, publication as well as passing on of this report is only allowed if it is complete and written permission from MCIND is given. MCIND is a licensing partner of PI Berlin, who provided technical consulting services for the establishment and operation of the laboratory. PI Berlin is not responsible for the module sampling, scope of work, test procedure, test completion or test results contained in this report.

Table of Contents

1 General Information about the Report

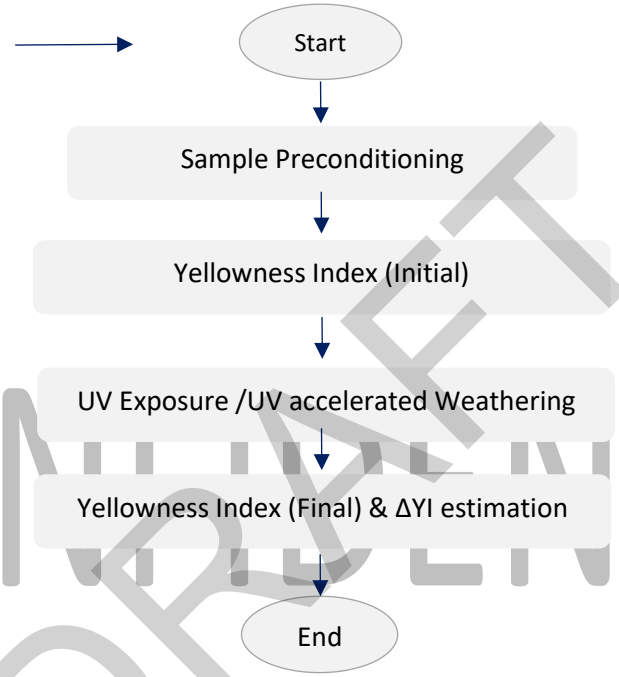
1.1 Order

The objective of the project is to evaluate Yellowness Index of encapsulant material intended to be used for PV module application.

1.2 Approach

MCIND received 3 nos. of Glass-EVA-Glass sample from Navitas Alpha Renewables Pvt. Ltd. model type EVO FCP HLT for which the following test sequence was agreed:

3 samples
+1 sample
*(control)**



*Note: UV exposure was not performed for control sample

1.3 List of abbreviations and symbols used

Abbreviation/symbol	Particulars
EVA	Ethylene Vinyl Acetate
N/A	Not applicable
IEC	International Electrotechnical Commission
RH	Relative Humidity
nm	Nano meter
ζ	transmittance
Std. Dev, ±σ	Standard deviation
Meas.	Measurement
λnm	Wavelength in nano meter
YI	Yellowness Index

2 General Information about the Test and Test Objects

2.1 Delivery Condition

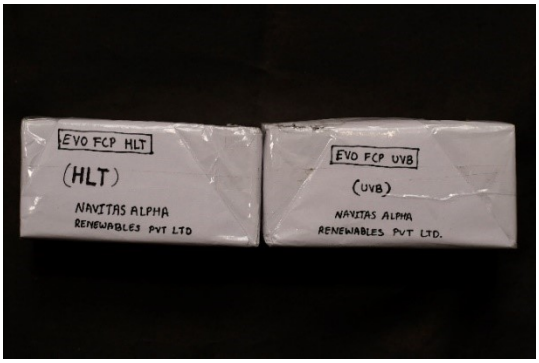


Figure 2-1 (A) Delivery condition (dated:24-08-2021)

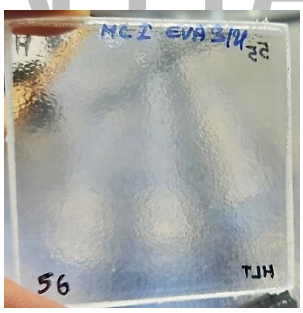
* **Delivery Condition:** No physical damage of the test samples observed.
* **Packaging comments:** Test samples are packing is acceptable

Location: Gate no. 4 , Solar PV Laboratory, Mitsui chemicals India Pvt. Ltd., Ahmedabad, Gujarat 382220.

Note: The PV modules received are Freshly Manufactured samples (as confirmed by the customer.)

2.2 Sample Description

Details of Sample			
Make	:	Navitas alpha Renewables Pvt. Ltd.	**Sample photograph**
Encapsulant material	:	EVA	
Model no.	:	EVO FCP HLT	
Thickness of Encapsulant used (in mm)	:	0.5 ± 5%	
Overall Sample Thickness including Superstrate/substrate (in mm)	:	6.42 ± 0.015 mm	



Specification of Superstrate – Substrate Material used				
Parameters		**Superstrate**	**Substrate**	**Unit**
Material	:	Low Iron solar Textured glass	Low Iron solar Textured glass	-
Make	:	Borosil Renewables Limited	Borosil Renewables Limited	-
Model type	:	Matt	Matt	-
Dimension (l×b×t) in mm	:	3.2×50×50	3.2×50×50	mm
Details of Coating	:	N/A	N/A	-
Transmittance %*		>91	>91	%
Reflectance %*		8.0	8.0	%

Test Specimen details			
MCIND Serial Number	**Product (Identification) No.**	**Dimension (l×b) in mm**	**Tested**
MCIND EVA 12/21			✓
MCIND EVA 04/21			✓
MCIND EVA 05/21			✓
MCIND EVA 06/21			✓

*as per Manufacturer datasheet/declaration (see Annex I&II)

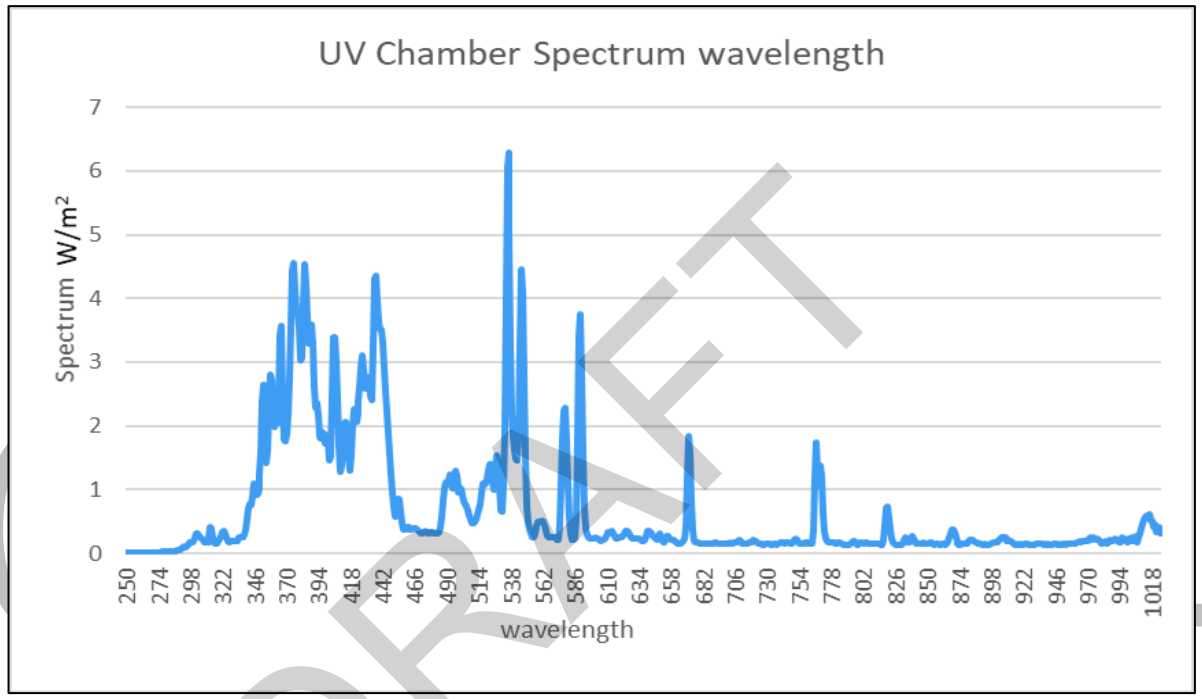
3 Performed Tests

3.1 Test Description

3.1.1 UV Exposure

Standard:
The test is carried out in accordance with the procedure mentioned in MQT 10 of IEC 61215-2:2021.

Spectrum of Lamp used for UV Exposure:



Temperature of sample: 60˚C ± 5˚C

Lamp Specification: UV lamp = 2000 Watts (UVA+UVB), UVA = 74.54%, UVB = 22.24%

Dosage: 60 kWh/m² (15 kWh/m² *4)

Uniformity (%) of lamp intensity of the UV chamber	8.36

Location: Environmental Test Zone, Mitsui Chemicals India Pvt. Ltd. - Solar PV Laboratory, Ahmedabad, Gujarat 382220, INDIA

Location Type: Permanent

Test & Operations Engineer:	**Shubham Kumar**	**Date of Test (DD/MM/YYYY)**	**Start :** -09-2021 **End:**

3.1.2 Yellowness Index

Standard:

The test is carried out in accordance with measurement procedure of Yellowness Index in IEC 62788-1-4:2016 for Encapsulant.

Purpose:

To determine the Yellowness Index, (deviation in chroma from colourless or whiteness toward yellow) of the test specimen perceived by a human observer.

Sample Preconditioning

Test samples were maintained at 23±2℃ and 50±5%RH for at least 24 h prior to optical measurement.

Environmental conditions

Test are conducted at an ambient Temperature conditions of 23±2℃ and Relative Humidity 50±5%RH.

Test Procedure:

For conducting the testing, Measurement procedure mentioned under relevant sections of IEC 62788-1-4:2016 has been followed. For Yellowness Index measurement spectrophotometer with CIE standard D65 illuminant spectrum as in ISO 11664-2 and the CIE 1964 XYZ colour space (for human observer with a 10° field of view,as in ISO 11664-1). YI is calculated for a wavelength increment eg. 1nm consistent with measured transmittance data.

Location: Material testing lab, Mitsui Chemicals India Pvt. Ltd. - Solar PV Laboratory, Ahmedabad, Gujarat 382220, INDIA

Location Type: Permanent

Test & Operations Engineer:	**Shubham Kumar**	**Date of Test (DD/MM/YYYY)**	23-09-2021

3. 2. Detailed Test Results

3.2.1 Test Result - Yellowness Index measurement

Manufacturer	Navitas Alpha				Product No.				
Model Type	EVO FCP HLT				MCIND Serial No.			MCIND EVA 04/21	
Lamp observer source	D65 10 deg								
	Initial/Reference				Final After UV exposure				
Trial Number	L*	a*	b*	YI_E313_D65 Initial [A]	L*	a*	b*	YI_E313_D65 After UV exposure 60 kwh/m² [B]	ΔYI
1	84.54	-1.19	2.29	3.75	84.25	-1.28	2.90	4.96	1.21
2	84.54	-1.19	2.29	3.75	84.25	-1.29	2.89	4.93	1.18
3	84.54	-1.19	2.29	3.75	84.54	-1.27	2.89	4.95	1.20

Manufacturer	Navitas Alpha				Product No.				
Model Type	EVO FCP HLT				MCIND Serial No.			MCIND EVA 05/21	
Lamp observer source	D65 10 deg								
	Initial/Reference				Final After UV exposure				
Trial Number	L*	a*	b*	YI_E313_D65 Initial [A]	L*	a*	b*	YI_E313_D65 After UV exposure 60 kwh/m² [B]	ΔYI
1	84.5	-1.19	2.10	3.35	83.96	-1.23	2.92	5.05	1.70
2	84.5	-1.19	2.10	3.35	84.23	-1.24	2.91	5.00	1.65
3	84.5	-1.19	2.10	3.35	84.40	-1.23	2.96	5.12	1.77

Manufacturer	Navitas Alpha				Product No.				
Model Type	EVO FCP HLT				MCIND Serial No.			MCIND EVA 06/21	
Lamp observer source	D65 10 deg								
	Initial/Reference				Final After UV exposure				
Trial Number	L*	a*	b*	YI_E313_D65 Initial [A]	L*	a*	b*	YI_E313_D65 After UV exposure 60 kwh/m² [B]	ΔYI
1	84.41	-1.16	2.17	3.53	84.33	-1.22	2.97	5.15	1.62
2	84.41	-1.16	2.17	3.53	84.27	-1.25	2.93	5.03	1.50
3	84.41	-1.16	2.17	3.53	84.30	-1.23	3.00	5.21	1.68

---------- **End of Test Report**----------