



# **From Research to Service – Quality Watch for Emergency Generators and Quality Label for Premium Heating Fuels**

**Dr. Klaus Lucka, Newport 14.09.2016**

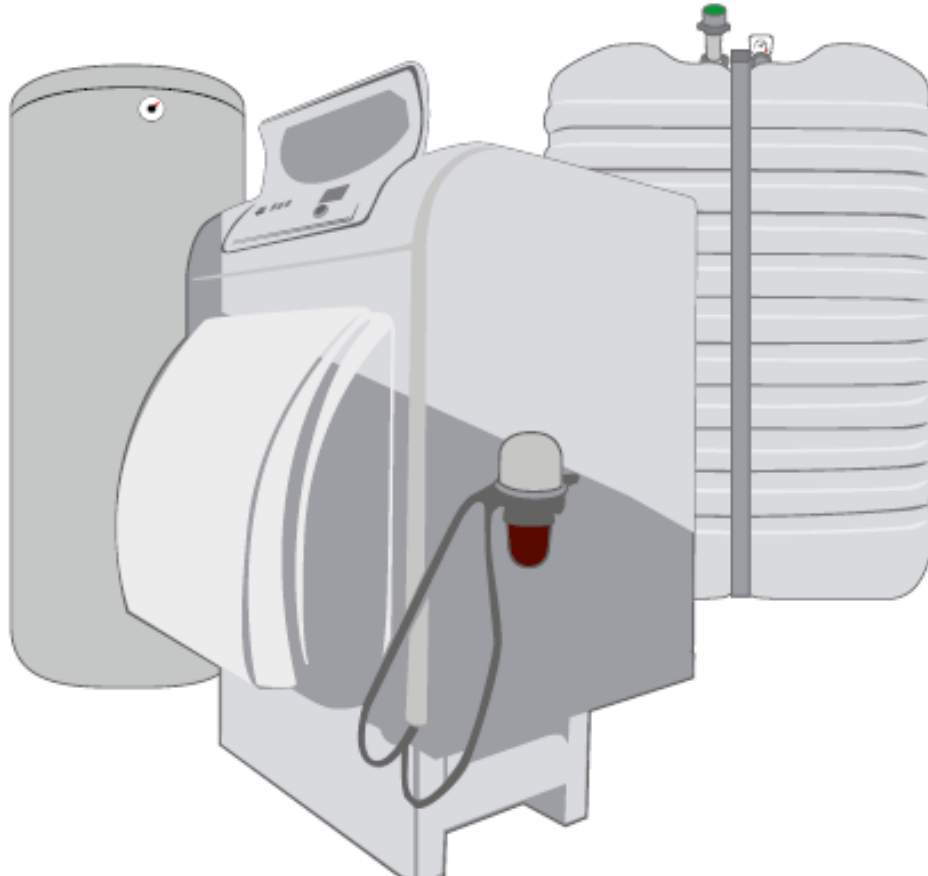
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**Performance-Test and Quality Label  
for Domestic Heating Oils**

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# GfK-Survey: 9 from 10 customers are happy with their oil heating systems



## Satisfaction:

Provider can be selected

**88,6**  
Prozent

Security

**87,8**  
Prozent

Robust Technology

**87,2**  
Prozent

# „Customers want to have a efficient and robust oil heating systems“

Robust Technology



Secure Technology



High efficiency



Long life-time



GfK- Survey Dez 2014

# Modern heating oil systems and heating oil qualities are what customers expect

- Heating Oil, low sulfur regarding German requirements DIN 51603-1 is available as a modern, environmentally friendly fuel for the use in high efficient full-condensing boiler systems
  - Reduction of fuel consumption and fuel costs
  - Durable high efficiency (no deposit formation ► clean heat exchanger)
- Premium Heating oils with Performance-Additives can improve application characteristics and long-term fuel quality
  - Reliability and long life-time of the heating oil system
  - Flexible heating oil purchase ► long storage times



# Manufacturers recommend heating oil low sulphur preferably in premium quality

## Von Heizgeräteherstellern empfohlen

Aufgrund seiner vorteilhaften Eigenschaften raten nahezu alle Gerätehersteller zum Einsatz von schwefelarmem Heizöl, vorzugsweise in Premiumqualität.

Die Empfehlungen der einzelnen Hersteller finden Sie unter:

[www.zukunftsheizen.de/hersteller-empfehlungen](http://www.zukunftsheizen.de/hersteller-empfehlungen).

Sie ergänzen oder ersetzen die Hinweise in den bestehenden Betriebsanleitungen älterer Heizkessel.



## Current Situation: „Premium-Heating Oils“

- Different trade names
- No uniform labeling
- Properties and performance not defined

# Background information

## Definition „Premium Heating Oil“

### BDH (Info paper No. 50 June 2013) part 1

- Standard Heizöl EL, schwefelarmes Heizöl EL and alternatives Heizöl EL are also available in premium quality, to satisfy changing customer needs.
- Efficient heating oil technologies and heat insulation in houses create new requirements on fuels with a high long term stability
- The Performance-Parameters are adjusted with Additive-Packages (chemical agents)

# Background information

## Definition „Premium Heating Oil“

BDH (Info paper No.50 June 2013) part 2

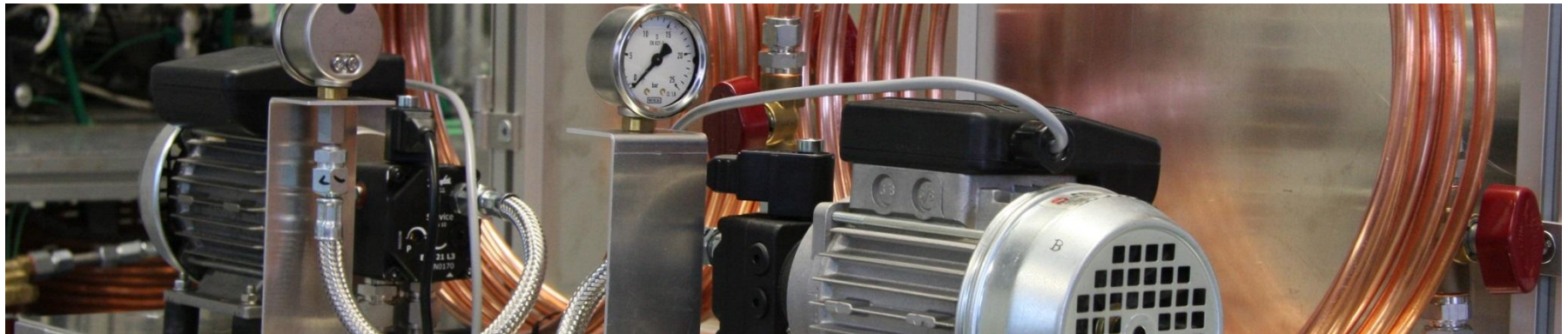
### Advantages:

- Long term storage stability
- High thermal stability
- Corrosion protection
- Protection against water insertion
- Keep-Clean/Clean-Up
- Microbial contamination
- Odour (deferred)
- No ash forming additives



# T4F- Heating Oil-Performance-Test and Quality Label

- Customer expectations: robust Technology/ security, low fuel consumption, long life-time, low maintenance costs, Heating Oil reserve
- Special additized low sulphur heating oils can fulfill these requirements
- „Premium-Heating Oil“: Labeling, Properties and Performance not clearly defined
- TEC4FUELS Qualification-System for Heating oils:
  - Test-Method accepted from industry and science
  - Independent Quality-Label for defined product parameters



# Requirements and Opportunities of a quality label for Heating Oils

- Ambitious and transparent test criteria for evaluation of product parameters
- Basis: public founded research projects
- Positive feedback from German customer protection agency regarding the test-and labeling system (legal requirements)
- **5-Star-Category-Label**
  - Promotional accentuation of tested product advantages/product differentiation
  - Valuable Customer Information for purchase decision
- Basis for “Manufacturers recommend heating oil low sulphur preferably in premium quality”



# Accolade for premium heating fuel: Qualified, verified statements



- ★ **Performance:** keeps heating device at its full heating power (100 %)
- ★ **Endurance:** longer usability of boiler and its components
- ★ **Reliability:** high operation safety due to minimal deposit formation
- ★ **Economy:** Reduction of maintenance and repair costs
- ★ **Storage Stability:** High quality of the fuel storage tank's content even after long storage.



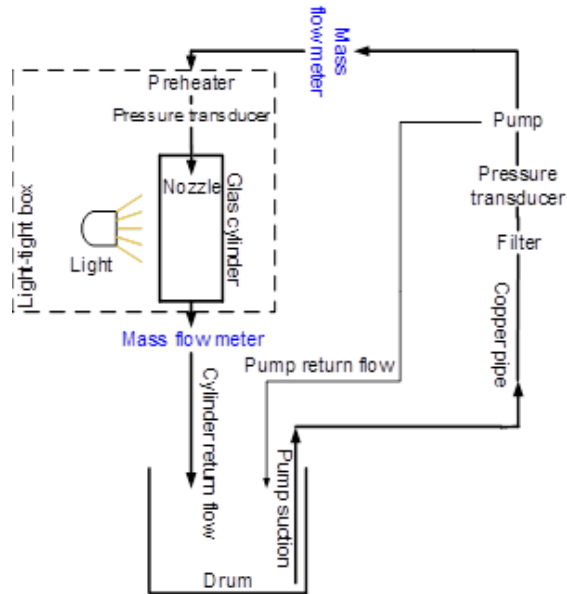
„Accolade-Premium Quality“ ► 5 stars

# Requirements for customer protection are fulfilled



- **Accolade from independent organization / defined criteria**
- **Test criteria transparent and public (online: [www.heizoeltest.info](http://www.heizoeltest.info))**
- **No deception by using the quality label for promotion:**
  - Differentiation of Heating Oils possible
  - „Premium-Heating Oils“ must show an Improvement in performance in comparison with „normal-Heating Oils“
  - The label can not be issued by a governmental organization

# Heating Oil-Performance-Test: Test method and test rig



- „Stress-Test“ for evaluation of the „Additive-Performance “ ► comparison of additive treated and not additive treated fuels
- Hardware-in-the-loop-Test principle ► Complete Heating-Oil-system: filter, pump, pre-heater, nozzle
- Fuel is pumped in a circle through all fuel-leading parts (no combustion)
- Defined Fuel-Aging: Light, Heat, Oxygen, Copper

# Method and Characteristics of the Heating-Oil-Performance-Tests

## Use of „ATES FUELS“ Test rig

- Scientific developed test method of OWI, Affiliated-Institute of RWTH Aachen University, in public founded projects via DGMK
- Test method for heating oils and bio heating oils

## Test criteria

- Test time: 1000 h
- Continuous/HiL
- Fuel amount: each 30 l (+/- Additiv)
- Fuel Aging is observed by hardware measurements and analytics

- Complete Heating-Oil-System: (filter, pump, pre-heater, nozzle)
- Temperature: Drum 50 °C
- Temperature Pre-Heater 110 °C
- Light-Box
- Copper-Wire in drum

## Comparison of additive treated and not additive treated fuels

# Method and Characteristics of the Heating-Oil-Performance-Tests

- **Volumen-Flow-Measurement**
- **Online-Diagnosis-Component blockage (pump, pre-heater, nozzle)**
- **End-Off-Life-Diagnosis (pump, pre-heater, nozzle):**  
optical evaluation of deposit formation
- **Periodic Analytics (3 measurements: 0 h, 500 h und 1000 h):**
  - Oxidation Stability
  - Acid Number
  - Water Content
  - norm./mod. Thermal Stability (16h/ 72 h)
  - norm./mod. Storage Stability (24h/ 72 h)
  - Steal-Pin-Corrosion-Test





# Method and Characteristics of the Heating-Oil-Performance-Tests/Quality Label



- **Requirements Label**

- First test: 2 different fuels with and without additive
- 5-Star-Test-matrix
- Annual Follow-Up-Test:
  - 1 different fuels with and without additive
  - Change in Additive-Composition: 2 different fuels with and without additive
- Statistical Validation
  - Test criteria must be fulfilled by 75 % of the investigated fuels
  - Otherwise further fuels must be tested
  - Fuel-Choice at random



# Performance-Test with Quality Label: Benefits and Timeline



1. Measurement and evaluation of praxis relevant quality parameters of heating oils on the basis of a scientific developed test method and a test matrix which is accepted by industry
2. Conclusion of test results in a report
3. Quality label
4. Licence rights quality label / Contract for beneficiary
5. Extension of licence rights by follow-up test



# Advantages of Performance-Test and Quality label



- **Test method with praxis relevant requirements in the test matrix and comparable results**
- **Test criteria transparent and public**
- **Low testing costs and short term test allow a higher amount of control samples**
- **Statistical Validation:**
  - Test criteria must be fulfilled by 75 % of the investigated fuels (annual test)
  - Fuel-Choice at random
- **Test and label are connected with the heating oil label /beside Additive-composition**
- **Environmentally „Hardware in the Loop“-Test Method**
  - Low fuel consumption
  - No combustion ► no exhaust gas emissions



## **Quality watch for fuels of emergency backup power systems**

**Quality Watch – „When it matters!“**

Increased reliability – lower costs

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# Why is it important to monitor the fuel quality?

- Users monitor the fill level, but not the quality of the fuel
- Bad fuel quality is in this case detected by engine failure
- Engine manufacturers usually request the use of Diesel fuel according to DIN EN 590 in their manuals
- Liability claims in case of total power loss due to malfunction of emergency backup power system



# What is the cause of the fuel problem?

**Admixture of FAME to diesel fuel (7% mandatory in Germany)**

**Dilemma:** Most engine manufacturers request the use of diesel fuel according to DIN EN 590, being unaware, that common diesel fuel is not adjusted for long storage periods.

**Engines of emergency power generators having malfunctions, damages or even complete failure leads to**

- Possible interruption of power supply
- Costs and trouble for customer, manufacturer, fuel supplier and service technicians



# Where do we find emergency backup power systems?



- 1. Hospitals**
- 2. Computer centers**
- 3. Banks**
- 4. Insurance companies**
- 5. Public buildings**
- 6. Logistics centers (cooling for food!)**
- 7. Police stations**
- 8. Civil protection stations**
- 9. ....**

# Impacts of emergency power system's failures



- **Material damage (to the emergency power generator)**
  - Damage to the engine
  - Damage to generator and electrical installation
  - Damage to electrical consumers
  - Discussion / negotiation about warranty issues
- **Personal injuries („damage to humans“)**
  - Surgery /ICU in hospitals
  - Public transportation
  - Airfields, air traffic control, shipping routes,...
- **Pecuniary losses**
  - Loss of profit or compensation claims, for example computer centers or telecommunications

## Published data

- **Field study performed by IWO (institute for heat and oil technologies) and BSI (German federal Office for Information Security) in 2014**
  - Investigation of 74 emergency backup power generators
  - Only 30 of them had a good fuel quality in the storage
  - The fuel of 13 installations was not fit-for-purpose, leading to malfunction in one installation during the time of the field study
  - Within the installations filled with Diesel fuel or mixtures (FAME present): only 8 % with a spotless fuel quality, 60 % with critical or borderline fuel quality
  - Many installations with copper piping (strong catalyst promoting fuel degradation)



# Regulations /recommendations

- **The BSI (German federal Office for Information Security) and the BBK (Federal Office of Civil Protection and Disaster Assistance) supplemented their guidelines for the installation and operation of emergency power systems based on the findings of the study**
  - Suggestion: Service contract for monitoring the fuel quality. The contract should include:
    - Sampling and analytics
    - Consideration of the data history
    - Recommendation for the necessary action under consideration of the installation and the fuel analytics including the data history
  - Exchange of copper pipes
  - Use of heating oil (without FAME) in combination with specialized additive
  - Emptying the day tank once a year

# Basic offer for quality monitoring of emergency power generator's fuels

**Sampling is performed by customer or his service technician.**

- T4F sends the necessary sampling equipment and storage/transport containers for the samples,
- ensures the correct mapping of emergency power generator, fuel tank and fuel sample,
- organizes the sample's shipping under observation of the hazardous materials regulations.



# How should be sampled?

- **Standard for sampling:**
  - 1/3 from top, 1/3 from middle, 1/3 from bottom
  - Scientifically correct sampling not required; status of the fuel being delivered to the engine is relevant
  
- **Sampling in emergency power units**

Approximately from the same level the fuel is taken from

  - Main storage tanks feeding day tanks: at the level of the sampling line (usually approximately 10 cm / 4" above tank's bottom)
  - Day tank: If sampling line is connected to the bottom: Through draining tap on bottom (if available), otherwise closely (2-3 cm / 1 " ) above the bottom (not directly from the bottom)
  - Jacketed tank: at the level of the sampling line (usually approximately 10 cm / 4" above tank's bottom)

# Report including analytical values

TEC4FUELS GmbH · Kaiserstraße 100 · 52134 Herzogenrath

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Telefon: +49 40 235113-14  
Telefax: +49 40 235113-8514  
E-Mail: lucks@iwo.de

Datum: 18.09.2015

## Bericht zur Brennstoffqualität im Rahmen der Brennstoffüberwachung in Netzersatzanlagen Auftragsnummer: Z54-42794611

Sehr geehrte Frau Heike Kleemann,

zur Überwachung der Qualität des Brennstoffs in der Netzersatzanlage am  
Standort Grävenwiesbach  
Adresse  
Gebäude NEA A Haupttank

haben wir auftragsgemäß am 04.09.2015 eine Brennstoffprobe zur Analyse erhalten.

Bei der Brennstoffprobe handelt es sich zum Zeitpunkt der Beprobung um schwefelarmes Heizöl. Anhand der durchgeführten Analyse genügt die vorhandene Brennstoffqualität mit einer Cetanzahl von 54,9 den Anforderungen für einen dieselmotorischen Betrieb in der vorgenannten Netzersatzanlage. Allerdings kann aus unserem Service keine garantierte Zusicherung der Eignung und Betriebssicherheit des Brennstoffs über den Zeitpunkt der Beprobung hinaus abgeleitet werden.

**Ergebnis:** Für die von uns analysierten Parameter sind zum Zeitpunkt der Beprobung keine Einschränkungen zu erwarten.

**Empfehlung:** Naturgemäß altert ein Brennstoff bei langer Lagerung, daher sollte der Brennstoff in spätestens 12 Monaten wieder untersucht werden.

Hamburg, am 18.09.2015

  
Dipl.-Ing. oec. Lambert Lucks  
Öffentlich bestellter und vereidigter Sachverständiger  
für Heizölverbraucheranlagen und Heizöle  
im Auftrag der TEC4FUELS GmbH



Anlage Analysedatenblatt NEA A Haupttank Grävenwiesbach

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Stz: Herzogenrath (AG Aachen, HRB 19676)

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18.09.2015

rote Nummer			998/15-3
Eingangsdatum			04.09.15
Produkt			HEL
IWO-Nr			0003-47-01-1H
Kunde			Bundesanstalt für den Digitalfunk der BOS
Standort			Grävenwiesbach
Gebäude			NEA A
Motor			Deutz
Aussehen	visuell		klar
Dichte bei 15 °C	DIN EN ISO 12185	kg/m³	-
Gesamtverschmutzung	DIN EN 12662	mg/kg	4
Wasser	DIN EN ISO 12937	mg/kg	46
FAME-Gehalt	DIN EN 14078	Vol.-%	0,05
Oxidationsstabilität, 110 °C	DIN EN 15751	Stunden	-
*Säurezahl	DIN EN 14104	mg KOH/g	-
Thermische Stabilität	DIN 51371	mg/kg	-
Schwefelgehalt	DIN EN ISO 20884	mg/kg	-
Schwefelgehalt	DIN EN ISO 14596	Mass.-%	-
Cetanzahl	DIN 51773		54,9
ICP Kupfer	GMA-Hausmethode	mg/kg	<0,1

Seite 2/2

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# Easy traffic light-like system recommended action



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Datum: 18.09.2015

## Bericht zur Brennstoffqualität im Rahmen der Brennstoffüberwachung in Netzersatzanlagen Auftragsnummer: Z54-42794611

Sehr geehrte Frau Heike Kleemann,

zur Überwachung der Qualität des Brennstoffs in der Netzersatzanlage am  
Standort Grävenwiesbach  
Adresse  
Gebäude NEA B Haupttank

haben wir auftragsgemäß am 04.09.2015 eine Brennstoffprobe zur Analyse erhalten.

Bei der Brennstoffprobe handelt es sich zum Zeitpunkt der Beprobung um schwefelarmes Heizöl. Anhand der durchgeführten Analyse genügt die vorhandene Brennstoffqualität mit einer Cetanzahl von 61 den Anforderungen für einen dieselmotorischen Betrieb in der vorgenannten Netzersatzanlage. Allerdings kann aus unserem Service keine garantierte Zusicherung der Eignung und Betriebssicherheit des Brennstoffs über den Zeitpunkt der Beprobung hinaus abgeleitet werden.

**Ergebnis:** Mind. ein von uns analysierter Parameter ist nicht normgerecht oder auffällig.

**Empfehlung:** Die Brennstoffqualität zeigt Anzeichen einer katalytisch bedingten Alterung und sollte innerhalb von **6 Monaten** verbraucht oder ausgetauscht werden, ansonsten verkürzt sich das Überwachungsintervall auf maximal **6 Monate**.

Hamburg, am 18.09.2015

  
Dipl.-Ing. oec. Lambert Lucks

Öffentlich bestellter und vereidigter Sachverständiger für Heizölverbrauchertankanlagen und Heizöle  
im Auftrag der TEC4FUELS GmbH



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Datum: 15.09.2015

## Bericht zur Brennstoffqualität im Rahmen der Brennstoffüberwachung in Netzersatzanlagen Auftragsnummer: Z10-42794612

Sehr geehrte Frau Heike Kleemann,

zur Überwachung der Qualität des Brennstoffs in der Netzersatzanlage am  
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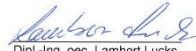
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**Ergebnis:** Einzelne Parameter sind kritisch und/oder nicht normgerecht.

**Achtung:** In der Brennstoffprobe wurde eine freie Wasserphase gefunden. Der Betrieb mit diesem Brennstoff kann zum Ausfall und Motorschaden führen.

Hamburg, am 15.09.2015

  
Dipl.-Ing. oec. Lambert Lucks

Öffentlich bestellter und vereidigter Sachverständiger für Heizölverbrauchertankanlagen und Heizöle  
im Auftrag der TEC4FUELS GmbH



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# Tank service partner network

## Tank service partner network for the exchange of the stored fuel (if necessary)

- Purchase of fuel if it is still in-spec (status: „yellow traffic light“) and fit for purpose if promptly used
- Disposal of fuel of a critical quality
- Cleaning and refitting of the tank installation



# Customer benefits of the quality monitoring



## Improved safety

- Reliable operational readiness in case of emergency
- Avoidance of hardly calculable follow-up costs
- Minimization of compensation risks

## Lower costs

- Use of low-cost fuel (tax benefit of heating oil) with a high storage live
- Prevention of high repair costs by fuel exchange in time

## Easy handling

- „All-round service“ for the customer within the scope of the regular technical servicing
- Appointment coordination by service partners and T4F

# Our recommendations regarding installation and operation



- All fuel bearing parts must be made of stainless steel or aluminum. Copper has to be avoided at all costs
- The day tank should be emptied as far as possible during test runs before being refueled from the main storage tank
- A tap for easy sampling should be installed at the day tank under observance of technical rules and water protection laws
- The fuel quality in the day tank is the critical one and should be monitored with higher priority