

# Study of Alternative Method for Gas Toxicity Test of Noncombustible Building Materials

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## 1. Introduction

At present, in addition to the heat generation test, etc., the gas toxicity test (ISO/TR 16312-2; Rotative cages smoke toxicity test) is also specified in performance evaluations of fire-preventive materials for certification by the Minister of Land, Infrastructure, Transport and Tourism (MLIT). In the gas toxicity test, a mouse is exposed to the combustion gas generated when a 22 cm square material test piece is heated, and toxicity is evaluated by comparing the time to behavioral incapacitation of the animal with a standard value of 6.8 minutes.

However, it has been noted that this gas toxicity test has various problems, including the fact that the formed gas cannot be quantified. Since this test is also undesirable from the viewpoint of animal welfare, an alternative evaluation method to the gas toxicity test is required.

In this research, the Fire Standards Division conducted a smoke density chamber test<sup>1)</sup> (ISO 5659-2; Smoke Density Chamber Test; hereinafter, SDC test), which is used in evaluations of toxic gas in Europe, while analyzing the gas composition. The results of the SDC test were compared with those of the conventional gas toxicity test, and their correlation was examined.

## 2. Overview of Research

An outline of the SDC test system is shown in **Figs. 1** and **2**. Using the SDC test system, the test specimen is heated in accordance with ISO 19021 “Test method for determination of gas concentrations in ISO 5659-2 using Fourier transform infrared spectroscopy,” and a quantitative analysis of the gas sampled from the center of the chamber ceiling is performed using Fourier transform infrared spectroscopy (FTIR). Among the heating conditions specified in ISO 19021, “25 kW/m<sup>2</sup> with pilot flame” and “50 kW/m<sup>2</sup> without pilot flame” were adopted in these tests. In addition, the Conventional Index of Toxicity CIT<sub>G</sub> value<sup>2)</sup> (G: general products) was calculated from the measured gas concentration in accordance with EN 17084-2018.

As test samples, rubber, wallpaper, medium-density fiberboard (MDF) and others were selected as materials that are generally used as building interior materials.

The obtained CIT<sub>G</sub> values were compared with the time



Fig.-1 Appearance of SDC test system<sup>2)</sup>

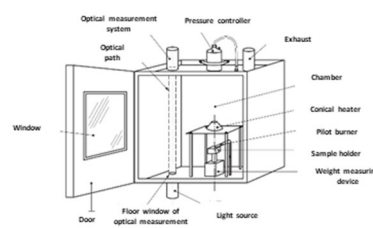


Fig.-2 Device diagram of SDC main unit<sup>2)</sup>

to behavioral incapacitation of mice when gas toxicity tests were performed using the same test samples, and a certain correlation between the two was confirmed.

## 3. Conclusion

In the future, we plan to publish more detailed study results in connection with the correlation between the gas toxicity test and the SDC test in conference presentations, technical materials, etc. when the occasion arises. In the future, we also plan to propose an alternative technique to the gas toxicity test using these research results.

For more information:

- 1) ISO 5659-2:2017, Plastics -- Smoke generation -- Part 2: Determination of optical density by a single-chamber test.
- 2) EN 17084-2018, Railway applications -Fire protection on railway vehicles – Toxicity test of materials and components.