GE
Measurement & Control

Advanced Sensors

ChipCap 2®

Chemical Exposure Test

imagination at work

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Chapter 1. Long Term Chemical Vapor Exposure Test

Chapter 2. Saturation and Recovery Test

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Chapter 1. Long Term Chemical Vapor Exposure Test

1.1 Test Procedure

1. For each test, 16 samples of HCPD-5V-U3 are measured at 25°C(77°F) 20, 50, 80% RH.
2. Measured samples are put into the test vessel contained with each liquid chemical.
   Distance between the chemical and test samples:under 4.0 cm (1.57 in.)
3. 4 samples are taken out respectively after 128 (7 days), 336 (14 days), 672 (28 days), 1008 (42days) hrs for measurement.
4. The samples are stabilized for 24 hrs at ambient condition (25±3°C, 50±10% RH) for measurement at 25°C 20,50,80% RH, and then stabilized for an additional 48hrs for final measurement.
5. After final measurement, samples go through recondition process as below:
   - Baking:80°C (176° F) 24 hrs
   - Hydration: 30°C (86°F) 80%RH 45~50 hrs
6. After recondition, measure again at 25°C, 20, 50, 80% RH.

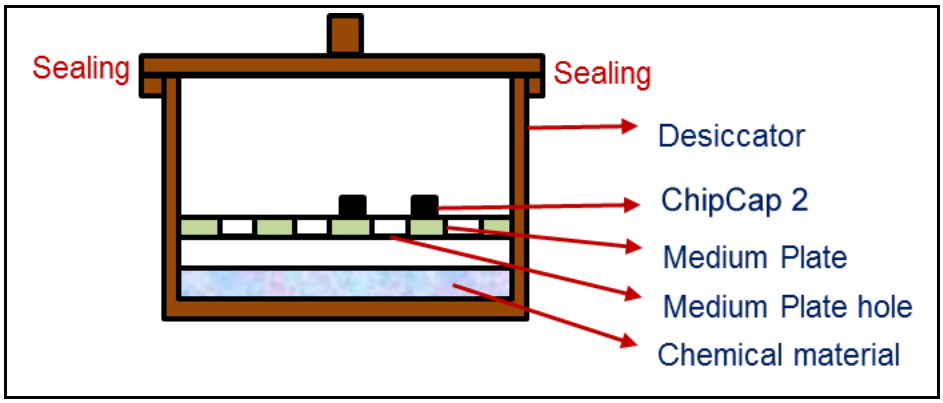

Figure 1: Chemical Exposure Test Schematic Diagram

1.2 ChipCap 2 Chemical Resistivity

1.2.1 Chemical Exposure Test

1. Test time: 1008 hrs

2. Test condition: ambient condition (25±3°C, 50±10% RH)

3. Sample: HCPD-5V-U3

4. Sample size: 16EA (Each test condition)
4 samples were taken out of test condition each test time (168, 336, 672, 1008 hrs)

5. Measurement equipment: PDR-3KP (Temp. & humidity chamber, ESPEC)

6. Measurement reference: Dew master

7. Test result: After test 72 hrs

Table 1: Chemical Exposure Test After 1008 Hours

	168 hrs		336 hrs		672 hrs		1008 hrs	
	20% RH	80% RH	20% RH	80% RH	20% RH	80% RH	20% RH	80% RH
1. Ammonia hydroxide (NH4OH)	F	F	F	F	F	F	F	F
2. Acetone ((CH3)2CO)	12.88	21.00	12.90	20.79	14.83	21.91	15.17	20.56
3. Ethanol (C2H5OH)	1.59	7.35	1.81	9.93	1.82	10.19	1.86	10.27
4. Methanol (CH3OH)	2.00	9.36	2.19	13.10	2.72	16.20	3.14	16.50
5. Ethanol + Methanol	1.85	11.02	2.41	13.34	2.69	13.29	2.55	15.08
6. Formaldehyde (CH2O)	-0.48	0.39	-0.12	1.77	0.25	0.04	0.20	0.33
7. Benzene (C6H6)	-3.81	-16.37	-5.68	-23.30	-11.77	-40.49	-16.61	-52.40
8. Toluene (C7H8)	-1.35	-6.86	-2.27	-10.73	-5.78	-25.06	-12.25	-43.41
9. Xylene (C8H10)	0.27	-0.37	0.56	0.47	1.07	-0.65	0.93	-1.07
10. Benzene + Toluene + Xylene	-1.08	-4.44	-1.43	-7.35	-3.80	-17.88	-4.89	-21.26

“F” indicates sensor failure.
All data is calculated average value of each test sample.

1.2.2Chemical Exposure Test After Recondition

8. Test result: After test 72 hrs and recondition
Sample recondition:
Baking: 80°C 24 hrs
Hydration: 30°C 80% RH 45~50 hrs.

Table 2: Chemical Exposure Test After 1008 Hours

	168 hrs		336 hrs		672 hrs		1008 hrs	
	20% RH	80% RH	20% RH	80% RH	20% RH	80% RH	20% RH	80% RH
1. Ammonia hydroxide (NH4OH)	F	F	F	F	F	F	F	F
2. Acetone ((CH3)2CO)	2.70	13.47	2.69	13.97	3.97	15.37	3.40	16.11
3. Ethanol (C2H5OH)	0.04	1.56	-0.02	1.38	0.36	1.97	0.02	2.34
4. Methanol (CH3OH)	0.44	2.15	0.63	2.90	1.56	4.83	1.32	5.38
5. Ethanol + Methanol	0.05	3.30	0.35	2.78	0.69	3.59	0.58	4.76
6. Formaldehyde (CH2O)	-0.97	-1.89	-0.73	-2.44	-0.78	-2.09	-1.00	-2.21
7. Benzene (C6H6)	-3.86	-13.39	-5.56	-20.90	-9.47	-31.60	-12.40	-36.99
8. Toluene (C7H8)	-2.06	-6.23	-3.32	-11.40	-6.25	-23.33	-11.23	-37.32
9. Xylene (C8H10)	-0.46	0.73	-0.82	-0.09	-0.53	-0.31	-0.85	-1.01
10. Benzene + Toluene + Xylene	-1.91	-3.67	-2.61	-7.81	-4.62	-15.90	-5.68	-18.81

"F" indicates sensor failure.
All data is calculated average value of each test sample.

1.2.2a Acetone ((CH3)2CO)

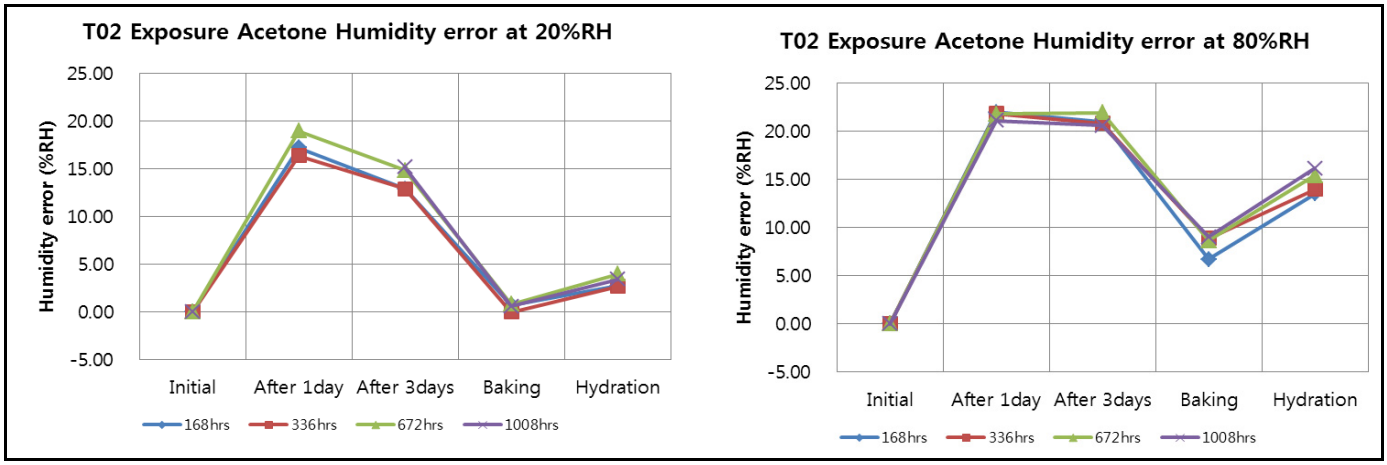

Figure 2: TO2 Exposure Acetone Humidity Error at 20% and 80% RH

1.2.2b Ethanol (C2H5OH)

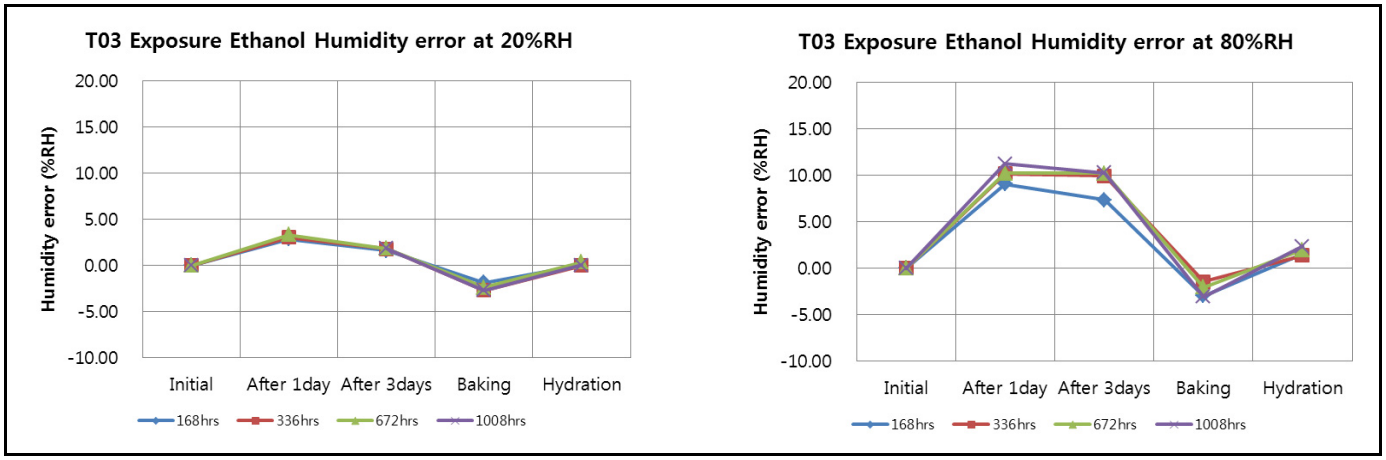

Figure 3: TO3 Exposure Ethanol Humidity Error at 20% and 80% RH

1.2.2c Methanol (CH3OH)

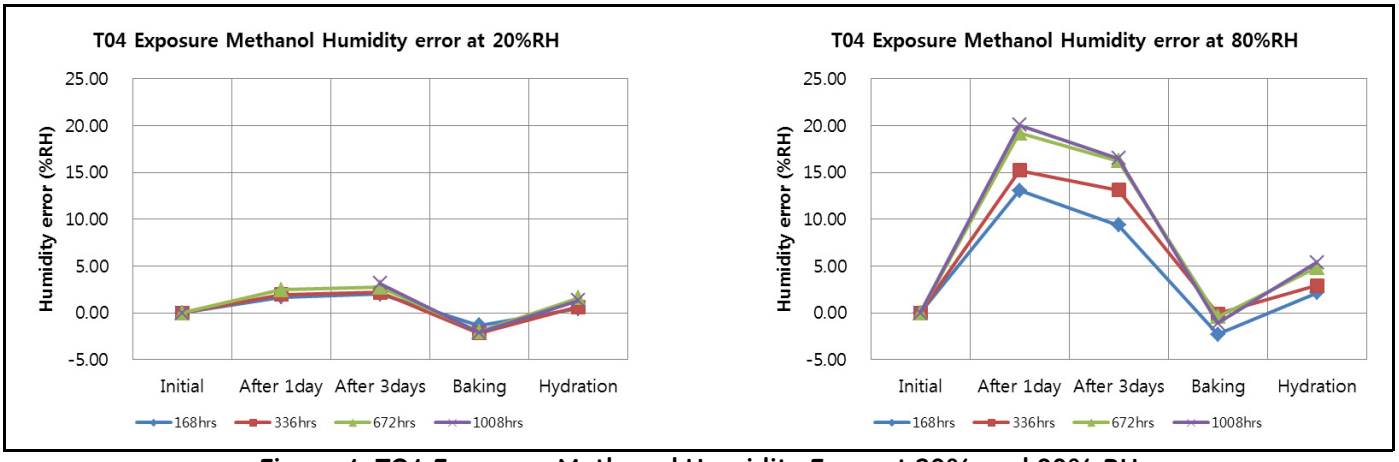

Figure 4: TO4 Exposure Methanol Humidity Error at 20% and 80% RH

1.2.2d Ethanol + Methanol

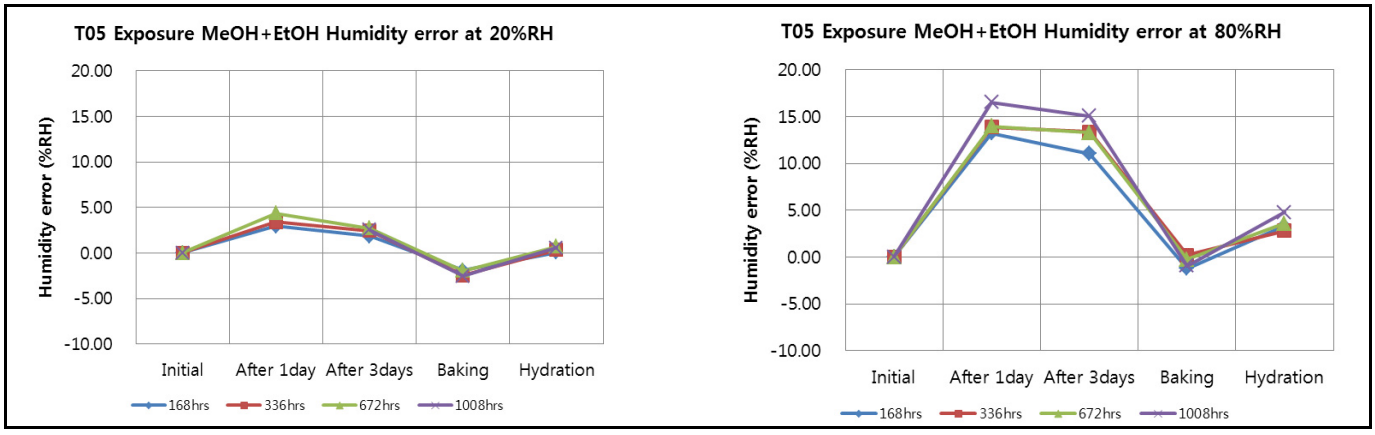

Figure 5: TO5 Exposure Ethanol + Methanol Humidity Error at 20% and 80% RH

1.2.2e Formaldehyde (CH2O)

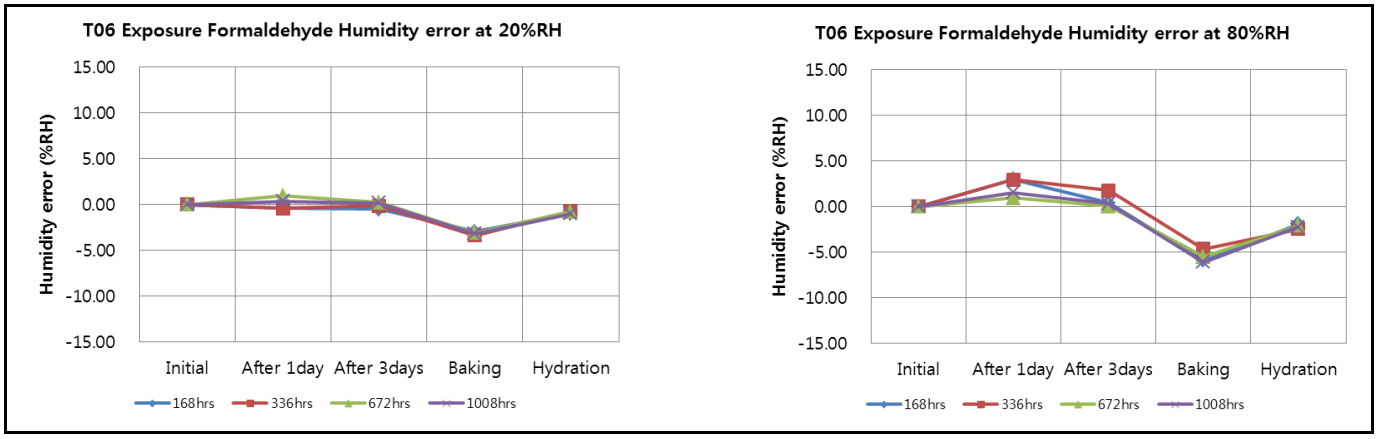

Figure 6: T06 Exposure Formaldehyde Humidity Error at 20% and 80% RH

1.2.2f Benzene (C6H6)

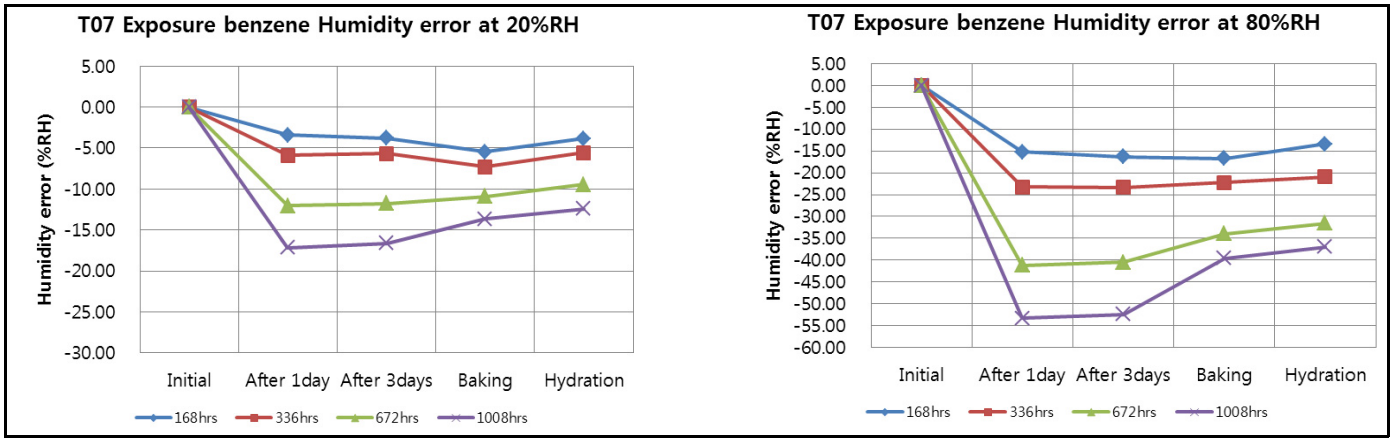

Figure 7: TO7 Exposure Benzene Humidity Error at 20% and 80% RH

1.2.2g Toluene (C7H8)

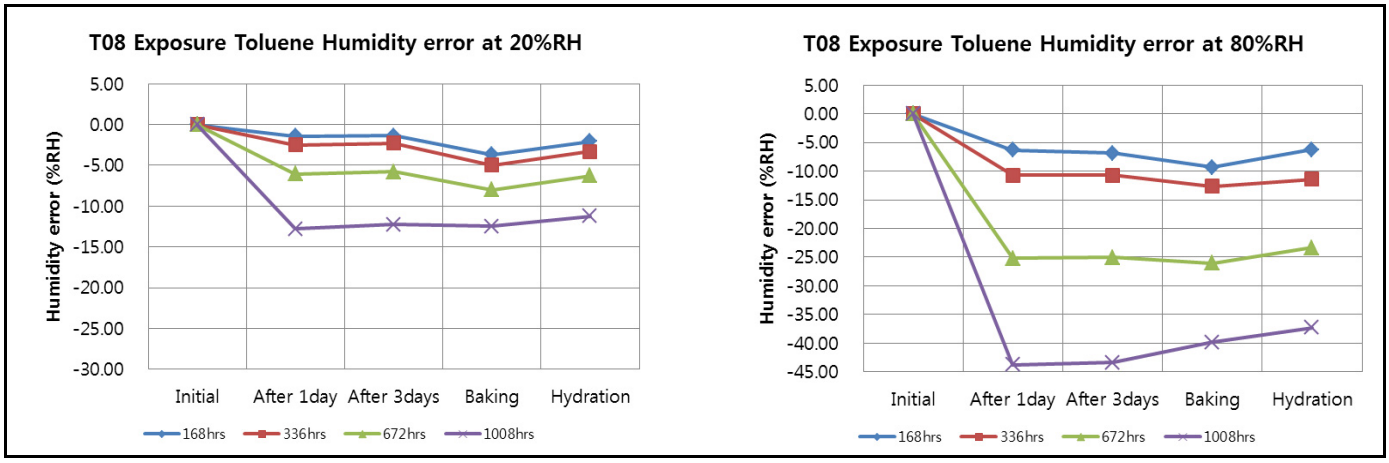

Figure 8: TO8 Exposure Toluene Humidity Error at 20% and 80% RH

1.2.2h Xylene (C8H10)

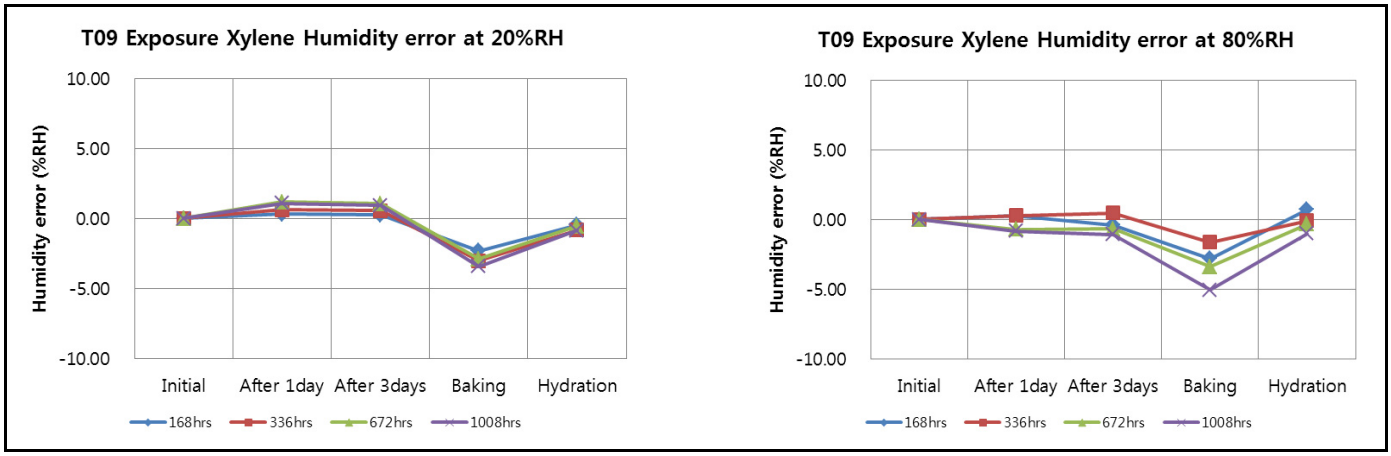

Figure 9: TO9 Exposure Xylene Humidity Error at 20% and 80% RH

1.2.2i Benzene + Toluene + Xylene

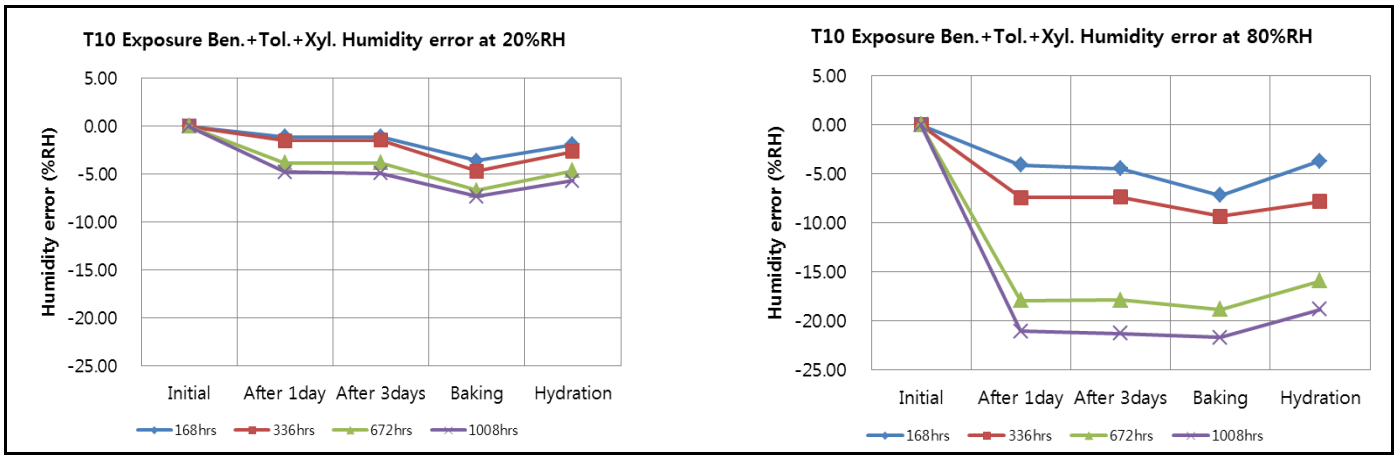

Figure 10: TO10 Exposure Benzene + Toluene + Xylene Humidity Error at 20% and 80% RH

Chapter 2. Saturation and Recovery Test

2.1 Test Procedure

1. 12 samples of HCPD-5V-U3 for each test are measured for initial value at 25°C(77°F) 20,50,80%RH.
2. Measured samples are dipped into the liquid chemical material for 1 hour.
3. The samples are stabilized for 24hrs at ambient condition (25±3°C, 50±10% RH) for measurement at 25? 20, 50, 80% RH
4. 6 samples are stored and monitored in ambient condition (25±3°C, 50±10% RH) continuously for 120 hrs (5days) to see the natural recovery.
5. The other 6 samples go through recondition process as below:
   - Baking: 80°C(176°F) 24hrs
   - Hydration: 30°C(86°F) 80%RH 45~50hrs
6. After recondition, measure again at 25°C 20, 50, 80% RH.

2.2 Saturation and Recovery Test at Ambient Condition

1. Test time: 1 hr
2. Test condition: ambient condition (25±3°C, 50±10%RH)
3. Sample: HCPD-5V-U3
4. Sample size: 12EA (Each test condition)
5. Measurement equipment: PDR-3KP (Temp. & humidity chamber, ESPEC)
6. Measurement reference: Dew master
7. Test result: After test 120 hrs

Table 1: Saturation and Recovery Test @ Ambient Condition

Recovery Time (@ ambient condition)	24 hrs		48 hrs		120 hrs	
	20% RH	80% RH	20% RH	80% RH	20% RH	80% RH
1. Di-isopropyl ether	0.95	0.05	0.72	0.40	0.75	0.42
2. Isopropyl alcohol	0.24	-0.88	0.33	-0.04	0.46	0.04
3. Ethylene glycol	1.27	-1.65	0.83	-1.01	0.95	-1.06
4. Ethanol	-0.08	-0.42	0.41	-2.21	0.26	-1.86
5. Methanol	0.70	8.22	1.20	6.35	1.18	4.99
6. Butyl acetate	-0.02	-0.13	0.12	-0.78	0.15	-1.07
7. Ethyl acetate	0.01	-0.08	0.11	-1.09	0.26	-1.32

2.3 Saturation and Recovery Test with Recondition Process

8. Test result : After test 24hrs and recondition process
Sample recondition

- Baking: 80°C 24 hrs
- Hydration: 30°C 80% RH 45~50 hrs

Table 2: Saturation and Recovery Test with Recondition Process

Recovery Time and recondition process	24 hrs		After Baking		After Hydration	
	20% RH	80% RH	20% RH	80% RH	20% RH	80% RH
1. Di-isopropyl ether	1.19	0.39	-2.03	-2.57	-0.08	0.92
2. Isopropyl alcohol	0.17	-0.98	-2.79	-3.81	-0.48	0.18
3. Ethylene glycol	0.64	-1.87	-2.66	-5.38	-0.36	-1.33
4. Ethanol	0.05	-0.16	-3.70	-5.07	-0.01	2.30
5. Methanol	0.66	8.01	-2.43	-3.87	-0.25	0.40
6. Butyl acetate	-0.01	-0.33	-3.38	-5.22	0.30	2.63
7. Ethyl acetate	0.07	0.02	-3.61	-5.49	0.21	2.31

2.3.1 Di-isopropyl Ether

2.3.1a Normal Condition

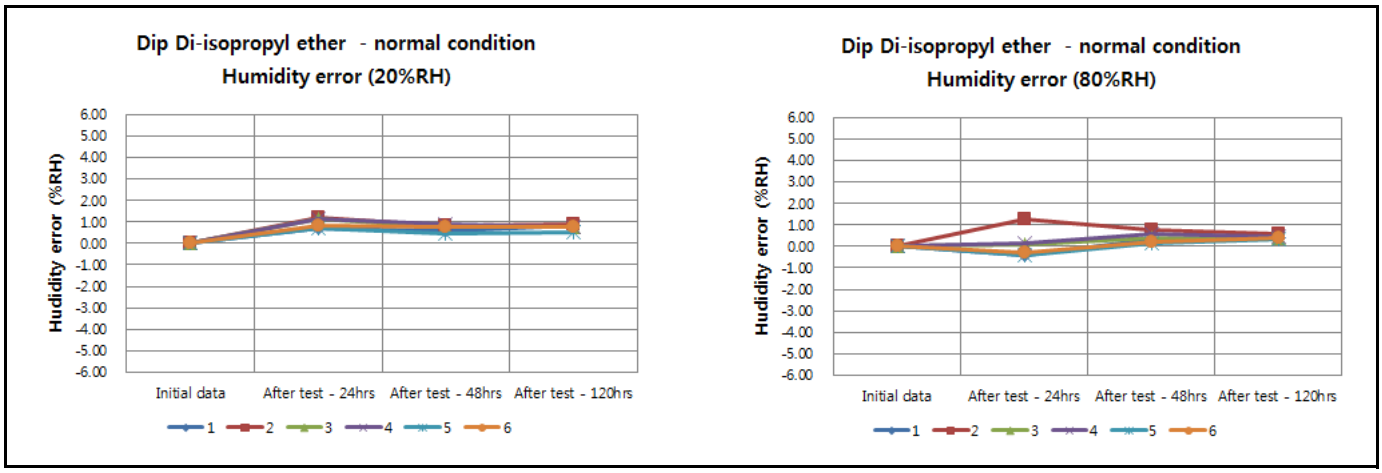

Figure 1: Test of Dip Di-isopropyl Ether @ Normal Condition

2.3.1b After Reconditioning

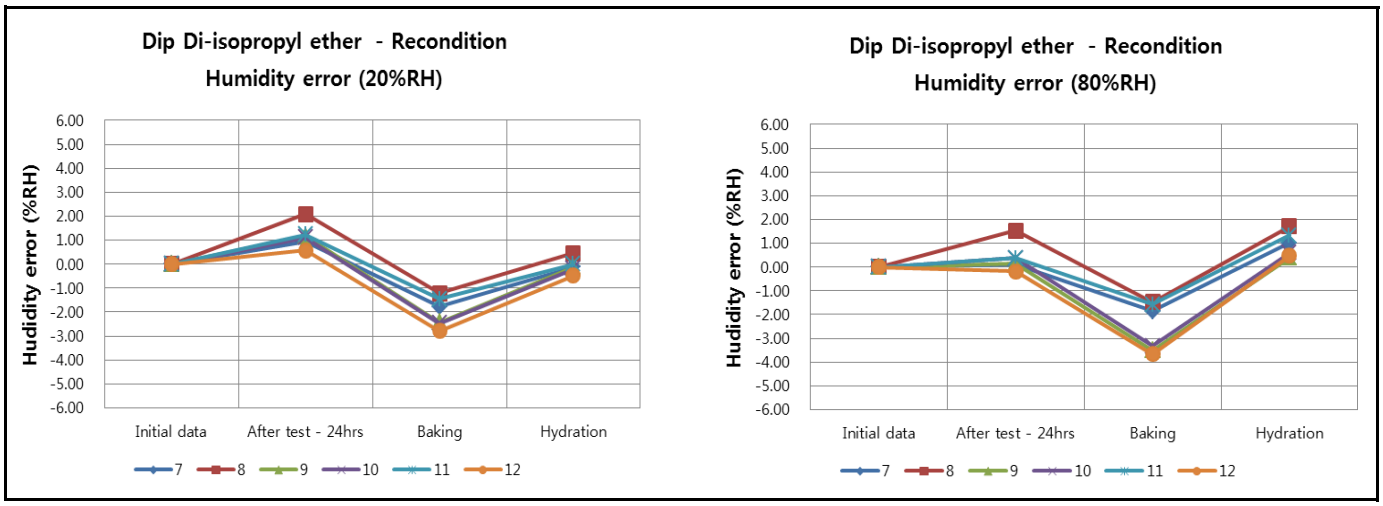

Figure 2: Test of Dip Di-isopropyl Ether After Reconditioning

2.3.2Isopropyl Alcohol

2.3.2a Normal Condition

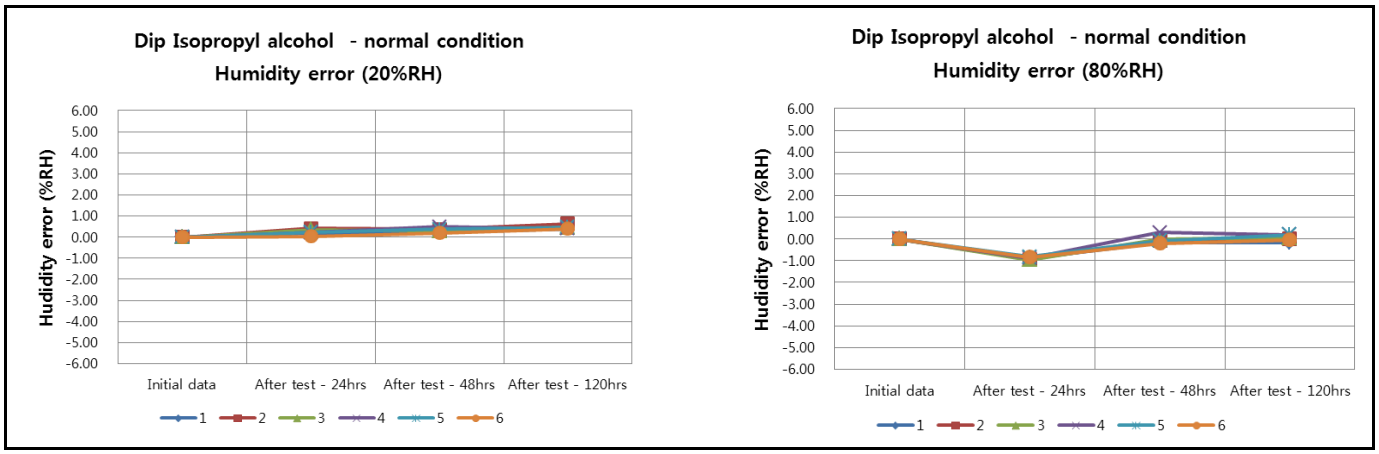

Figure 3: Test of Dip Isopropyl Alcohol @ Normal Condition

2.3.2b After Reconditioning

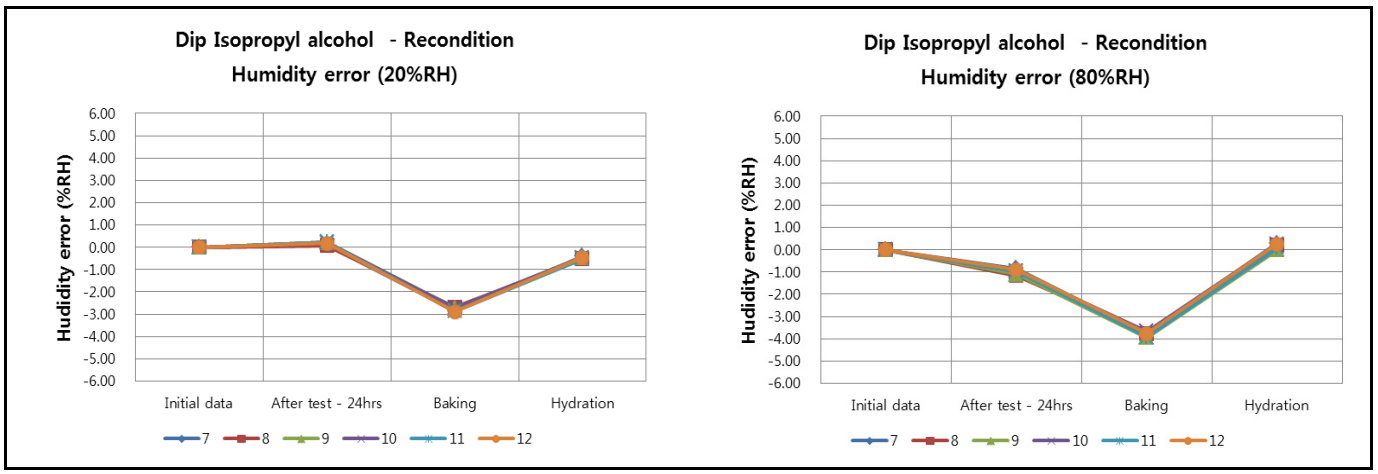

Figure 4: Test of Dip Isopropyl Alcohol After Reconditioning

2.3.3 Ethylene Glycol

2.3.3a Normal Condition

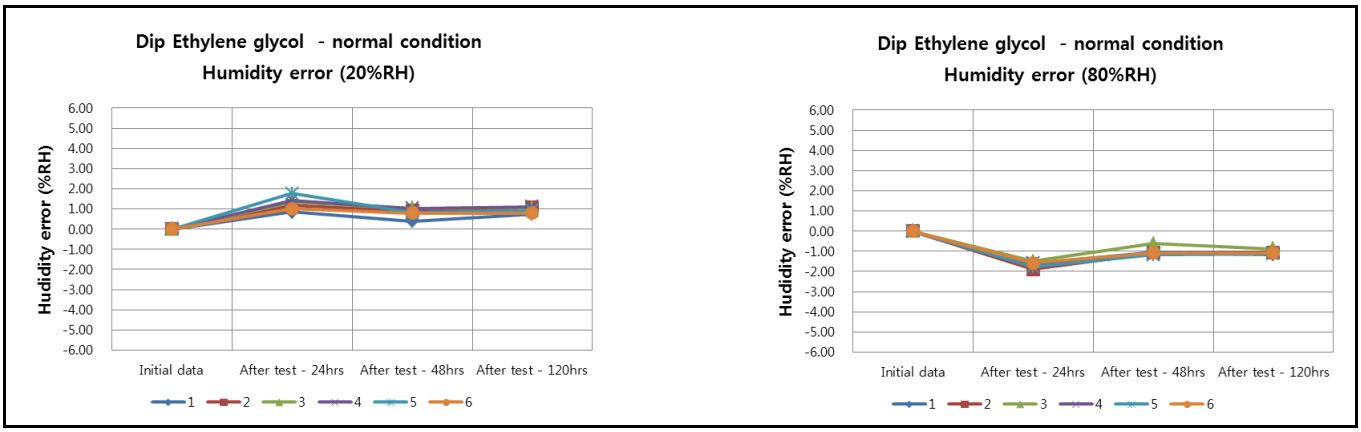

Figure 5: Test of Dip Ethylene Glycol @ Normal Condition

2.3.3b After Reconditioning

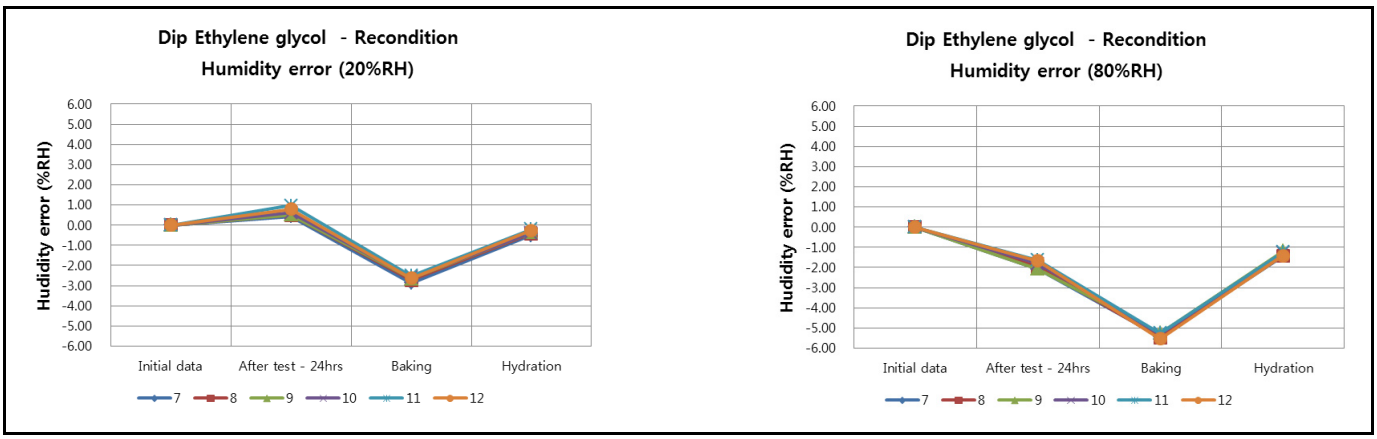

Figure 6: Test of Dip Ethylene Glycol After Reconditioning

2.3.4Ethanol

2.3.4a Normal Condition

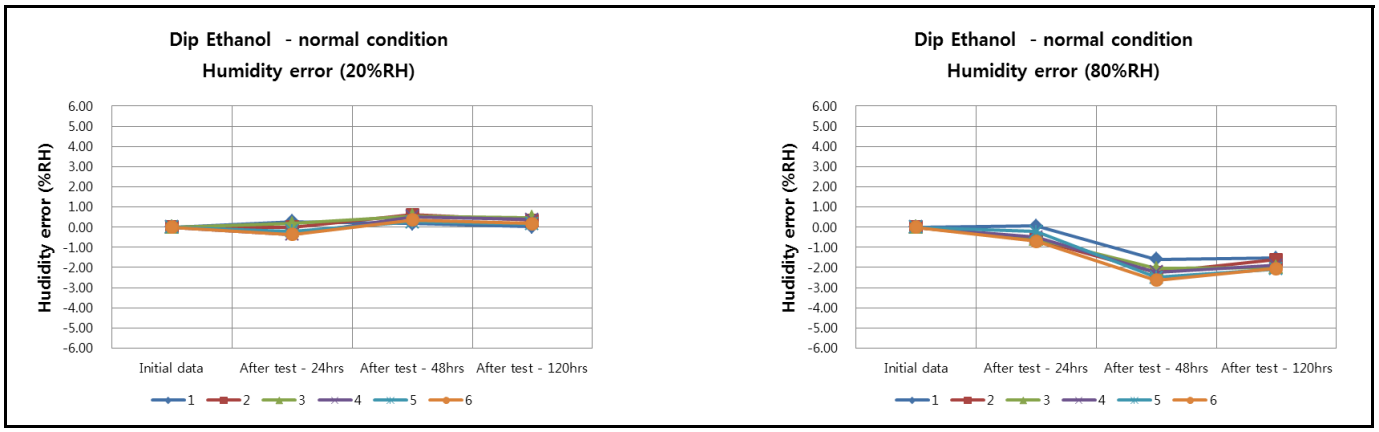

Figure 7: Test of Dip Ethanol @ Normal Condition

2.3.4b After Reconditioning

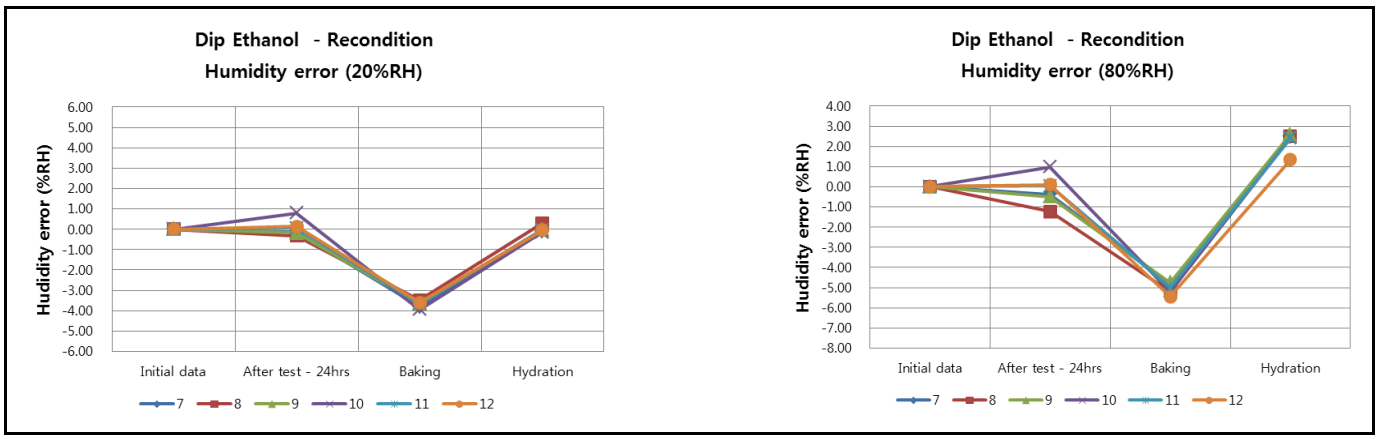

Figure 8: Test of Dip Ethanol After Reconditioning

2.3.5Methanol

2.3.5a Normal Condition

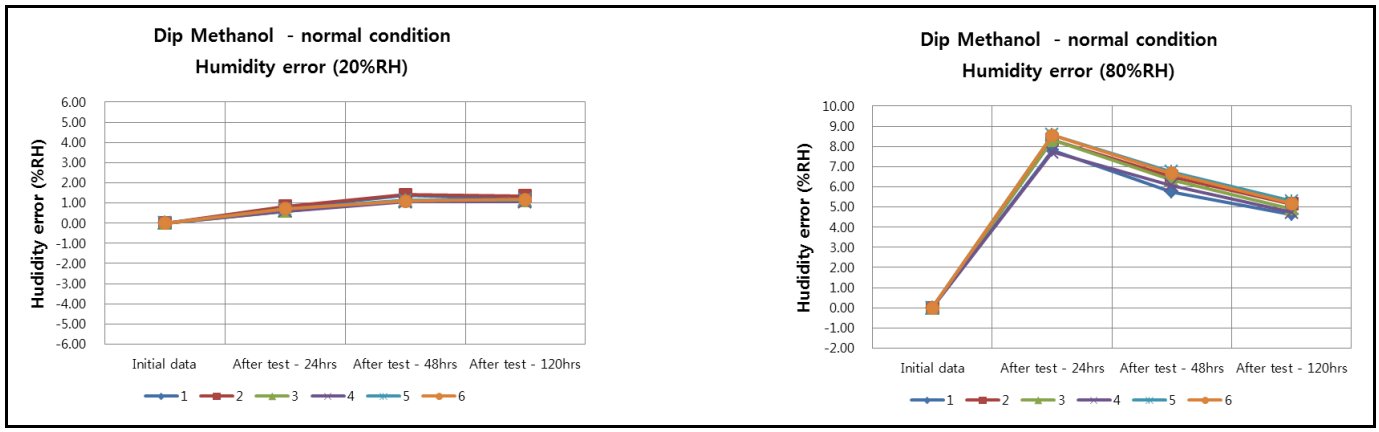

Figure 9: Test of Dip Methanol @ Normal Condition

2.3.5b After Reconditioning

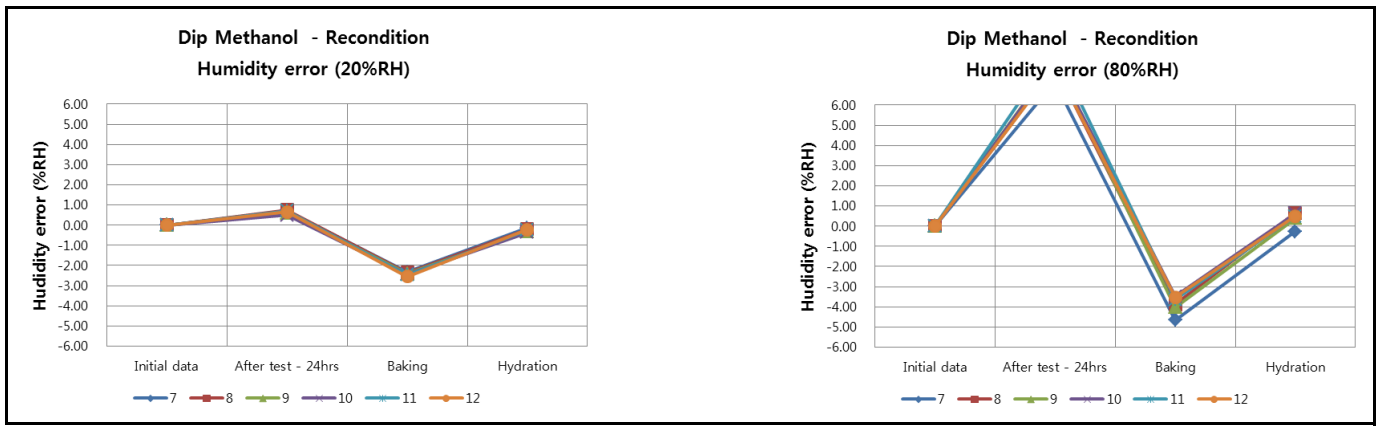

Figure 10: Test of Dip Methanol After Reconditioning

2.3.6Butyl Acetate

2.3.6a Normal Condition

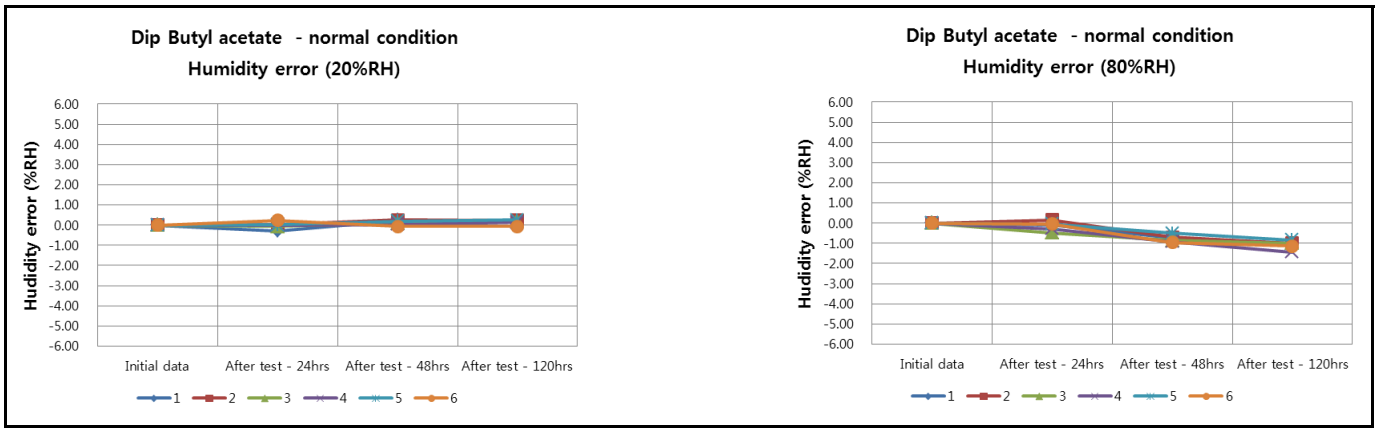

Figure 11: Test of Dip Butyl Acetate @ Normal Condition

2.3.6b After Reconditioning

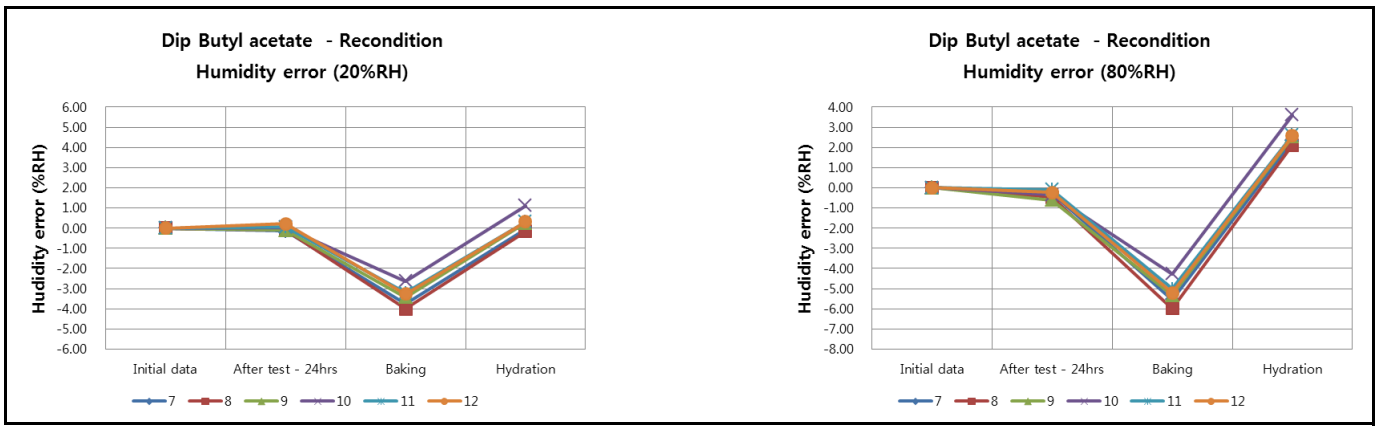

Figure 12: Test of Dip Butyl Acetate After Reconditioning

2.3.7 Ethyl Acetate

2.3.7a Normal Condition

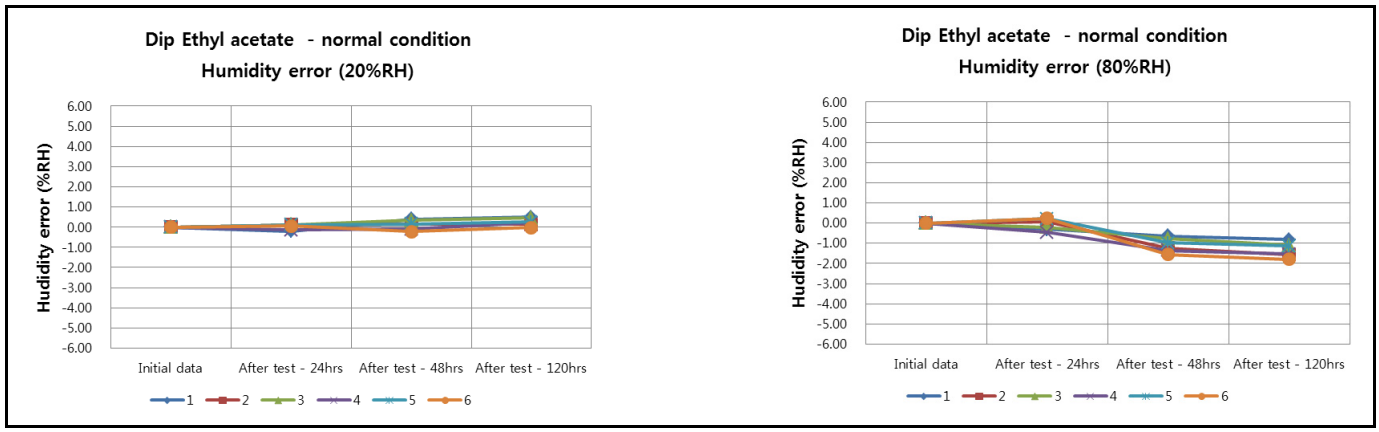

Figure 13: Test of Dip Ethyl Acetate @ Normal Condition

2.3.7b After Reconditioning

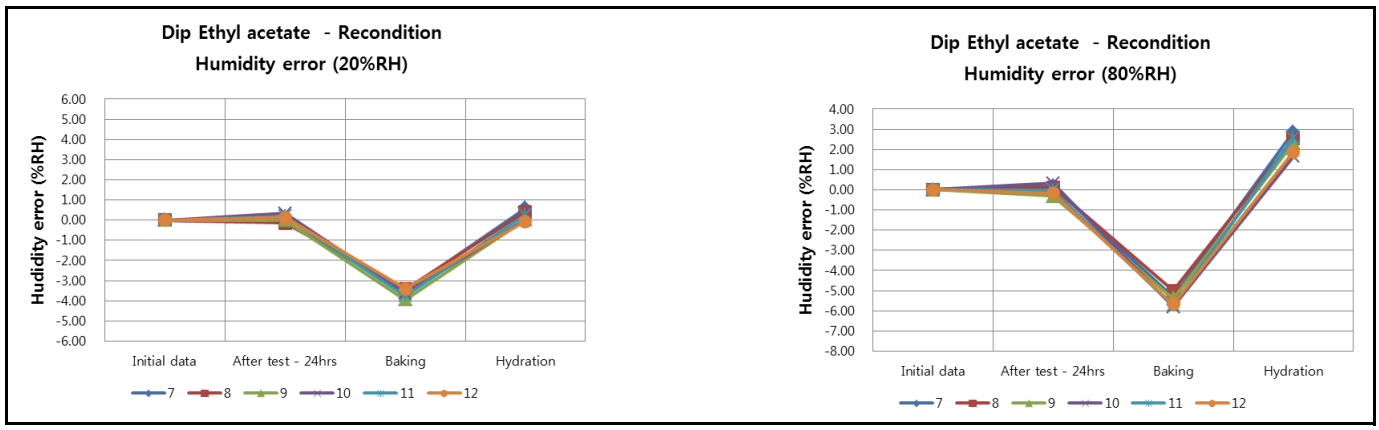

Figure 14: Test of Dip Ethyl Acetate After Reconditioning

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Customer Support Centers

U.S.A.

The Boston Center
1100 Technology Park Drive
Billerica, MA 01821
U.S.A.
Tel: 800 833 9438 (toll-free)
978 437 1000
E-mail: sensing@ge.com

Ireland

Sensing House
Shannon Free Zone East
Shannon, County Clare
Ireland
Tel: +353 (0)61 470291
E-mail: gesensingsnnservices@ge.com

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