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TNI	**Biooleje z rýchlej pyrolýzy pre stacionárne motory s vnútorným spaľovaním Určovanie kvality**	**TNI CEN/TR 17103** 65 7911

Fast pyrolysis bio-oil for stationary internal combustion engines - Quality determination

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English Version

Petroleum and related products - Fast pyrolysis bio-oils for stationary internal combustion engines - Quality determination

Pétrol et produits rélatives - Huiles biologique de pyrolyse rapide pour application en moteurs stationés avec combustion interne - Désignation de qualité

Pyrolyseprodukte - Schnell Pyrolyse-Bio-Öle für stationäre Verbrennungsmaschinen - Qualitätsbezeichnung

This Technical Report was approved by CEN on 11 April 2017. It has been drawn up by the Technical Committee CEN/TC 19.

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European foreword

This document (CEN/TR 17103:2017) has been prepared by Technical Committee CEN/TC 19 “Gaseous and liquid fuels, lubricants and related products of petroleum, synthetic and biological origin”, the secretariat of which is held by NEN.

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 [1] given to CEN by the European Commission and the European Free Trade Association.

Introduction

The European Union is promoting the use of renewable energy. Liquid biofuels have rarely been used for CHP applications with the exception of vegetable oils which in some cases have been used in combined heat and power (CHP) applications and several boiler manufacturers promote its use. However, given the demand for biodiesel for the transport sector little uptake has been reported for biodiesel in the CHP sector. Hence the European Commission (EC) requested CEN to develop a 'Technical Specification for a quality specification for pyrolysis oil replacing fuel oils in stationary internal combustion engines' [1].

Fast pyrolysis bio-oils (FPBO) or fast pyrolysis liquids are completely different from conventional fossil fuels both in their physical properties and chemical composition. They are brownish liquids with a distinct and smoky odour. They can be produced from woody biomass [3] and agrobiomass (herbaceous [3]) and there is a wide range of reactor types suitable for fast pyrolysis bio-oil production. Contrary to fossil fuels, they are highly polar, mainly water-soluble containing typically about 25 % (*m/m*) (on wet basis) water, are acidic in nature, dense, and viscous liquids, very poorly or not miscible with hydrocarbons [4].

CEN adopted work item 00019499 for the requested work and installed CEN/TC 19/WG 41 'Pyrolysis oil' to develop the CEN Technical Specification. During its work the group encountered the following:

- FPBO is not yet commercialized for stationary internal combustion engines (ICE) and there is neither enough data on the properties for FPBO for ICE use and parameters to determine combustion properties are not fully understood. Also the long-duration tests in ICE have not yet been carried out.

- WG 41 performed an enquiry within the leading engine manufacturers to collect data and proposals for threshold values. Most of the manufacturers did not have experience with FPBO. Several comments made by the manufacturers was that further research and development work was required on several issues (e.g. type of fuel injection system, chemical resistance, effect of solids/char content of bio-oil on erosion/corrosion at fuel nozzles, and ignition properties).

- There are several important properties (e.g. combustion properties, flash point and chlorine) that should be incorporated as grade criteria, but no established test methods for fast pyrolysis bio-oil are available. Research and development is needed to develop these methods to be used for specification of FPBO for ICE.

WG 41 thus proposed to CEN/TC 19 to draft a Technical Report (TR) instead of a Technical Specification, which was approved [2] and thereafter adopted by the CEN/BT and accepted by the EC. This document is laying down the outcome of the study and the quality that so far has been found acceptable for ICE. Further investigations and market application should be continued in order to decide to eventually revise this document into a deliverable originally requested by the EC.

1 Scope

This Technical Report describes the key properties of fast pyrolysis bio-oils and their importance to the fuel quality for use in stationary internal combustion engines.

Internal combustion engine (ICE) in the scope of this document means a type of engine in which heat energy and mechanical energy is produced inside the engine. ICE include compression ignition engines (diesel engines) and gas turbines.

Attention is drawn to differences especially in those properties, which can have an effect on the required engine performance, such as ash, acidity, viscosity, combustion properties, and sulfur content.

In addition to the quality requirements and related test methods for FPBO, further instructions on storage (Annex A), sampling (Clause 4), and materials compatibility (Annex B) are given.

NOTE For the purposes of this Technical Report, the terms "% (*m/m*)" and "% (*V/V*)" are used to represent the mass fraction (μ) and the volume fraction (φ) of a material, respectively.

2 Normative references

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

EN 16476, *Liquid petroleum products - Determination of Sodium, Potassium, Calcium, Phosphorus, Copper and Zinc contents in diesel fuel - Method via Inductively Coupled Plasma Optical Emission Spectrometry (ICP OES)*

EN 16900:2017, *Fast pyrolysis bio-oils for industrial boilers - Requirements and test methods*

EN ISO 2719, *Determination of flash point - Pensky-Martens closed cup method (ISO 2719)*

EN ISO 3104, *Petroleum products - Transparent and opaque liquids - Determination of kinematic viscosity and calculation of dynamic viscosity (ISO 3104)*

EN ISO 3170:2004, *Petroleum liquids - Manual sampling (ISO 3170:2004)*

EN ISO 6245, *Petroleum products - Determination of ash (ISO 6245)*

EN ISO 8754, *Petroleum products - Determination of sulfur content - Energy-dispersive X-ray fluorescence spectrometry (ISO 8754)*

EN ISO 9038, *Determination of sustained combustibility of liquids (ISO 9038)*

EN ISO 12185, *Crude petroleum and petroleum products - Determination of density - Oscillating U-tube method (ISO 12185)*

EN ISO 20846, *Petroleum products - Determination of sulfur content of automotive fuels - Ultraviolet fluorescence method (ISO 20846)*

ISO 3016, *Petroleum products — Determination of pour point*

ASTM D93, *Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester*

ASTM D4294, *Standard Test Method for Sulfur in Petroleum and Petroleum Products by Energy Dispersive X-ray Fluorescence Spectrometry*

ASTM D5291, *Standard Test Methods for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Petroleum Products and Lubricants*

ASTM D5453, *Standard Test Method for Determination of Total Sulfur in Light Hydrocarbons, Spark Ignition Engine Fuel, Diesel Engine Fuel, and Engine Oil by Ultraviolet Fluorescence*

ASTM D7579, *Standard Test Method for Pyrolysis Solids Content in Pyrolysis Liquids by Filtration of Solids in Methanol*

ASTM E70, *Standard Test Method for pH of Aqueous Solutions With the Glass Electrode*

ASTM E203, *Standard Test Method for Water Using Volumetric Karl Fischer Titration*

DIN 51900-1:2000, *Testing of solid and liquid fuels — Determination of gross calorific value by the bomb calorimeter and calculation of net calorific value — Part 1: Principles, apparatus, methods*

DIN 51900-3, *Testing of solid and liquid fuels — Determination of gross calorific value by the bomb calorimeter and calculation of net calorific value — Part 3: Method using adiabatic jacket*