

PRE-STANDARD DIN V 51605 FOR RAPESEED OIL FUEL

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ABSTRACT: A reliable and environmentally low impact operation of combustion engines is only possible, when relevant fuel properties are defined and range within specified limits. Standardised fuel quality is an important pre-condition for the assessment of operational and emission characteristics, engine development as well as a basis for fuel trading. The demands on rape seed oil fuel quality were first laid down in the "Quality Standard for Rapeseed Oil as a Fuel (05/2000)". Based on this "RK-Quality Standard", national standardization was initiated. At July 1st 2006 the pre-standard DIN V 51605 „fuels for vegetable oil compatible combustion engines – fuel from rapeseed oil – requirements and test methods” was published. Pre-standard DIN V 51605 differs from the "RK-Quality Standard 05/2000" in consideration of limiting values of following properties: Contamination, oxidation stability, sulphur and phosphorus content. Additionally the parameters visual examination and sum of calcium and magnesium content were included. It was decided to develop the DIN V 51605 to a definite standard. Therefore further research work such as round robin analyses tests and engine test runs with graduated rapeseed oil fuel qualities need to be performed. Moreover quality assurance systems have to be established in practice.

Keywords: rapeseed oil, liquid biofuels, engines

1 INTRODUCTION AND PROBLEM

A reliable operation of combustion engines is only possible, when important characteristics and substances of content of the fuel are defined. These properties have to fulfill certain limiting values, otherwise guaranty and warranty agreement for proper engine operation or the conformity with relevant emission regulations can not be given. Besides that, defined fuel qualities are essential for the evaluation of operation characteristics and the ongoing development of engine technique. The specification of fuel quality by the use of consistent parameters and testing methods also enables fuel improvement, if necessary. Moreover, the comparison of engines' emission behaviour is only possible, when certified fuels (reference fuels) are used. Finally a defined fuel quality are basis for trading fuels.

In Germany rapeseed oil fuel is increasingly demanded particularly by agriculture, but also by shipping companies. The use of rapeseed oil fuel in practice is still associated with certain risks, due to the lack of industrial releases of rapeseed oil fuel compatible engines. Thus, the user himself is responsible, to choose an appropriate company for the adaptation of series-produced diesel engines. Because of the high demand of customers, meanwhile agricultural machinery manufacturer and one engine supplier for the agricultural machinery industry have started own developments. Also manufacturer of commercial vehicles monitor fleet trials with rapeseed oil fuel. Additionally the use of rapeseed oil in locomotives is investigated.

Under the lead management of the "Technologie- und Förderzentrum" (Technology and Support Centre) already in 1996 the definition of the demanded quality of rapeseed oil fuel for the use in combustion engines, suitable for vegetable oil fuels, was initiated. The results were combined in the so-called „Quality standard for rapeseed oil used as a fuel (RK-Quality-Standard) 05/2000" [1] [2] [3].

2 STANDARDIZATION SUB-COMMITTEE FAM UA 632.2

In autumn 2003 the sub-committee 632.2 „Prüfung von Rapsöl als Kraftstoff für pflanzenölaugliche Motoren“ (Testing of rapeseed oil, used as fuel for vegetable oil compatible combustion engines) was established at the DIN, the German Institute for Standardization. The aim was first, to work out a pre-standard for rapeseed oil fuel for the use in vegetable oil compatible engines. The work was financed by the „Union zur Förderung von Öl- und Proteinpflanzen e.V.“ (UFOP) and the Bavarian State Ministry for Agriculture and Forestry, as well as by other members of the sub-committee. Members of the standardization committee are diesel engine manufacturer, agricultural machinery industry, manufacturer and adaptation companies of vegetable oil compatible engines, rapeseed oil fuel producing industrial and decentral oil mills, rapeseed oil fuel traders, lubricating oil producers, analytical laboratories, authorities, associations and research institutes.

3 APPROACH

As basis for the standardization activities, the "Quality Standard for Rapeseed Oil as a Fuel 05/2000" was used. Latest experiences, which were made since the publication, regarding rapeseed oil fuel quality and the effect on the operation and emission characteristics were incorporated.

The standardization procedure takes place on a national level. However, the results can also be used as a pattern for future standardization on a European level, such as CEN. All European national standardization committees have been informed about the project. The standardization committee agreed to standardize explicitly rapeseed oil but not plant oil in general, due to a lack of meaningful long-term experiences for the fuel application of other vegetable oils. The field of application of rapeseed oil fuel according to DIN V 51605 is restricted to the application in vegetable

oil compatible engines. This means that the use in non vegetable oil compatible engines, including blends with other fuels, is not commented.

4 PRE-STANDARD DIN V 51605

A draft of pre-standard DIN V 51605 „fuels for vegetable oil compatible combustion engines - fuel from rapeseed oil - requirements and test methods” was published in June 2005. Comments were admissible until September, 30th 2005. All notes have been revised and, if appropriate, implemented within the document. At July 1st 2006 the pre-standard DIN V 51605 was published (Figure 1).



Figure 1: Pre-standard DIN V 51605 for “Fuel from Rapeseed Oil”

The production of rapeseed oil fuel can either be done by mechanical extraction with or without solvent extraction. Thus, both cold-pressed rapeseed oil and chemically extracted and refined rapeseed oil can be used, as long as limiting values are fulfilled. It is not allowed to use rapeseed oil, which has gone through any prior application (e.g. cooking oil or lubrication oil). Denaturation of rapeseed oil fuel, e. g. when produced on set-aside land, can be done by adding a maximum share of 2,9 mass-% rapeseed oil methyl ester according to DIN EN 14214. For this purpose diesel is not applicable, in order to guarantee the classification „not hazardous to waters“ for rapeseed oil fuel. Cold flow properties are not laid down in the pre-standard, because measures of engine adaptation usually affect temperature-/viscosity behaviour and subsequently cold flow properties.

Pre-standard DIN V 51605 differs from the “Quality Standard 05/2000” in consideration of limiting values of following properties: Contamination, oxidation stability, sulphur and phosphorus content. Additionally the parameters visual examination and sum of calcium and magnesium content were included (Table I). All properties with the corresponding limiting values and testing methods are displayed in Table 1. The data are only an excerpt of the pre-standard DIN V 51605, which is available at www.din.de or www.beuth.de.

5 CONCLUSION AND OUTLOOK

The members of the sub-committee 632.2 have decided to continue standardization of rapeseed oil fuel from the status of the pre-standard DIN V 51605 as soon as possible to a definite DIN standard.

Table I: Demands on Rapeseed Oil Fuel Properties According to DIN V 51605 (Excerpt from DIN V 51605, Full Version Available at www.din.de or www.beuth.de)

Properties	Unit	Limiting Value		Testing Method
		min.	max.	
Visual Examination	--	Free of visible contamination, sediment and not chemically bound water		--
Density at 15 °C	kg/m ³	900,0	930,0	DIN EN ISO 3675 or DIN EN ISO 12185
Flash Point by Pensky-Martens	°C	220	--	DIN EN 22719
Kinematic Viscosity at 40 °C	mm ² /s	--	36,0	DIN EN ISO 3104
Calorific Value	kJ/kg	36000	--	DIN 51900-1, -2, -3
Ignitability	--	39	--	Look section 5.5
Carbon Residue	% (m/m)	--	0,40	DIN EN ISO 10370
Iodine Number	g Iodine / 100g	95	125	DIN EN 14111
Sulphur Content	mg/kg	--	10	DIN EN ISO 20884 or DIN EN ISO 20846
Contamination	mg/kg	--	24	DIN EN 12662
Acid Number	mg KOH / g	--	2,0	DIN EN 14104
Oxidation Stability at 110 °C	h	6,0	--	DIN EN 14112
Phosphorus Content	mg/kg	--	12	DIN EN 14107
Sum of Magnesium and Calcium Content	mg/kg	--	20	DIN EN 14538
Ash Content (Oxide Ash)	% (m/m)	--	0,01	DIN EN ISO 6245
Water Content	% (m/m)	--	0,075	DIN EN ISO 12937

Therefore further experiences and research work have to be made. In particular round robin analyses tests with experienced laboratories are urgently needed, in order to work out the repeatability and comparability of test methods, which are predominantly proven for FAME (Fatty Acid Methyl Ester) or diesel fuel. Besides that engine test runs with graduated rapeseed oil fuel qualities need to be performed to quantify the interaction between rapeseed oil quality parameters, such as contents of P, Ca and Mg on the operation and emission characteristics of vegetable oil compatible combustion engines. Finally quality assurance systems for production and storage of rapeseed oil need to be established in practice. This applies especially for decentral oil mills, due to the gentle production without a downstream technically intensive refining process.

6 REFERENCES

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**Pre-standard DIN V 51605 is available at:
Beuth Verlag GmbH, 10772 Berlin
www.beuth.de or www.din.de**