SLOVENSKI STANDARD
SIST-TP CEN/TR 17238:2018

01-december-2018

Predlagane mejne vrednosti za onesnaževala v biometanu na podlagi meril zdravstvene presoje

Proposed limit values for contaminants in biomethane based on health assessment criteria

Vorgeschlagene Grenzwerte für Verunreinigungen in Biomethan auf Grundlage von Gesundheitsgefährdungskriterien

Valeurs limites proposées pour les contaminants dans le biométhane sur la base de critères d'évaluation de la santé

Ta slovenski standard je istoveten z: **CEN/TR 17238:2018**

ICS:

27.190	Biološki viri in drugi alternativni viri energije	Biological sources and alternative sources of energy
75.060	Zemeljski plin	Natural gas

SIST-TP CEN/TR 17238:2018 **en**

TECHNICAL REPORT

RAPPORT TECHNIQUE

TECHNISCHER BERICHT

CEN/TR 17238

April 2018

ICS 75.160.30; 27.190

English Version

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Vorgeschlagene Grenzwerte für Verunreinigungen in Biomethan auf Grundlage von Gesundheitsgefährdungskriterien

This Technical Report was approved by CEN on 9 April 2018. It has been drawn up by the Technical Committee CEN/TC 408.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Ref. No. CEN/TR 17238:2018 E

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European foreword

This document (CEN/TR 17238:2018) has been prepared by Technical Committee CEN/TC 408 “Natural gas and biomethane for use in transport and biomethane for injection in the natural gas grid”, the secretariat of which is held by AFNOR.

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.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

Introduction

This standard was prepared by CEN/TC 408 in response to the European Commission standardization mandate M/475.

The Mandate asks for the development of a set of quality specifications for biomethane to be used as a fuel for vehicle engines and to be injected in natural gas pipelines (network).

However, the scope of the standard was widened according to BT decision C109/2012 that redefined the scope of CEN/TC 408: "Standardization of specifications for natural gas and biomethane as vehicle fuel and of biomethane for injection in the natural gas grid, including any necessary related methods of analysis and testing. Production process, source and the origin of the source are excluded".

One of the aims of European policy in the field of energy is to increase the security of energy supply in the EU as well as to contribute to reduce the emission of greenhouse gases accepted by the EU at Kyoto. In this context a special focus is given to the development and use of energy from renewable sources.

Directive 2009/28/EC on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC stipulates clear aims regarding the percentage of renewables in EU energy consumption and states the related need to support the integration of energy from renewable sources into the energy networks including the establishment of appropriate technical rules in line with Directive 2003/55/EC (Article 6) replaced by 2009/73/EC (Article 8) for the realization of the competitive single European Gas Market and the technical interoperability of gas networks, (network connection, gas quality, gas odorization and gas pressure requirements).

Supporting the EU policy and therefore the maximization of the production and use of biomethane and considering the absence of standards the European Commission DG ENER has included the injection of biomethane in natural gas pipelines in Mandate M/475. Biomethane in this context can be produced from biological (fermentation, digestion ...) and thermochemical processes and it is essential that it is appropriate to be used as a blending component to natural gas.

1 Scope

This document explains an approach for assessment of limit values for contaminants that may be found in biomethane. Limit values are generally required as an adjunct to a biomethane specification (such as parts 1 and 2 of EN 16723, or an equivalent National specification) or as part of a Network Entry Agreement for injection of biomethane into gas networks.

The methodology employed will permit derivation of limit values based solely on consideration of potential for impact on human health and does not consider other impacts, such as integrity and operation of plant and pipelines used to convey biomethane or appliances involved in its combustion or other regulations like CLP regulation. Where consideration of such impacts would result in proposing lower limit values than those based on health impacts, then the lowest limit values should generally be proposed.

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 16723-1:2016, *Natural gas and biomethane for use in transport and biomethane for injection in the natural gas network — Part 1: Specifications for biomethane for injection in the natural gas network*

EN 16723-2:2017, *Natural gas and biomethane for use in transport and biomethane for injection in the natural gas network — Part 2: Automotive fuels specification*

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:

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

3.1
biogas
gas, comprising principally methane and carbon dioxide, obtained from the anaerobic digestion of biomass

3.2
biomass
biological material from living, or recently living organisms, typically this may be plants or plant-derived materials

3.3
biomethane
gas comprising principally methane, obtained from either upgrading of biogas or methanation of bio-syngas

3.4
bio-syngas
gas, comprising principally carbon monoxide and hydrogen, obtained from gasification of biomass

3.5
contaminant
chemical with undesired properties which may be present in biomethane at a low concentration and for which no maximum concentration is specified in EN 16723

3.6
Chemicals Of Potential Concern
(COPC)
chemicals that may present a risk to the environment directly or after combustion

3.7
Health Criteria Value
(HCV)
generic term to describe a benchmark level of exposure to a chemical derived from available toxicity data for the purposes of safeguarding human health. They are defined for instance by US EPA (US), ANSES (FR), Environment Agency (UK), RIVM (NL), ARPA (IT). The unit is mg/m^3

3.8
limit value
maximum concentration of a contaminant that is allowed in a gas quality specification

3.9
natural gas
complex gaseous mixture of hydrocarbons, primarily methane, but generally includes ethane, propane and higher hydrocarbons, and some non-combustible gases such as nitrogen and carbon dioxide

Note 1 to entry: Natural gas can also contain components or contaminants such as sulphur compounds and/or other chemical species.

3.10
natural gas network
transmission network or local distribution system

3.11
non-threshold effect chemical
chemical that may theoretically pose a risk at any level of exposure

3.12
(Health) Risk
possibility that a harmful event (death, injury or loss) arising from exposure to a chemical or physical agent may occur under specific conditions

3.13
threshold effect chemical
chemical which might be present in such concentrations that it might initiate a health risk of concern

3.14
upgrading of biogas
removal of carbon dioxide and contaminants from biogas

4 Symbols, units and abbreviated terms

4.1 Cg: maximum acceptable concentration in biomethane (mg/m^3)

4.2 Cexp: exposure concentration

4.3 M: multiplier in the exposure model

4.4 CAS number: Unique numerical identifier assigned by Chemical Abstracts Service

5 Global Approach for assessment of limit values

5.1 General

The approach described in this technical report is similar to that commonly employed in environmental health risk assessment, an example of which can be seen at the US Dept. of Energy's Risk Assessment Information System (RAIS) website [9].

Conventional health risk assessments aims to assess and quantify the health risk presented by a particular activity. If the risk exceeds a maximum acceptable value, then mitigation actions are assessed and implemented. In conventional risk assessment, therefore, the *output* is a (quantified) level of risk associated with the process. However, in the context of specifying limit values for contaminants in biomethane the *INVERSE* of this risk assessment procedure is followed: an acceptable level of risk is agreed and the activity (in this instance injection of biomethane into natural gas grids) is modified by implementing an appropriate gas quality specification. In this situation, the acceptable level of risk is an *input* to the risk assessment procedure and the *output* is a gas quality specification. Such a specification will contain limit values for content of those contaminants that are likely to be present.

NOTE The contaminants that are likely to be present that can present a risk to the environment are commonly called "Chemicals of Potential Concern" (COPCs).

Similar approaches have been previously employed for development of gas quality specifications for biomethane: in 2008 in France (Afsset [1]) and in 2012 in the UK (UK Environment Agency [7]). This approach may be used whenever compounds of interest are added in the list of data. In addition, several realistic scenarios should be assessed in order to identify the worst case that will lead to the most appropriate limit value.

These scenarios depend at least on these elements:

- The national laws and regulations,
- The conceptual model designed,
- The national practices,
- Specific assumptions.

The procedure for assessing limit values in this Technical Report can be summarized in following scheme (Figure 1):

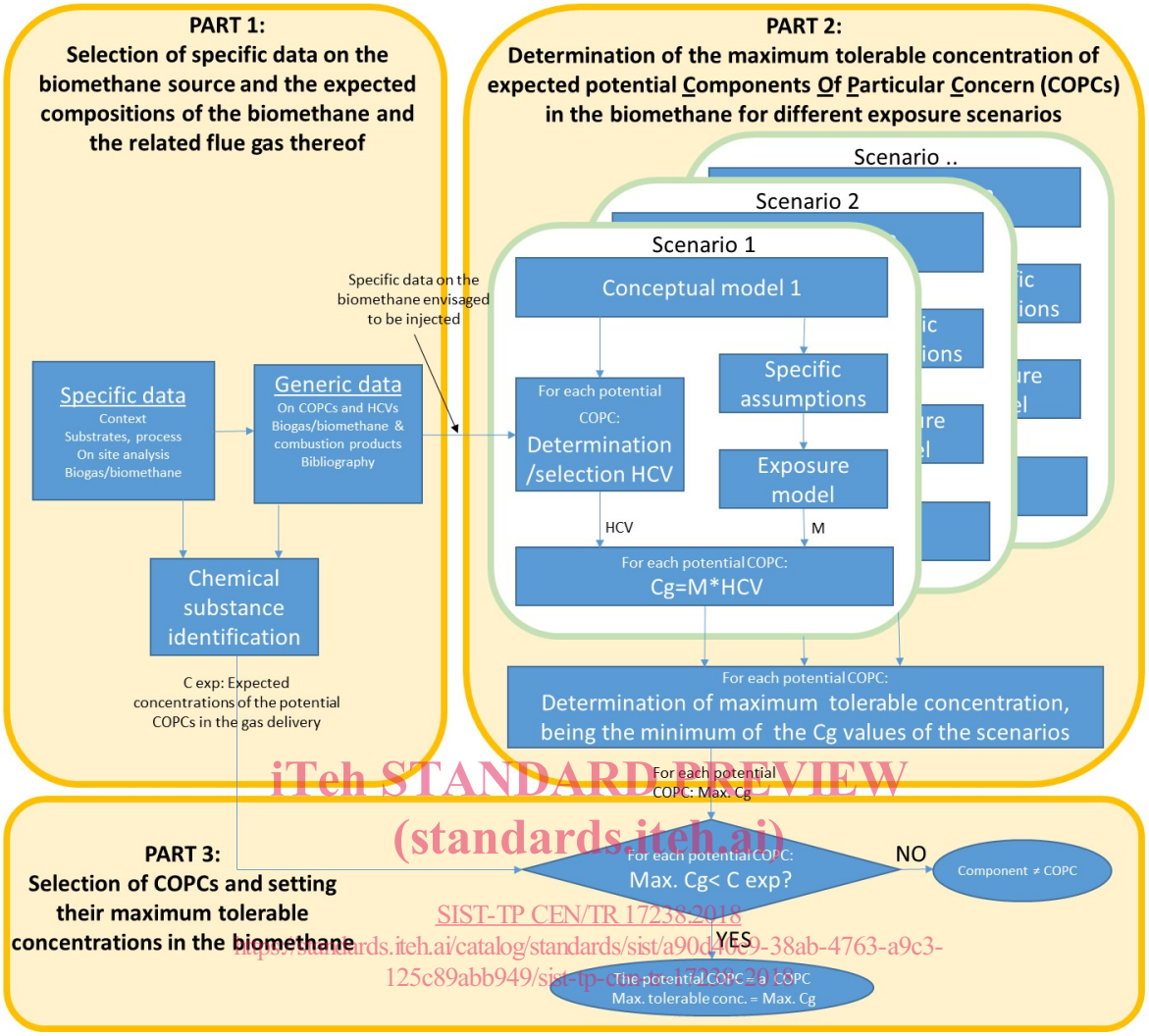

Figure 1 — Description of the methodology to apply to each contaminant

5.2 Definition of the database for gas composition and HCVs

When assessing limit values for contaminants present in biomethane, the point at which COPCs are identified will depend on the context, i.e. whether a site-specific or generic assessment is being carried out and whether a detailed chemical analysis of biogas/biomethane is available or not.

Trace compounds will strongly be influenced by its production process. Production processes for biomethane vary significantly. For example:

- Anaerobic digestion of a wide range of biomass feedstocks, followed by upgrading (carbon dioxide removal) and purification (removal of contaminants).
- Gasification of a wide range of biomass feedstocks to a bio-syngas, followed by purification and upgrading (water gas shift and methanation).

It means that **the database** of the target compounds is defined using gas analysis and literature. Each target compound should be described with its CAS number. C_{exp} (concentration to be expected in biomethane) will be estimated also and included in the database.

Health Criteria Values (HCVs) are obtained for each contaminant, **based on expert assessment** reported in the literature and the scenario considered. At the end of the process, one HCV will be