

Eco-friendly Building Material Test Report

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 Product name (model): HI-MACS(Alpine White)
 Testing Institution: Korea Conformity Laboratories

Manufacturing date: February 15, 2017
 Sample collection date: March 23, 2017
 Test completion date: April 10, 2017
 Product category: Others
 Use of report: For collective quality certification of
 the eco-friendly building material

Test Results

Test item	Item	Test result	Test method
Pollutant emission test (mg/m ³ ·h)	TVOC	<u>0.007</u>	Standard of Korea Air Cleaning Association (ES 02131.1a)
	5VOCs / Toluene	<u>0.000 / 0.000</u>	
	HCHO	<u>0.000</u>	
	CH ₃ CHO	<u>0.002</u>	

Remarks)

1. Five VOCs: This is the sum of Benzene, Toluene, Ethylbenzene, Xylene, and Styrene.
2. This report cannot be used for publicity, flack, advertisement or lawsuits without prior written consent of the Korea Air Cleaning Association, and it is forbidden to use this report for anything other than collective quality certification of eco-friendly building material
3. This report can be verified via the homepage of the Korea Air Cleaning Association (<http://db.kaca.or.kr>).
4. Attachment: One (1) copy of the Test Report

We hereby certify that this document is the test report of the above-mentioned product.

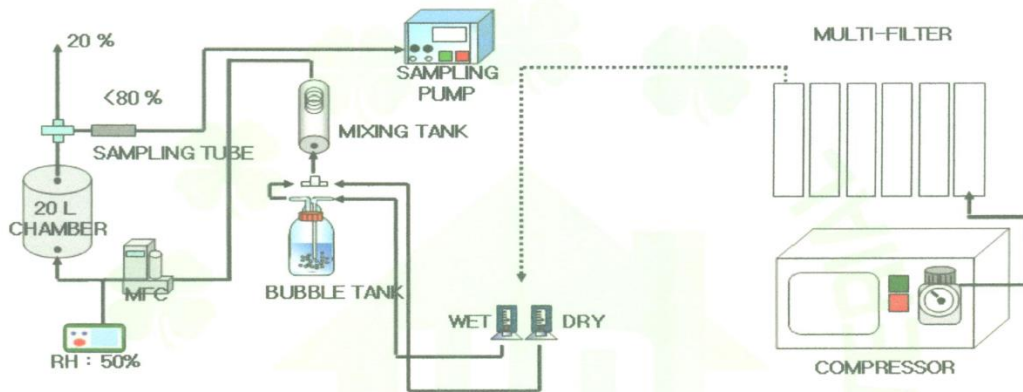
April 21, 2017



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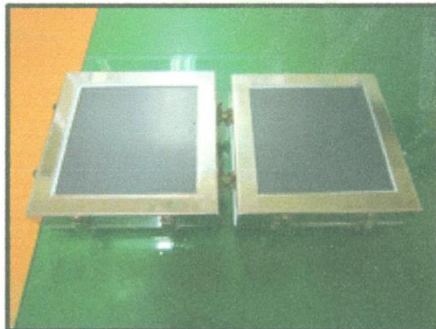
1. Test Method

This test applied the method of determining the emissions of volatile organic compounds and aldehyde per unit area of the tested building material by assessing the air concentration in the emission test chamber, the mass flow rate of the air passing through, and surface area of the specimen. We calculated the emissions of volatile organic compound and aldehyde per unit surface area at a specific time, by mixing the air completely in the emission test chamber having constant conditions of temperature, relative humidity and ventilation amount, and determining air concentration, blank concentration and ventilation amount of the inside of the emission test chamber from the air captured at the exit.



2. Test Specimen

In the pollutant emissions test of the building material, we packaged two test specimens cut by 165mm x 165mm respectively using the aluminum foil with its shiny side facing outward, and then put them in the frame and eliminated the aluminum foil of the relevant part in order to get only the area of 143mm x 143mm to be exposed, then secured them to the central part of the small chamber, and then measured the emission intensity after seven days.



(Installation figure of the test specimen)

3. Test Conditions

Capacity of the small chamber	20ℓ	Temperature	25°C ± 1°C
Relative humidity	50% ± 3°C	Ventilation rate	0.5 times/h± 3%
Sample load factor	2.0 m ² / m ³	Sample size	165mm x 165mm
Sampling tube	- TVOC: Tenax TA - Aldehyde: Ozone Scrubber(Waters 054420)+LP-DNPH(SUPECO 505358)		

4. Analysis Method

A. Definition of the terms

(1) Total Volatile Organic Compounds

Targeting the VOCs detected in the range from the normal hexane to the n-hexadecane measured with the gas chromatogram, we calculated the concentration by converting each compound into toluene.

(2) Aldehyde

We defined the aldehyde detected at the air from the exit of the emission test chamber released from the test specimen as the aldehyde for the test.

B. Analysis of the volatile organic compounds (VOCs)

(1) We eliminated the volatile organic compounds by putting the Tenax TA absorption tube into the heating desorption position and heating it.

When checking the type of the volatile organic compounds, we operated the mass spectrometer (MS) on scan mode, and distinguished the type based on the mass spectrum.

(2) As for the quantifying method, we used the Total Ion Chromatograph (TIC) by GC (Gas Chromatograph) attached to the mass spectrometer (MS).

C. Analysis of the aldehyde

We dissolved and eliminated the DNPH acceptor in the DNPH cartridge using acetonitrile, and quantified the eliminated solution using the high pressure liquid chromatography (HPLC).

5. Analysis Conditions

T V O C	Cryogenic concentration system		Split Ratio 10: 1, -30°C→40°C/s→350°C (5min)
	Thermal desorption system		Splitlessmode, Flow: 40mL/min295°C (10 min)
	Thermal Desorber		Perkin-Elmer Turbo Matrix 650
	GC/MS		GC/MSD(SHIMADZU GCMS-QP2010)
	Column		DB-1 (60m Length, 0.32 mm I.D, Film 1.0 μm
	Carrier Gas and Flow		He(99.999%), 2.5 Ml/min
	Temperature Program	Initial Temperature	40 °C (5 min)
		Temperature Program	5 °C/min
		Final Temperature	280°C (15 min)
	MS Condition	Mode	El (electron ionization)
Electron Energy		70 eV	
Detection Mode		TIC(Scan), m/z: 35 ~ 350	
A l d e h y d e	HPLC		LC-30A Prominence series (SHIMADZU)
	Detector		UV/vis 360 nm
	Column		C18 Column (100mm Length, X 2.1mm I.D)
	Mobile Phase		CAN/Water (40/60)
	Analysis Time		15 min
	Injection Volume		5 uL
	Column Temperature		40 °C
Flow Rate		0.5 ML/min	

6. Analysis Results

- Five VOCs (Five Volatile Organic Compounds)

No	Item	Measurement value
		Emission intensity (mg/m ³ •h),
1	Benzene	0.000
2	Toluene	0.000
3	Ethylbenzene	0.000
4	Xylene	0.000
5	Styrene	0.000
	Five VOCs' Total	0.000

※ Standard material recommended by Ministry of Environment for the interior air quality of newly built apartment homes

- Standard Volatile Organic Compounds

No	Item	Measurement value
		Emission intensity (mg/m ³ •h),
1	Chloroform	0.000
2	1,2-Dichloroethane	0.000
3	1,1,1-Trichloroethane	0.001
4	Carbon tetrachloride	0.000
5	1,2-dichloropropane	0.000
6	Trichloroethylene	0.000
7	Cis-1,3-Dichloropropene	0.000
8	Trans-1,3-Dichloropropene	0.000
9	1,1,2-Trichloroethylene	0.000
10	1,2-Dibromoethane	0.000
11	Tetrachloroethylene	0.000
12	Chlorobenzene	0.000
13	1,1,2,2-Tetrachloroethylene	0.000
14	1,3,5-Trimethylbenzene	0.000
15	1,2,4-Trimethylbenzene	0.000
16	1,3-Dichloropropene	0.000
17	1,4-Dichloropropene	0.000
18	1,2-Dichloropropene	0.000
19	1,2,4-Trimethylbenzene	0.000
20	Hexachlorobutadiene	0.000
21	Unidentified	0.006