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**Test Report: ICL/H20/12911**

**EN 45545-2**

**Railway applications— Fire protection on railway vehicles**

**Part 2: Requirements for fire behaviour of materials and components**

**Annex C Testing methods for determination of toxic gases from railway products.**

**Clause C.2 Method 1.**

**Sponsored By**

Hanwha Techwin Co., Ltd

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**1 Introduction**

Tests were undertaken at the request of the sponsor on a specimen of a sheet product. The test was conducted in accordance with the procedures specified in EN 45545-2 Annex C “Test method for the determination of toxic gases from railway products” Clause 2 Test Method 1.

EN 45545-2 Annex C details a test procedure, the results being expressed as CIT value, for the measurement of toxic fumes generated under the conditions of test carried out in apparatus detailed in ISO 5659-2.

The principle of the test method ISO 5659-2 is to expose a material to specified thermal conditions of pyrolysis and combustion in a continuous procedure. The change in optical density of the smoke produced when dispersed within a fixed volume of air is recorded throughout the period of test. The resulting smoke density/time curve is used to calculate the smoke index.

Fire gas samples are taken at 4 and 8 minutes into the test and quantitative analysis carried out using FTIR.

The test method provides a means for the comparative assessment of products, however, it does not model a real fire situation and the results cannot therefore be used to describe the fire hazard of materials under actual fire conditions.

**2 Description Of Test Specimens**

The description of the specimens given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given.

The test specimens consisted of 1.2mm thick steel plate (density 7.8g/cm<sup>3</sup>) coated on one face with paint EMS BLACK MATT(MNC)-1 manufactured by Akzonobel applied at 15-20µm thickness.

The sponsor of the test has not supplied additional information relating to the product that was tested.

### 3 **Conditioning Of Specimens**

The specimens were received on 8<sup>th</sup> September 2020.

The specimens were conditioned to constant mass in accordance with the requirements of ISO 5659-2 at  $23 \pm 2^{\circ}\text{C}$  and  $50 \pm 5\%$  RH, before testing.

### 4 **Date Of Test**

The tests were performed on 23<sup>rd</sup> September 2020.

### 5 **Test Procedure**

The tests were carried out in accordance with the procedures specified in EN 45545 -2 Annex C Clause C.2 and this report should be read in conjunction with this standard.

The face with black paint was exposed to the heating conditions of the test.

The specimens were tested at  $50\text{kW/m}^2$  without pilot flame.

### 6 **Test Results**

The test results apply to the sample as received tested after conditioning. The test results relate only to the behaviour of the specimens of the product under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential toxicity hazard of the product in use.

The test results relate only to the specimens of the product in the form in which they were tested. Small differences in the composition or thickness of the product may significantly affect the performance during the test and will therefore invalidate the test results. It is the responsibility of the supplier of the product to ensure that the product, which is supplied, is identical with the specimens, which were tested. Uncertainty measurement has not been taken into account when presenting the test results.

The results of tests carried out can be summarised as follows:-

**Table 1: Toxic gas emission data at 4 minutes.**

|                                     | <b>Concentration (ppm) 4 mins</b> |              |              |                |
|-------------------------------------|-----------------------------------|--------------|--------------|----------------|
| <b>Gas species</b>                  | <b>Run 1</b>                      | <b>Run 2</b> | <b>Run 3</b> | <b>Average</b> |
| Carbon dioxide, CO <sub>2</sub>     | ND                                | ND           | ND           | -              |
| Carbon monoxide, CO                 | ND                                | ND           | ND           | -              |
| Oxides of Nitrogen, NO <sub>x</sub> | ND                                | ND           | ND           | -              |
| Sulphur dioxide, SO <sub>2</sub>    | ND                                | ND           | ND           | -              |
| Hydrogen Chloride, HCl              | ND                                | ND           | ND           | -              |
| Hydrogen Bromide, HBr               | ND                                | ND           | ND           | -              |
| Hydrogen Fluoride, HF               | ND                                | ND           | ND           | -              |
| Hydrogen Cyanide, HCN               | ND                                | ND           | ND           | -              |

Where : ND=Not detected

**Table 2: Toxic gas emission data at 8 minutes.**

|                                     | Concentration (ppm) 8 mins |       |       |         |
|-------------------------------------|----------------------------|-------|-------|---------|
| Gas species                         | Run 1                      | Run 2 | Run 3 | Average |
| Carbon dioxide, CO <sub>2</sub>     | 4475                       | 4515  | 4420  | 4470    |
| Carbon monoxide, CO                 | 20                         | 15    | 25    | 20      |
| Oxides of Nitrogen, NO <sub>x</sub> | ND                         | ND    | ND    | -       |
| Sulphur dioxide, SO <sub>2</sub>    | ND                         | ND    | ND    | -       |
| Hydrogen Chloride, HCl              | ND                         | ND    | ND    | -       |
| Hydrogen Bromide, HBr               | ND                         | ND    | ND    | -       |
| Hydrogen Fluoride, HF               | ND                         | ND    | ND    | -       |
| Hydrogen Cyanide, HCN               | ND                         | ND    | ND    | -       |

Where : ND=Not detected

**Table 3: CIT<sub>G</sub> calculations for 4 minutes**

| Gas species                         | ci (mg/m <sup>3</sup> ) | Ci (mg/m <sup>3</sup> ) | CIT <sub>G</sub> |
|-------------------------------------|-------------------------|-------------------------|------------------|
| Carbon dioxide, CO <sub>2</sub>     | ND                      | 72000                   | -                |
| Carbon monoxide, CO                 | ND                      | 1380                    | -                |
| Oxides of Nitrogen, NO <sub>x</sub> | ND                      | 38                      | -                |
| Sulphur dioxide, SO <sub>2</sub>    | ND                      | 262                     | -                |
| Hydrogen Chloride, HCl              | ND                      | 75                      | -                |
| Hydrogen Bromide, HBr               | ND                      | 99                      | -                |
| Hydrogen Fluoride, HF               | ND                      | 25                      | -                |
| Hydrogen Cyanide, HCN               | ND                      | 55                      | -                |
| CIT <sub>G</sub>                    |                         |                         | 0.000            |

Where : ND=Not detected

**Table 4 CIT<sub>G</sub> calculations for 8 minutes**

| Gas species                         | ci (mg/m <sup>3</sup> ) | Ci (mg/m <sup>3</sup> ) | CIT <sub>G</sub> |
|-------------------------------------|-------------------------|-------------------------|------------------|
| Carbon dioxide, CO <sub>2</sub>     | 7196.74                 | 72000                   | 0.008            |
| Carbon monoxide, CO                 | 20.49                   | 1380                    | 0.001            |
| Oxides of Nitrogen, NO <sub>x</sub> | ND                      | 38                      | -                |
| Sulphur dioxide, SO <sub>2</sub>    | ND                      | 262                     | -                |
| Hydrogen Chloride, HCl              | ND                      | 75                      | -                |
| Hydrogen Bromide, HBr               | ND                      | 99                      | -                |
| Hydrogen Fluoride, HF               | ND                      | 25                      | -                |
| Hydrogen Cyanide, HCN               | ND                      | 55                      | -                |
| CIT <sub>G</sub>                    |                         |                         | 0.009            |

Where : ND=Not detected

## 7 Requirements

The following requirements are given in Table 5 of EN 45545-2 for R1

| Test method reference                | Parameter                    | Requirements for R1<br>Values are maximum allowed |     |      |
|--------------------------------------|------------------------------|---------------------------------------------------|-----|------|
|                                      |                              | HL1                                               | HL2 | HL3  |
| T11.01<br>EN ISO 5659-2:<br>50 kWm-2 | <i>CITG</i><br>dimensionless | 1.2                                               | 0.9 | 0.75 |

## 8 Conclusion

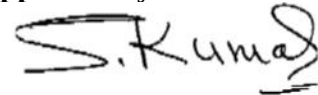
When tested in accordance with the procedure called up EN 45545-2 Annex C Clause C.2 the sheet product tested satisfies the toxicity requirements given in EN 45545-2 Table 5 R 1: for hazard level HL1, HL2 and HL3.

**Prepared by**



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**Approved by**



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Photo 1: Specimen before test (From left to right 1,2 and 3)

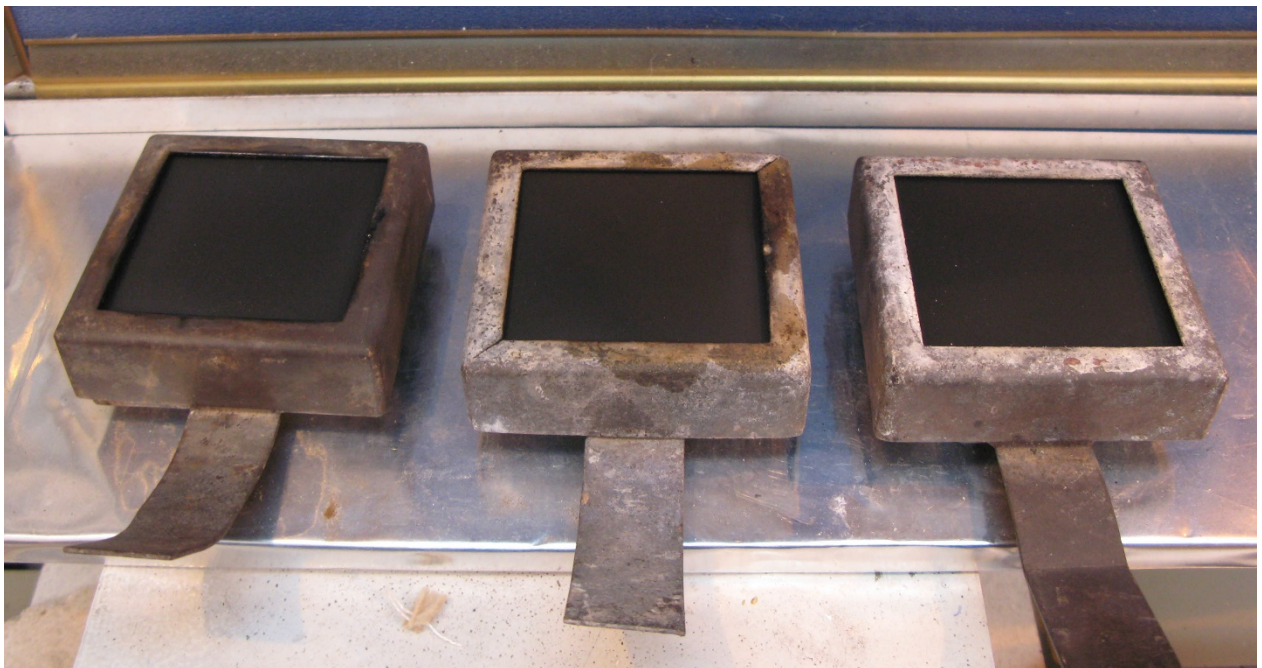


Photo 2: Specimen after test (From left to right 1,2 and 3)