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Water pipe tobacco products — Determination of carbon monoxide emission of glowing water pipe charcoal — NDIR method

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Foreword

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This document was prepared by Technical Committee ISO/TC 126, *Tobacco and tobacco products*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

For the testing of water pipe tobacco a routine analytical water pipe tobacco smoking machine is used, heating the water pipe tobacco with an electrical heater. This is done to prevent contamination of the collected phase by the emission of glowing water pipe charcoal. Nevertheless, most of the users use glowing water pipe charcoal to heat up the water pipe tobacco for smoking.

Water pipe tobacco products — Determination of carbon monoxide emission of glowing water pipe charcoal — NDIR method

1 Scope

This document specifies a method for the determination of carbon monoxide (CO) emission of glowing water pipe charcoal.

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.

ISO 3402, *Tobacco and tobacco products — Atmosphere for conditioning and testing*

ISO 22486, *Water pipe tobacco smoking machine — Definitions and standard conditions*

ISO/TS 22487, *Water pipe tobacco — Determination of total collected matter and nicotine*

3 Terms and definitions

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:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
vapour phase
portion of gas, which passes the glowing charcoal and the water bottle during smoking in accordance with ISO/TS 22487 using a machine conforming to ISO 22486

4 Principle

Light up a sample of charcoal for water pipe smoking, place it in the sample holder of a routine analytical water pipe tobacco smoking machine and take puffs in accordance with the procedures given in ISO/TS 22487. Collection of the vapour phase and measurement of the carbon monoxide using a non-dispersive infrared (NDIR) analyser calibrated for carbon monoxide. Calculation of the amount of carbon monoxide per sample.

5 Apparatus

Usual laboratory apparatus and, in particular, the following items.

5.1 Conditioning enclosure, maintained accurately in accordance with the conditions specified in ISO 3402, for conditioning the cigarette sample prior to smoking (see also 7.1).

5.2 Routine analytical water pipe tobacco smoking machine and accessories, complying with the requirements of ISO 22486.

5.3 Gas-phase collection system, which can be fitted to the water pipe tobacco smoking machine. The use of the system shall ensure collection of all the generated vapour phase to be stored in a previously evacuated container for subsequent sampling through an NDIR analyser.

The collection system shall not cause interference with the normal performance of the smoking machine.

The impermeability of the vapour phase collecting device to a vapour phase shall be checked with a vapour phase containing a volume fraction of 4 % to 6 % of CO. The CO concentration shall be measured directly after filling the previously evacuated gas-collecting device. After a period of not less than 2 h, the measured value of CO concentration in the vapour phase in the device shall not differ by more than a volume fraction of 0,2 % from the value expected from the first determination.

When a bag is used as the gas-collecting device, it shall be large enough to avoid the final pressure of its contents exceeding the ambient atmospheric pressure. The volume of the bag should also be no greater than twice the volume of the gas content collected at atmospheric pressure. In practice, the collection of the vapour phase from 175 puff requires a bag volume of 120 l to 185 l.

It can be inconvenient to collect all of the vapour phase generated from a single smoked test portion in one single 120 l bag. Other possibilities exist and may be considered for inclusion in this document.

a) Use two or more smaller bags, which are changed at the same time as the TCM collection pad is changed after every 35 puff. The practical bag size for this option is roughly 30 l; at least two bags are required. Both should be evacuated prior to commencement of the smoking process. The first bag is filled during the first 35 puffs, then removed for analysis and re-evacuated while the next bag is in use and so on. A modified version of Formulae (1) and (2) given in Clause 8 is required in order to combine the partial vapour phase concentrations measured during each bag fill.

b) Use a constant flow gas splitting system to deliver a known fraction of the total vapour phase to an appropriate-sized collection bag. A ratio 20:1 splitting system requires a 10 l bag (connected to the low flow output of the splitter) to collect the vapour phase output for a complete smoked test portion. The vapour phase from the high flow output of the splitter is routed directly to the waste smoke exhaust system. The contents of the collection bag are then analysed in the normal way. The relative volumes of the split sample are not required; Formula (1) or Formula (2) in Clause 8 only needs the total volume which is the puff volume time the number of puffs. This system works correctly provided that the vapour phase sample is homogeneous at the entrance to the splitter and that the split flows remain at a constant ration throughout the smoking process.

c) The vapour phase for a single puff only is collected, analysed and disposed of on a puff by puff basis. The CO is calculated on the basis of mg per puff and the total CO per sample is the sum of the mass for all puffs.

5.4 Non-dispersive infrared (NDIR) analyser, selective and calibrated for the measurement of carbon monoxide in vapours.

Analysers are available from several manufacturers and should have a suitable measurement range. The sampling rate should be between 0,5 l/min and 5 l/min. The analyser shall have a linearity of 0,1 % CO and a repeatability of 0,2 % CO, under conditions of constant temperature and pressure. In terms of volume fractions its response to 10 % CO_2 shall not exceed 0,05 % as CO. Its response to 2 % water vapour shall not exceed 0,05 % as CO.

5.5 Flame or heating device, capable to ignite the charcoal.

5.6 Barometer, capable of measuring atmospheric pressures to the nearest 0,1 kPa.

5.7 Thermometer, capable of measuring temperature to the nearest 0,1 °C.

6 Standard gas mixtures

Make-up gas shall be nitrogen as other gases can change the detected response of carbon monoxide. Gases used should be of high purity (with low content of carbon dioxide) and used within the manufacturer's time limits.

The NDIR analyser should be calibrated with at least three standard gas mixtures of accurately known concentrations within a relative error of 2 %, covering the expected range in such a way as to avoid extrapolation of the calibration curve. Typically used concentrations are approximately 25 %, 50 % and 75 % of the analyser's measurement range.

7 Procedure

7.1 Conditioning

Condition the test portion taken from and representative of the laboratory sample in accordance with ISO 3402. Verify that equilibrium has been properly attained as described in ISO 3402.

The atmosphere in the laboratory where the smoking is to be carried out shall also be in accordance with ISO 3402. Place the conditioned test portion in a vapour-tight container (just large enough to contain the portion) and remove from the container just before smoking.

7.2 Calibration of the NDIR analyser

7.2.1 Warm up the instrument according to the manufacturer's recommendations, purge the instrument with air and adjust to read zero.

7.2.2 Fill a previously evacuated vapour phase collection container with the standard gas mixture of a known volume fraction, re-evacuate and refill with gas. Ensure that the gas in the container is at ambient temperature and pressure. Introduce the gas into the measuring cell using the system sampling pump allowing 5 s to 10 s for equilibration of pressure of the analyser. Note the reading on the analyser concentration display when a steady value has been obtained.

If necessary, adjust the analyser reading to agree with the certified value of the standard gas.

7.2.3 Repeat the procedure as specified in 7.2.2 for at least two other standard gas mixtures. If there is a difference of greater than a volume fraction of 0,2 % CO between the observed and expected values, attention should be given to the analyser linearity.

7.2.4 Recalibrate the instrument at least once a week, using the standard gases. The calibration shall be linear within the limits reported in 5.4.

7.2.5 Check the calibration prior to the measurement using the same standard gas used under 7.2.2. If there is a difference greater than a volume fraction of 0,2 % CO between observed and expected values, repeat the full calibration.

7.3 Smoking and collection of vapour phase

7.3.1 Preparation of vapour phase collection system

Prepare the system using the instructions pertinent to the equipment fitted.