

Standard DIN 51605 for Rapeseed Oil Fuel

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Abstract

A reliable and environmentally low impact operation of combustion engines is only possible, if relevant fuel properties are defined and range within specified limits. Standardized 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 rapeseed oil fuel quality were first laid down in the 'Quality Standard for Rapeseed Oil as a Fuel (05/2000)', which was transformed into a pre-standard. This pre-standard DIN V 51605 'Fuels for vegetable oil compatible combustion engines – Fuel from rapeseed oil – Requirements and test methods' (06/2006) has been turned into a German standard DIN 51605 (09/2010). The standard DIN 51605 differs from the pre-standard DIN V 51605 in regard to limiting values of the content of phosphorus, calcium and magnesia. Furthermore, the parameters carbon residue and ash content were withdrawn from the standard because of their low informative value for quality control of rapeseed oil fuel. For further plant oils a separate pre-standard DIN V 51632 is being developed, which is still in process.

Introduction

A reliable operation of combustion engines is only possible, when important characteristics and substances of content of the fuel are defined. The demands on rapeseed oil fuel quality were first laid down in the 'Quality Standard for Rapeseed Oil as a Fuel (05/2000)', which was developed into a pre-standard DIN V 51605 for 'Rapeseed Oil Fuel' (6/2006) [1] [2] [3] [4] [5]. After further four years of researching and gathering know-how, this pre-standard was turned into a national DIN standard DIN 51605 (09/2010), lead-managed by the Technologie- und Förderzentrum (TFZ). The research work was financed by the Bavarian State Ministry of Food, Agriculture and Forestry, the standardisation by members of the sub-committee.

Approach

The members of the DIN NA 062-06-32-02 UA, former sub-committee 632.2, at the DIN (German Institute for Standardization) have decided to continue standardization of rapeseed oil fuel from the status of the pre-standard DIN V 51605 to a definite DIN standard. Members of the standardization committee are diesel engine manufacturers, agricultural machinery industry, manufacturers 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.

On basis of the pre-standard DIN V 51605 national standardization was continued. Here, latest experiences in terms of fuel quality and effects on engines, especially those with exhaust gas after-treatment, were incorporated. In spite of national standardization, the DIN standard can also be applied for international procedures. It was decided to standardize rapeseed oil explicitly. For further plant oils a separate pre-standard is being developed, which is still in process.

German Standard DIN 51605

In September 2010 the standard DIN 51605 was published, and replaced the pre-standard DIN V 51605 (06/2006) (Figure 1). According to that the production of rapeseed oil fuel can be produced 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 use (e.g. cooking oil or lubrication oil). The field of application of rapeseed oil fuel according to DIN 51605 is restricted to the application in vegetable oil compatible engines. This means, that the use in engines not capable of running on vegetable oil as well as including blends with other fuels is not commented.

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	DIN 51605	DIN
ICS 75.160.20	Ersatz für DIN V 51605:2006-07	
<p>Kraftstoffe für pflanzenöлтаugliche Motoren – Rapsölkraftstoff – Anforderungen und Prüfverfahren</p> <p>Fuels for vegetable oil compatible combustion engines – Fuel from rapeseed oil – Requirements and test methods</p> <p>Combustibles pour moteurs adaptés aux huiles végétales – Combustible à base d'huile de colza – Exigences et méthodes d'essai</p>		

Figure 1: Standard DIN 51605 for 'Fuel from Rapeseed oil'

The standard DIN 51605 differs from the 'pre-standard DIN V 51605 (06/2006)' mainly in consideration of limiting values of the content of phosphorus, calcium and magnesia. Furthermore, the parameters carbon residue and ash content were excluded from the standard because of their low informative value for quality control of rapeseed oil.

Due to the ongoing tightening of exhaust gas limits for diesel engines an increasing number of manufacturers use exhaust gas after-treatment-systems to fulfil the compulsory limits. For this, oxidation catalysts, selective catalytic reduction systems or particle filters are used. The phosphorus content in the exhaust gas has a damageable effect on the efficiency of exhaust gas after treatment techniques. In addition, calcium and magnesia in rapeseed oil fuel are found as ash deposited in the particulate filter, with in turn leads to an increasing exhaust gas back pressure. To provide a correct operation of exhaust gas after treatment systems with rapeseed oil, the limiting value of the element contents for phosphorus, calcium and magnesia are tightened up. The limiting value of phosphorus was reduced to a maximum of 3.0 mg/kg, calcium as well as magnesia were reduced to a maximum of 1.0 mg/kg. This was done to provide an effective exhaust gas after treatment with rapeseed oil fuels. These new limiting values for phosphorus, calcium and magnesia are compulsory from 01.01.2012 on, the same time the new Emission Stage IIIB tractors with a rated power of 56 to 130 kW have to be introduced in the market. For analysis of the very low limiting values a new testing method, the DIN 51627-6 'Automotive Fuels – Test methods – Part 6: Direct determination of trace elements in vegetable oils by inductively coupled plasma optical emission spectroscopy (ICP OES)', was developed and verified with round robin analysis tests.

The analysis of the '**flash point**' by Pensky-Martens of rapeseed oil fuel was simplified. The minimum of the limiting values of DIN 51605 was dropped down to 101 °C, to avoid multiple measurements of the laboratories as it was often necessary to guarantee the former minimum value of 220 °C. The lowering of the limiting value does neither affect the rapeseed oil quality nor change any requirements of storage or transport. Possibly the use of additives is facilitated, because of the common decreasing effect of many additives on the flash point. With this new requirement, the flash point is not any longer suitable as a „quick test method“ for the dilution of rapeseed oil with other fuels. For this case, the limiting value range for the **density** at 15 °C was tightened to avoid the implementation of another method (minimum of 910.0 kg/m³ to a maximum of 925.0 kg/m³).

The minimum of the limiting value for **iodine number** was withdrawn from the standard. There are no further technical reasons for a minimum limiting value. Formerly the iodine number was a characteristic to show that the plant oil originated from rapeseed oil. However a mixture of different plant oil types could not always be detected with this parameter.

Furthermore, the property '**ash content (oxide ash)**' is withdrawn from the standard, because of the accurate determination of the ash forming elements calcium and magnesia with the new testing method (ICP OES) for each element.

The evaluation of analysis data from the property '**carbon residue**' showed a very good compliance with the limiting value in the past years. Nevertheless the testing method shows a low reproducibility and comparability with rapeseed oil. In addition, there was no influence onto this parameter from the rapeseed oil quality observed. For these reasons the specification 'carbon residue' was excluded from the standard.

Conclusion and Outlook

The standard DIN 51605 'Fuels for vegetable oil compatible combustion engines – Fuel from rapeseed oil – Requirements and test methods' was published in September 2010. It cleared the way for the use of rapeseed oil in vegetable oil compatible combustion engines with exhaust gas after-treatment techniques.

With the publication of the DIN 51605, the standardization committee closed the work on the rapeseed oil topic at the moment. But the members keep on working; this enables a regular discussion on a reconsidering of an adaption of the standard DIN 51605.

It is obvious that many of the requirements in standard DIN 51605 for rapeseed oil can also be fulfilled by other plant oils. Though, further properties that are not relevant for rapeseed oil, need to be considered individually for each type of plant oil (e.g. content of waxes for sunflower oil). Thus, for further plant oils a separate pre-standard DIN V 51632 is being developed, its publication is expected in 2011.

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The standard DIN 51605 is available at:
Beuth Verlag GmbH, 10772 Berlin
www.beuth.de or www.din.de

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