BUREAU OF INDIAN STANDARDS

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Draft Indian Standard

Textiles —Test method for accelerated hydrolysis of textile materials and biodegradation under controlled composting conditions of the resulting hydrolysate

Chemical Methods of Test Sectional Committee, TXD 05

NATIONAL FOREWORD

This Indian Standard intended to be adopted is identical with ISO 21701:2019 'Textiles —Test method for accelerated hydrolysis of textile materials and biodegradation under controlled composting conditions of the resulting hydrolysate' issued by the International Organization for Standardization (ISO).

The text of ISO Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.
b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In the standard intended to be adopted, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their respective places are listed below along with their degree of equivalence for the editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
ISO 1628-1, Plastics — Determination of the viscosity of polymers in dilute solution using capillary viscometers — Part 1: General principles	IS 13360 (Part 11/Sec 9) : 2023/ ISO 1628-1 : 2021 Plastics — Methods of test Part 11 Special properties Section 9 Determination of the viscosity of	Identical with ISO 1628-1:2021.

	polymers in dilute solution using capillary viscometers — General principles (*second revision*)	
ISO 14855-1, Determination of the ultimate aerobic biodegradability of plastic materials under controlled composting conditions — Method by analysis of evolved carbon dioxide — Part 1: General method	IS/ISO 14855-1 : 2012 Determination of the Ultimate Aerobic Biodegradability of Plastic Materials Under Controlled Composting Conditions — Method by Analysis of Evolved Carbon Dioxide Part 1 General Method (*first revision*)	Identical with ISO 14855-1:2012.

The technical committee has reviewed the provisions of the following International Standard referred in this adopted standard and has decided that it is acceptable for use in conjunction with this standard:

International/Other Standard	*Title*
ISO 13885-1:2020	Gel permeation chromatography (GPC) Part 1: Tetrahydrofuran (THF) as eluent

In reporting the result of a test or analysis made in accordance with this standard, if the final value; observed or calculated, is to be rounded off, it shall be done in accordance with IS 2: 2022 ‘Rules for rounding off numerical values (*second revision*).

Extract of ISO 21701:2019 'Textiles —Test method for accelerated hydrolysis of textile materials and biodegradation under controlled composting conditions of the resulting hydrolysate.

Introduction

Textile fibres can be classified into natural fibres and man-made fibres according to ISO/TR 11827. Some of man-made fibres manufactured from organic materials are biodegradable and can be divided into three major categories in relation to their origin, i.e. natural material base, biology base and petroleum base. The representative bio-based, man-made biodegradable fibre is polylactide and petroleum based, man-made biodegradable fibres are manufactured from polyethylene terephthalate succinate, polycaprolactone, polypropylene carbonate, polybuthylene succinate or copolymer using them.

The biodegradation of petroleum-based fibres is relatively slow compared to biology-based or natural fibres due to the chemical structure. In addition, the rate of biodegradation of textile materials such as fibres and yarns can also be affected negatively by high molecular weight, degree of crystallinity and orientation occurred during the spinning. Although some standards refer to the instrument analysis, such as gas chromatograph or infrared analysis, the process and calculation method are not standardized. Therefore, it is difficult to determine the biodegradation of petroleum-based textile materials using the existing standards available for natural fibres, biology-based fibres or plastic materials used for packaging.

To overcome these difficulties, the new test method is proposed by a combination of accelerated hydrolysis and biodegradation using instrument analysis for analysis of evolved carbon dioxide.

Under the composting of textile materials both mechanisms, abiotic and biotic processes, operate together and the microorganisms eventually remove the hydrolysate in a synergistic process. It is difficult and time consuming to reproduce this in the laboratory. For convenience, the accelerated hydrolysis, which is an abiotic process, should be carried out followed by biodegradation subsequently. The rate and extent of molecular weight loss is measured as indicative of losses in physical properties from accelerated hydrolysis and then the biodegradability of hydrolysate is estimated by direct measurement of evolved carbon dioxide with a gas chromatograph

1 Scope

This document specifies a test method for the determination of the biodegradability of the hydrolysate of textile materials obtained after accelerated hydrolysis under controlled composting conditions by measurement of the amount of evolved carbon dioxide with a gas chromatography.

This test method can be applied to petroleum-based man-made biodegradable textile materials which are manufactured from polyethylene terephthalate succinate, polycaprolactone, polypropylene carbonate, polybuthylene succinate or copolymer using them.

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.

i) ISO 1628-1, Plastics — Determination of the viscosity of polymers in dilute solution using capillary viscometers — Part 1: General principles

ii) ISO 13885-1, Binders for paints and varnishes — Gel permeation chromatography (GPC) — Part 1: Tetrahydrofuran (THF) as eluent

iii) ISO 14855-1, Determination of the ultimate aerobic biodegradability of plastic materials under controlled composting conditions — Method by analysis of evolved carbon dioxide — Part 1: General method.

3 Terms and definitions

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

4 Principle

The test method determines the ultimate biodegradability of test material after accelerated hydrolysis under conditions simulating an intensive aerobic composting process. It aims to determine the ultimate biodegradability of the hydrolysate by using a small-scale reactor. The degradation rate is periodically measured by determining the amount of the evolved carbon dioxide using gas chromatography.

Firstly, the test material is hydrolysed under the constant temperature and humidity until the substantial loss of molecular weight in order to initiate the biodegradation process shortly.

During the aerobic biodegradation of the hydrolysate, carbon dioxide, water, mineral salts and new microbial cellular constituents (biomass) are the ultimate biodegradation products. The carbon dioxide produced is continuously monitored, or measured at regular intervals, in test and blank vessels to determine the cumulative carbon dioxide production. The percentage biodegradation is given by the ratio of the carbon dioxide produced from the test material to the maximum theoretical amount of carbon dioxide that can be produced from the test material. The maximum theoretical amount of carbon dioxide produced is calculated from the measured total organic carbon (TOC) content.

FORMAT FOR SENDING COMMENTS ON BIS DOCUMENTS

(Please use A4 size sheet of paper only and type within fields indicated. Comments on each clause/sub clause/table/fig etc. be started on a fresh box. Information in column 3 should include reasons for the comments and suggestions for modified working of the clauses when the existing text is found not acceptable. Adherence to this format facilitates Secretariat's work)

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NAME OF THE COMMENTATOR/ORGANIZATION:

DOCUMENT NO: TXD 05 (25861)

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Item, Clause Sub-Clause No. Commented upon (Use Separate Box afresh)	**Comments**	**Specific Proposal (Draft clause to be add/amended)**	**Remarks**	**Technical References and justification on which (2), (3), (4) are based**
(1)	**(2)**	**(3)**	**(4)**	**(5)**