



TESTING CERT # 1136.03

Chemitox

TEST REPORT

Report Number: 200329
Date of Issue: May 13, 2020

Report to:

Hanwha Techwin Co., Ltd.

6, Pangyo-ro 319 Beon-gil, Bundang-gu, Seongnam-si, Gyeonggi-do, 13488, Korea

Prepared by:

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A handwritten signature in black ink, appearing to read 'K. Sakamoto'.

Responsible Officer
Kiyohiko Sakamoto
Director

A handwritten signature in black ink, appearing to read 'Mitsuya Mochizuki'.

Authorized
Mitsuya Mochizuki
Engineering Leader

- (1) Chemitox is accredited by the following agency to ISO/IEC 17025.
American Association for Laboratory Accreditation (A2LA) — Certificated No: 1136.03
- (2) This TEST REPORT refers only to the sample tested, unless stated otherwise.

Hanwha Techwin Co., Ltd.

6, Pangyo-ro 319 Beon-gil, Bundang-gu,
Seongnam-si, Gyeonggi-do, 13488, Korea

Oxygen Index Measurement Test Report**1. Objective**

As per client's request, oxygen index test is conducted in accordance with ISO 4589-2:2017 "Plastics -- Determination of burning behaviour by oxygen index -- Part 2: Ambient-temperature test".

2. Test Date

April 6, 2020

3. Test Specimen(s)

The description of the specimens given in Table 1 has been prepared from information provided by Hanwha Techwin Co., LTD. This information has not been independently verified by Chemitox. All values quoted are nominal, unless specified.:

Table 1 Description of test specimens

Material Composition	Product Name	Color	Nominal Dimension (mm)	Received on
Silicon Rubber	PAD-THERMAL,W30,D45,T2;GP1500,2	Gray	140 x 52 x 2.0	March 19, 2020

4. Conditioning

Test Method and Conditioning is indicated in Table 2.

Table 2 Test Method and Conditioning

Test	Oxygen Index Measurement
Applicable Standard	ISO 4589-2 : 2017
Test Mode	Procedure A (Top surface ignition)
Conditioning	Specimens are conditioned to be stabilized constant mass or at least 88h at 23±3°C/50±10 %RH

5. The Method

A small test specimen is supported vertically in a mixture of oxygen and nitrogen flowing upwards through a transparent chimney. The upper end of the specimen is ignited and the subsequent burning behavior of the specimen is observed to compare the period for which burning continues, or the length of specimen burned, with specified limits for such burning. By testing a series of specimens in different volume fractions of oxygen, the OI is estimated. For the purposes of calculation of estimated standard deviation σ , the OI is calculated to two decimal places when OI is expressed as a percentage. For the purposes of reporting OI results, express OI values to the nearest 0.1 when OI is expressed as a percentage, with exactly intermediate results being rounded downwards.

6. Test Results

The following Table 3 shows the summary of obtained test results. See Appendix for details.

Table 3: Test Results

Product Name	PAD-THERMAL,W30,D45,T2;GP1500,2
OI (%)	>95

Note: The test results relate only to the behavior of the test specimens under the conditions of this test and that these results shall not be used to infer the fire hazards of the materials in other forms or under other fire conditions.

7. Test Location

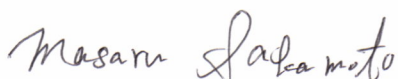
Chemitox, Inc., Yamanashi Testing Center
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8. Performed by



Masaru Sakamoto, Engineer (Level 2)

9. Reported by



Masaru Sakamoto, Engineer (Level 2)

10. Reviewed by



Makoto Horimizu, Technical Manager (Level 3)

Note: This report shall not be reproduced except in full.

Appendix

(1 Pages)

- Detailed test results

Oxygen Index Test Result

TP-48-R3
Issued: 2005-07-29
Revised: 2019-06-03

Test Date: 2020/4/6
Product Name: PAD-THERMALW30,D45,T2:GP1500,2 Material:
Specimen form: V L: 140 mm / W: 52 mm T: 2 mm / Color:-)
Color: Gray
Test chimney Diameter: 75 mm
Room Temperature: 22 °C
Relative Humidity: 19 %
Ignition Procedure: Procedure B - (Propagating ignition)
Chimney Inside Temp.: 24 °C
Ox. Conc. Change Interval (d): 0.2 %
Test method: ☐ JIS K6269 ☐ JIS K7201-2 ☐ ASTM D2863 ☒ ISO4589-2 ☐ other

A. Determination of preliminary volume fraction of oxygen

Oxygen volume fraction (%)	28.0	50.0	75.0	90.0	95.0
Burning period (s)	0.0	0.0	0.0	0.0	0.0
Length burnt (mm)	0.0	0.0	0.0	0.0	0.0
Response (O or X)	O	O	O	O	O

OI > 95%※

B. Determination of Oxygen Index

Found that differ by d = 0.2% are

Oxygen Concentration (%)
Burning Time (s)
Burned Length (mm)
Response (O or X)

※: During the test, the concentration of oxygen was increased to 95% with "O" result. The standard requires 0.2 % intervals to determine the minimum oxygen concentration required to support combustion; however, it was considered that such a high concentration of oxygen would have exposed the test operator to a potentially dangerous situation. The test was therefore terminated at this point. As a result, it is not possible to report a specific oxygen index for the product tested, and the result was reported as ">95.0%".

* COLUMN (2, 3, 4 or 5):

* ROW (1 to 16):

k =

$$OI = C_f + k \cdot d = 0.0 + (0.00 \times 0.2) = 0.0 \% \text{ (To Report; one decimal place)}$$

$$= 0.00 \% \text{ (To Calculate Standard Deviation; two decimal places)}$$

C. Verification of step size d% oxygen volume fraction

Last Six Specimens' Results		Oxygen Concentration (%)			
		C_i	OI	$C_i - OI$	$(C_i - OI)^2$
C_f	1	0.0	0.00	0.00	0.0000
	2	0.0	0.00	0.00	0.0000
	3	0.0	0.00	0.00	0.0000
	4	0.0	0.00	0.00	0.0000
	5	0.0	0.00	0.00	0.0000
n	6	0.0	0.00	0.00	0.0000
		$\sum (C_i - OI)^2 = 0.0000$			

Estimation of Standard Deviation

$$\hat{\sigma} = \left[\frac{\sum (c_i - OI)^2}{n - 1} \right]^{1/2} = 0.0000$$

$$\frac{2\hat{\sigma}}{3} = 0.0000 \quad d = 0.2 \quad \frac{3\hat{\sigma}}{2} = 0.0000$$

D. Uncertainty estimation

$$\sigma_{OI} = \sqrt{\left(\frac{0.5}{\sqrt{3}} \right)^2 + \left(\frac{\hat{\sigma}}{\sqrt{6}} \right)^2} = 0.289$$

$$\Delta OI = \sqrt{3} \times \sigma_{OI} = 0.50$$

E. Observation

N/A

Performed by: Masaru Sakamoto