



SLOVENSKI STANDARD

SIST EN 17120:2019

01-maj-2019

Fotokataliza - Čiščenje vode - Ugotavljanje zmogljivosti fotokatalitičnih materialov z merjenjem razgradnje fenola

Photocatalysis - Water purification - Performance of photocatalytic materials by measurement of phenol degradation

Photokatalyse - Wasserreinigung - Verhalten von photokatalytischen Werkstoffen durch Messung der Verminderung von Phenol

Photocatalyse - Purification de l'eau - Évaluation des performances des matériaux photocatalytiques par mesurage de la dégradation du phénol

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ICS:

25.220.20 Površinska obdelava Surface treatment

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EUROPEAN STANDARD

EN 17120

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English Version

Photocatalysis - Water purification - Performance of photocatalytic materials by measurement of phenol degradation

Photocatalyse - Purification de l'eau - Évaluation des performances des matériaux photocatalytiques par mesurage de la dégradation du phénol

Photokatalyse - Wasserreinigung - Leistungsbewertung von photokatalytischen Werkstoffen durch Messung des Phenolabbaus

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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European foreword

This document (EN 17120:2019) has been prepared by Technical Committee CEN/TC 386 "Photocatalysis", the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 2019, and conflicting national standards shall be withdrawn at the latest by August 2019.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

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EN 17120:2019 (E)**1 Scope**

This document describes a test method to evaluate the performance of photocatalytic materials in water purification by measuring phenol degradation. This test method is applicable to photocatalytic materials in form of powders (suspensions in water, slurries) under UV irradiation. The photocatalytic performance of the tested material is assessed by the observed rate of phenol degradation at specified experimental conditions as determined by HPLC.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

EN 1484:1997, *Water analysis - Guidelines for the determination of total organic carbon (TOC) and dissolved organic carbon (DOC)*

CEN/TS 16599:2014, *Photocatalysis — Irradiation conditions for testing photocatalytic properties of semiconducting materials and the measurement of these conditions*

ISO 8245:1999, *Water quality - Guidelines for the determination of total organic carbon (TOC) and dissolved organic carbon (DOC)*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
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- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1**photocatalyst**

catalyst able to produce, upon absorption of light, chemical transformations of the reaction partners

Note 1 to entry: The excited state of the photocatalyst repeatedly interacts with the reaction partners forming reaction intermediates and regenerates itself after each cycle of such interactions.

3.2**photocatalytic materials**

materials in which or on which the photocatalyst is added by coating, impregnation, mixing, etc.

3.3**water purification**

purification by decomposing contaminants contained in water

4 Abbreviations

For the purposes of this document, the following abbreviations apply.

UV	Ultra Violet
HPLC	High Performance Liquid Chromatography
TOC	Total Organic Carbon
DOC	Dissolved Organic Carbon

5 Principle

A test solution is prepared by suspending a given amount of the material to be tested in water with the addition of a certain amount of phenol. The test solution is irradiated with UV in a batch photo-reactor under controlled conditions. The concentration of phenol is measured against irradiation time by HPLC with UV detection. The photocatalytic performance of the material is assessed by the observed rate of phenol degradation. Additional information regarding mineralization of phenol can be obtained by measuring the decrease of organic carbon (TOC or DOC) during the photocatalytic process (optional).

6 Interferences

The laboratories carrying out this test shall perform tests for possible interferences in the chromatographic system for measurement of phenol (HPLC) and in the TOC/DOC analyser (where applied). The laboratories shall document the absence of significant interferences that could affect the measurements of phenol/TOC/DOC.

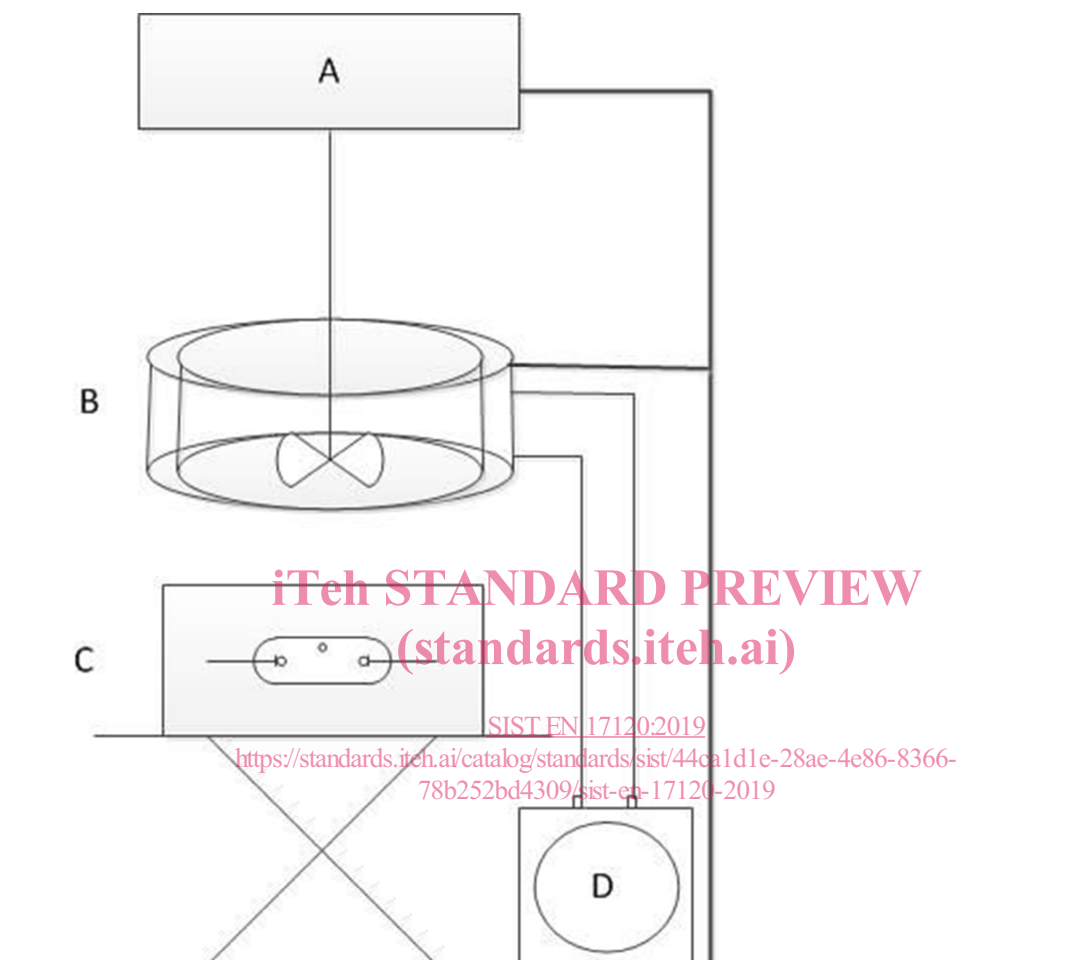
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7 Equipment and materials

7.1 Irradiation system and photo-reactor

The irradiation system arrangement is shown in Figure 1.



Key

- A stirrer
- B photo-reactor cell (D = 5cm, V = 100ml)
- C light source
- D water cooler

Figure 1 — Irradiation system arrangement (light source and stirrer positions can be reversed)

A batch-type cylindrical photo-reactor cell made of pyrex glass, 5 cm in diameter and 100 ml volume with ability for magnetic or mechanical stirring is used. The temperature of the irradiated solution shall be measured and recorded inside the reactor during the test and should be kept within 25 ± 5 °C.

The irradiation source shall consist of any lamp able to excite the photocatalyst in UV such as quartz mercury vapor lamps, UV-A fluorescent lamps, Xenon lamps, LED, lamps consisting of a metal vapor element combined with tungsten incandescence elements, etc., as specified in the technical specification CEN/TS 16599:2014. The irradiation system should be checked according to the test method procedure (Clause 8) in the absence of test material (photocatalyst) to ensure that no significant degradation of phenol takes place (<5 % degradation) over the time of the test due to direct photolysis.

The irradiation source shall yield an average irradiance of $(10 \pm 5 \%) \text{ W/m}^2$, according to CEN/TS 16599:2014. Irradiance shall be measured by placing a radiometric sensor in the position of the reactor, besides a pyrex window in order to measure the real irradiance at the surface of the glass reactor. Irradiance can be measured continuously during the test or, alternatively, just before the beginning of the test and immediately after its conclusion. The irradiance values shall be measured only after the lamp intensity has stabilized as a result of its warming-up (typically 10 min after being turned on). The irradiance value shall be recorded as average value in the test. The light emission spectrum of the lamp should be also stated in the test report.

The radiometer used for the measurement shall have been previously calibrated by means of a spectroradiometer, which in turn has been previously calibrated by means of standard sources.

7.2 HPLC analysis apparatus

High Performance Liquid Chromatography system with UV detection (e.g. 270 nm to 280 nm) suitable for the quantitative determination of phenol in water. The HPLC system typically consists of a high-pressure pump, a sampler, a chromatographic column in a thermostated compartment and a detector (spectrophotometer or Photo Diode-Array). Several alternative combinations of chromatographic columns, elution solvents and gradient elution programs can be used. The method used for the determination of phenol by HPLC shall be documented (e.g. chromatographic column, elution solvents and program, injection volume, retention time, etc.) and its performance verified/validated by the laboratory. The limit of quantification of phenol shall be $\leq 0,5 \text{ mg/l}$. HPLC measurements should be preferably carried out in duplicates.

7.3 TOC analyser (optional)

Total Organic Carbon analyser (capable for determinations of TOC/DOC in water according to ISO 8245:1999 and EN 1484:1997. The limit of quantification of TOC shall be $< 2 \text{ mg/l}$.

7.4 Other Equipment and materials

- a) pH meter, calibrated with standard solutions with the required traceability;
- b) magnetic or mechanical stirring system, compatible for use with the photoreactor;
- c) phenol, (CAS Number 108-95-2), purity $\geq 99 \%$;
- d) water, ultrapure ($18,2 \text{ M}\Omega/\text{cm}$);
- e) stopwatch for the measurement of irradiation times.

7.5 Photocatalytic reference material

A photocatalytic reference material, when available should be used for comparisons and evaluation of test results especially between laboratories. An example of such a material is the NIST SRM 1898-Titanium Dioxide Nanomaterial (National Institute of Standards and Technology, US Department of Commerce).