INFORMATION

Deutsche Wissenschaftliche Gesellschaft
für Erdöl, Erdgas und Kohle e.V.

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PROJECTS

DGMK-COMMITTEE
FUELS

2008 – 2010

Hamburg, 18.02.2010 Lu/za

Überseering 40 · D-22297 Hamburg · Amtsgericht Hamburg, 69VR6898 · USt-IdNr. DE 118712841
Telefon 040 639004 0 · Telefax 040 639004 50 · www.dgmk.de · email: downstream@dgmk.de

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DGMK-Project 661 Deposit formation by 5 % FAME blends in premix burner systems

Modern burnersystems for Domestic Heating Oil (DHO) with low emissions use an extensive mixing preparation, which is an important criterion for the quality of the combustion. Changes on the fuel may lead to higher emissions and deposit formation and can furthermore affect the storage stability. Analogous to the fuel sector, a further development of DHO concerning the admixture or substitution by alternative fuels is pursued at the moment. The DIN V 51603-6 “alternative Domestic Heating Oil” defines the requirements of blends of mineral oil based low sulphur Domestic Heating Oil with biogenic and other alternative compounds such as Fatty Acid Methyl Esters (FAME), Vegetable Oil (VO) or Gas to Liquid (GtL) and Biomass to Liquid (BtL). The utilization of burners which are available in the market right now with minor technical modifications is desired. The project aim was to research the practical usage of DHO with an admixture of 5 % (V/V) FAME and 5 % (V/V) VO in oil heating systems. The project was divided into three parts: first the deposit formation and the emissions of stationary oil firing systems were determined in the lab. This was conducted on three different types of burners (blue burner, yellow burner, and rotation evaporator), that are supposedly relevant for today’s stock. Secondly, the effect of the fuel matrix on the deposit forming of idealized droplet evaporation in a crucible furnace was qualified and quantified, to make temperature ranges and layout criterions for burner components available. Thirdly a practical storage of the blends used was conducted which was attended by suitable fuel analysis. Besides the documentation of the ageing state and the correlation to the experiments, the validation of a measuring method for the determination of the oxidation stability was emphasized.

Source: DGMK-Forschungsbericht 661
Ablagerungsbildung durch 5 % FAME Blends in Vormischbrennersystemen
(Deposit formation by 5 % FAME blends in premix burner systems)
Authors: Dipl.-Ing. Oliver van Rheinberg, Dipl.-Ing. (FH) Helma Dirks, Priv.-Doz. Dr.-Ing. Klaus Lucka, Prof. Dr.-Ing. Heinrich Köhne, 2009
82 pages, 50 figures, 27 tables
ISBN: 978-3-941721-04-3
Price: EUR 50,00 plus VAT (DGMK-Members 50 %)

Further Information: J. Ludzay, DGMK ludzay@dgmk.de

Ideen eine Zukunft geben

This research project is sponsored through the Consortium of Industrial Research Associations (Arbeitsgemeinschaft industrieller Forschungsver-einigungen e.V., AiF) by funds of the Federal Ministry of Economics and Technology (14784 N).

DGMK-Project 641 Development of a procedure for the decentralized desulphurisation of liquid fuels for processes in fuel cells

Reason and Objective

Within the scope of the project, a significant contribution to the development of a process should be made, which makes the use of liquid fuels in fuel cells possible. Neither a process nor the equipment for a decentralised desulphurisation of liquid fuels is currently available in the range of performance of a few kW. Therefore, in the submitted research project, such a desulphurisation process shall be developed and investigated. It will be realised with light heating oil (low sulphur, < 50 ppm) as an example within a reforming process.

Brief Description

Within the scope of the project, test equipment is adapted to the fundamental investigation of the mixture preparation, using cool flames and desulphurisation of the product. At OWI, a reactor for the investigation of mixture preparation under the conditions of desulphurisation is assembled, and possible operational circumstances are determined. At EBI, preexaminations of a suitable catalyst selection and of the influence of the composition of cool flames on desulphurisation are carried out initially on available equipment. On the basis of these results, test equipment for desulphurisation is designed, which is combined with the premixing unit. The results of this combined operation are used for an optimisation of mixture preparation, and the new design is combined with optimised operational parameters for desulphurisation. With this system, long term investigations of the stability of the components are carried out. At the same time, an almost commercial functional pattern is developed, which is optimised with respect to volume and weight.

Duration 2006 - 2008

Research Institute Oel-Wärme-Institut gGmbH, Aachen
Engler-Bunte-Institut, Universität Karlsruhe

AiF Ideen eine Zukunft geben

This research project is sponsored through the Consortium of Industrial Research Associations (Arbeitsgemeinschaft industrieller Forschungsvereinigungen e.V., AiF) by funds of the Federal Ministry of Economics and Technology (14783 N).

Further Information J. Ludzay, DGMK ludzay@dgmk.de

Download results:
http://www.dgmk.de/downstream/publikationen/informationen/Info_2309_641.pdf

DGMK-Project 570-1 Investigations on Thermal Stability of Light Heating Oil and DGMK-Project 570-2 Investigations on Storage Stability of Light Heating Oil

Product stability of light heating oil gained increasing importance by various factors during the ninety-nineties. These factors include:

- Higher thermal loads of the fuel in increasingly more compact oil systems
- Sensitive constructional elements (nozzles of oil burners) for burners of low power
- Longer storage periods of the fuel as a result of improved efficiency of the oil burners with unaltered storage volumes.

Product stability was already taken into consideration as an additional quality feature, when the specification for light heating oil (DIN 51603-1) was revised in March 1998. The two criteria: thermal and storage stability were included into the list of requirements; however, no suitable test procedure was specified.

Since 1999, the DGMK Project Group 570 has been working on the development of two test procedures. This work differentiates between two project parts:

- 570-1 “Investigations on thermal stability of light heating oil”,
- 570-2 “Investigations on storage stability of light heating oil”.

Brief description of the method for the determination of thermal stability:

After filtration through a membrane filter, an oil sample is thermally treated at 105 °C for 16 h in the presence of a copper wire, and subsequently, after cooling down to room temperature, again filtered through a membrane filter. The filter residue is washed, dried, and weighed in mg/kg as “filtratable ageing residue”. The residue, which remained in the ageing vessel and on the copper wire, is dissolved in a solvent and transferred into a vessel for evaporation. After evaporation of the solvent and drying, this residue is weighed in mg/kg and reported as “not filtratable ageing residue”. The sum of filtratable and not filtratable ageing residues is reported in mg/kg as “thermal sediment”.

Brief description of the method for the determination of storage stability:

After filtration through a membrane filter, an oil sample is exposed to five artificial light sources (light box) for 24 h in the presence of a copper wire, and subsequently again filtered through a membrane filter. The filter residue is washed, dried, and weighed in mg/kg as “filtratable ageing residue”. The residue, which remained in the ageing vessel and on the copper wire, is dissolved in a solvent (4.5) and transferred into a vessel for evaporation. After evaporation of the solvent and drying, this residue is weighed in mg/kg and reported as “not filtratable ageing residue”. The sum of filtratable and not filtratable ageing residues is reported in mg/kg as “storage sediment”.

Status: Both DGMK projects are completed. The results were submitted to FAM.
DIN 51371 *Liquid fuels - Determination of thermal stability of fuel oil EL* and DIN 51471 *Liquid petroleum products - Determination of storage stability of fuel oil EL* are available at www.din.de

Further Information: Jan Ludzay, DGMK ludzay@dgmk.de

DGMK-Project 726 Development of a hardware-in-the-loop-test rig to verify the reliability of oil burner pumps - Application by the use of biocide in domestic heating oil

Within this project, a hardware-in-the-loop test rig has been developed to investigate the influence of different fuels on the reliability of oil burner pumps. The test rig is constructed with commercial burner components. One test rig consists of four pump cycles, where the fuel recirculates for max. 2000 h. Low powered electric motors of 90 Watts have been used deliberately, so that the apparatus is more sensitive to failure due to an increase in pump load. A practise relevant intermittent operating mode has been implemented for the simulation of real operation characteristics. The measured variable and evaluation parameters are start-up torque, intake pressure, fuel pump pressure and temperature. Operation failures of oil burner pumps in the field, due to an over-additisation of biocides, have been observed. These failures could be reproducibly simulated on the pump test stands. The results of the project are a redefinition of limits of biocide concentration and the development of new biocides, which are suitable for use in domestic heating oil with a content of up to 20% Fatty-Acid-Methyl-Ester.

Source: DGMK-Forschungsbericht 726
Entwicklung eines Hardware-in-the-loop-Prüfstands zum Nachweis der Betriebssicherheit von Ölbrennerpumpen – Anwendungen bei Einsatz von Biozidadditiven
(Development of a hardware-in-the-loop-test rig to verify the reliability of oil burner pumps - Application by the use of biocide in domestic heating oil)
Authors: Oliver van Rheinberg, Jayadi Lukito, Martin Liska, 2009
42 pages, 20 figures, 14 tables
ISBN 978-3-941721-03-6
Price: EUR 50,00 plus VAT (DGMK-Members 50 %)

Further Information: J. Ludzay, DGMK ☎ 040 – 63 90 04 33

DGMK-Project 646-1 Catalogue of Criteria for Light Heating Oil Additives (Light Heating Oil Standard, low sulphur LHO, LHO A)

Reason and Objective

Against the background of the use of biogenic components in the area of heating oils, the DGMK Committee Fuels has decided to revise the catalogue of criteria for light heating oil additives (DGMK Research Report 646). This revision must include the following qualities:

standardised in	DIN 51603-1		DIN V 51603-6
	light heating oil standard	light heating oil low sulphur	light heating oil A

Brief Description

Test criteria with corresponding laboratory tests shall be established. The established test criteria shall be an integral part of the requirements for additives, in order to exclude adverse effects. The established test criteria are minimum requirements, which shall exclude possible impairments of light heating oil for the use in the different fuel combustion units of the market (incl. tank, oil pipes etc).

Duration 2009 - 2010

Projectadvisors DGMK-Working Group Additives

Further Information J. Ludzay, DGMK ludzay@dgmk.de

DGMK-Project 702 Oxidation Stability of Light Heating Oil/Fatty Acid Methyl Ester Blends or Light Heating Oil/Vegetable Oil Blends

Reason and Objective

Modern oil burners for fluid fuels have a fuel mixture generation adjusted to a fuel according to DIN 51603 part 1. Long storage periods in tanks have the effect that in the presence of oxygen and light, oil degradation products can be formed. The addition of fatty acid methyl ester (FAME) or vegetable oils (VO) to light heating oil (LHO) can result in a destabilisation of the blend due to the different chemical structure (unsaturated compounds). For the time being, the Rancimat test (DIN EN 14112) is approved according to the biodiesel standard DIN EN 14214 for the determination of oxidation stability of FAME and vegetable oils. It is the objective of the project to develop a procedure for the determination of the oxidation stability of LHO/FAME and LHO/VO blends with a biogenic share of at least 20 % within 24 hrs.

Brief Description

The purpose of the project is to determine, which oxidation products are formed in the blends and how these can be correlated with a measurable physical value. For a better understanding of the reaction process, the chemical compositions of the fuels shall be analysed. On this basis, an evaluation of the first oxidation products with regard to their reactivity can be made and information about the stability can be given.

Duration	2010 - 2012
Research Institute	Oel-Waerme-Institut gGmbH An-Institut der RWTH Aachen

AiF
Ideen eine Zukunft geben

This research project is sponsored through the Consortium of Industrial Research Associations (Arbeitsgemeinschaft industrieller Forschungsvereinigungen e.V., AiF) by funds of the Federal Ministry of Economics and Technology (16342N).

Further Information J. Ludzay, DGMK ludzay@dgmk.de

DGMK-Project 714 Deposit Formation by 20 % FAME Blends in Premix Burner Systems

Reason and Objective

Fluid fuels are currently further developed in the heating market with regard to supplementation or substitution by alternative fuels in analogy to power fuels. Fuel changes can lead to higher emissions or deposit formation and they can also influence storage stability. The objective is that alternative fluid fuels can be used in oil burners which are on the market, with technical modifications where required.

Brief Description

In DGMK project 661 (AiF 14784 N), an addition of 5 % FAME to LHO was established; in this follow-up project, the maximum addition of FAME and vegetable oil shall be investigated in an analogous way. The tests (emissions, deposits) are carried out with commercial burner systems representative for the market and with idealised systems. Additionally, the effect of storage stability is highlighted by appropriate fuel analysis and by the application in technical systems. Therefore, all relevant parameters are taken into consideration within the scope of this project and their effects are shown.

Duration	2009 - 2011
Research Institute	Oel-Waerme-Institut gGmbH An-Institut der RWTH Aachen

AiF
Ideen eine Zukunft geben

This research project is sponsored through the Consortium of Industrial Research Associations (Arbeitsgemeinschaft industrieller Forschungsvereinigungen e.V., AiF) by funds of the Federal Ministry of Economics and Technology (16129N).

Further Information J. Ludzay, DGMK ludzay@dgmk.de

DGMK-Project 715 Microbiological contamination of biogenic fuels

Reason and Objective

The objective of this project is to investigate, which micro-organisms can occur in light heating oil, in FAME/vegetable oil and in blends, and whether the potential of a microbiological contamination further increases during the application of biogenic fuels.

Brief Description

Three essential routes are being pursued:

1. Investigation of facilities in the field and identification and isolation of microbes;
2. Laboratory tests for the determination of the chemical-physical properties and the operational safety of oil burner pumps;
3. storage of inoculated fuels.

Duration	2010 - 2012 (planned)
Research Institute	Oel-Waerme-Institut gGmbH An-Institut der RWTH Aachen

AiF
Ideen eine Zukunft geben

For this project, public funds of the programme for the promotion of the "Industrial Joint Research (IGF)" of the Federal Ministry of Economics and Technology were requested via AiF (IGF application no. ZN 07466/09).

Further Information: J. Ludzay, DGMK ludzay@dgmk.de

DGMK-Project 729 Application-technological properties of fluid fuels with biogenic components including relevant influencing factors

Reason and Objective

The addition of alternative fuels to low sulphur light heating oil according to DIN V 51603-6 verifiably leads to a change of the physical, chemical and application-technological properties of the total product, when FAME or vegetable oils are used. These are to be collected in the forefront and curtailed in such a way that the later applicability of the fuel blends in oil burning installations can be warranted. Property changes are curtailed by the definition of verifiable analytical parameters according to DIN V 51603-6. As far as analytical methods are concerned, like storage stability and thermal stability, it turned out, however, that these are not applicable for blends of LHO with FAME. Therefore, the fuel analysis so far available does not suffice for an adequate characterisation of the fuels in the forefront. Therefore, the determination of application-technological properties assumes an essential relevance.

Brief Description

For the determination of application-technological properties, an existing test method named ATES FAME shall be further developed in such a way that the test periods are reduced from currently > 2.000 hrs to < 1.000 hrs. Additionally, it shall be clarified, which chemical-physical changes are caused during the addition of FAME, HVO and BtL by the influence of light, temperature, water etc. It should especially be examined how these factors affect the application-technological properties. The interconnection of the chemical-physical changes in the fuel blend with the application-technological properties is of decisive importance against the background of the assessment of the fuels as such as well as of claims from the field. Because, the fuel specific causes can only be assessed correctly with the knowledge of the different modes of action of the particular determining factors.

Duration	2010 bis 2012 (planned)	
Research Institute	Oel-Waerme-Institut gGmbH An-Institut der RWTH Aachen	
Further Information	J. Ludzay, DGMK	ludzay@dgmk.de