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Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for antibacterial activity of semiconducting photocatalytic materials under indoor lighting environment

Céramiques techniques — Méthode d'essai de l'activité antibactérienne des matériaux photocatalytiques semiconducteurs dans un environnement d'éclairage intérieur

ICS 81.060.30

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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ISO 17094 was prepared by Technical Committee ISO/TC 206, *Fine ceramics*.

This second/third/... edition cancels and replaces the first/second/... edition (), [clause(s) / subclause(s) / table(s) / figure(s) / annex(es)] of which [has / have] been technically revised.

Introduction

The test method for cloths or textiles is not included in this draft, because of lack of indoor light-active photocatalytic cloths or textiles. When the indoor light-active photocatalytic cloths or textiles will be developed, test method for indoor light-active photocatalytic cloths or textiles will be proposed with remediated glass adhesion method in **ISO27447**.

Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for antibacterial activity of semiconducting photocatalytic materials under indoor lighting environment

WARNING – Handling and manipulation of microorganisms that are potentially hazardous requires a high degree of technical competence. Only personnel trained in microbiological techniques should carry out tests.

1 Scope

This test method covers the determination of the antibacterial activity of materials that contain an indoor light-active photocatalytic materials or have indoor light-active photocatalytic films on the surface, by measuring the enumeration of bacteria after illumination with indoor light.

This standard is intended for use with different kinds of indoor light-active photocatalytic materials used in construction materials in flat sheet, board, plate shape that are the basic forms of materials for various applications. It does not include powder, granular or porous indoor light-active photocatalytic materials. Also this standard is not applicable for cloths or textiles.

This test method is applicable to indoor light-active photocatalytic materials produced for antibacterial application. Other types of performance of indoor light-active photocatalytic materials, i.e., decomposition of water contaminants, self-cleaning, antifogging and air purification, are not to be determined by this method.

The values expressed in this standard are in accordance with the International System of Units (SI).

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 80000-1, *Quantities and units -- Part 0: General principles*

ISO 27447, *Fine ceramics (advanced ceramics, advanced technical ceramics) -- Test method for antibacterial activity of semiconducting photocatalytic materials*

ISO/DIS 14605, *Fine Ceramics (advanced ceramics, advanced technical ceramics) -- Visible light source for testing semiconducting photocatalytic materials*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
photocatalyst
substance that carries out many functions based on oxidization and reduction reactions under photoirradiation, including decomposition and removal of air and water contaminants, deodorization, and antibacterial, antifungal, self-cleaning and antifogging actions.

3.2
indoor light-active photocatalyst
photocatalyst that functions under illumination with artificial light used for general lighting purposes.

3.3
indoor lighting environment
illumination with artificial light source(s) used for general lighting purposes and excluding sunlight.

3.4
indoor light-active photocatalytic materials
materials in which or on which the indoor light-active photocatalyst is added by coating, impregnation, mixing, etc.

3.5
antibacterial
condition inhibiting the growth of bacteria on the surface of flat surface materials.

3.6
indoor light-active photocatalyst antibacterial activity value
difference between the total number of viable bacteria of indoor light-active photocatalytic treated materials and non-treated materials after indoor light illumination.

NOTE This value includes the decrease of number of bacteria without indoor light illumination.

3.7
indoor light-active photocatalyst antibacterial activity value with indoor light illumination
difference between the total number of viable bacteria on indoor light-active photocatalytic treated materials after indoor light illumination and the total number of viable bacteria on indoor light-active photocatalytic treated materials kept in the dark place

4 Symbols

A average number on viable bacteria of non-treated specimen, just after inoculation

B_D average number on viable bacteria of non-treated specimens, after being kept in a dark place

B_L average number on viable bacteria of non-treated specimens, after indoor light illumination of intensity L

C_D average number on viable bacteria of indoor light-active photocatalytic treated specimens, after being kept in dark place

C_L average number on viable bacteria of indoor light-active photocatalytic treated specimens, after indoor light illumination of intensity L

D_F dilution factor

L illuminance of indoor light

$Lmax$ maximum logarithmic value of viable bacteria

$Lmean$ average logarithmic value of viable bacteria for 3 specimens

Lmin minimum logarithmic value of viable bacteria

N number of viable bacteria

P bacteria concentration

R_L indoor light-active photocatalyst antibacterial activity value, after illumination at a constant intensity (*L*) on a indoor light-active photocatalytic material

ΔR indoor light-active photocatalyst antibacterial activity value with indoor light illumination

V volume of soybean-casein digest broth with lecithin and polysorbate 80 medium for washout

Z average number of colonies in 2 Petri dishes

5 Principle

This standard is for development, comparison, quality assurance, characterization, reliability, and design data generation of indoor light-active photocatalytic materials. The method is used to obtain the antibacterial activity of indoor light-active photocatalytic materials by contact of a specimen with bacteria, under indoor lighting condition. The film adhesion method is available for flat sheet, board or plate shaped materials.

The specimen is laid in a Petri dish and the bacterial suspension is dripped onto the specimen. Then the adhesive film is placed on the suspension and the moisture conservation glass is placed on top of the Petri dish. The Petri dish containing the specimen is exposed to light. After exposure, the test bacteria are washed out of the specimen and the adhesive film. This washout suspension is measured by the viable bacterial count method.

6 Materials

6.1 Bacteria strains and preparation for tests

6.1.1 Bacteria strains

The bacteria strains to be used in the test shall be the same as or equivalent to those described in Table 1 and supplied by an entity that is registered under the World Federation for Culture Collections or the Japan Society for Culture Collections.

Table 1 — Bacteria strains to be used in test

Bacteria species	WDCM code
Staphylococcus aureus	WDCM 00195 http://refs.wdcm.org/getinfo.htm?sid=WDCM_00195
Escherichia coli	WDCM 00196 http://refs.wdcm.org/getinfo.htm?sid=WDCM_00196
NOTE Refer to WDCM and its website: http://refs.wdcm.org/search.htm . (Note that WDCM stands for World Data Centre for Microorganisms.)	

6.1.2 Bacteria preparation

Aseptic manipulations using microorganisms can be performed in an adequate safety cabinet. Inoculate each strain into slant culture medium (nutrient agar medium), incubate for 16 h to 24 h at 37 ˚C ± 1 ˚C, and then store in a refrigerator at 5 ˚C to 10 ˚C. Repeat subcultures within 1 month by replicating this process. The