

D. Bockey

J. Haupt

Arbeitsgemeinschaft Qualitätsmanagement Biodiesel e.V., Berlin, Germany

Biodiesel Fuels Between Acceptance and Quality

The production and the application of Biodiesel have passed through some steps beginning from the check of the suitability as a fuel in principle over the construction of larger production facilities to the present time characterized by a parallel use as B100 for passenger cars and heavy duty cars as well for B5 for a general use as an component of Diesel fuel according DIN EN 590.

From the very first this fuel had to struggle for a real acceptance by car producers and customers. For the pioneer phases may be suggested, that the quality of the product was instable but in this time the creation of a general accepted standard was started.

In fact Diesel and Biodiesel are similar but never identical fuels. Comparing some aspects Biodiesel and Diesel have their benefits or handicaps on different fields. Possible or observed problems in applications are the consequence. Only an interaction between the car producers, the Biodiesel producers and the traders can prevent such problems.

We will try to show some critical fields and solutions from the point of view of the Biodiesel quality.

For example: To reach the requirements of the DIN EN 14214 for the CFPP Biodiesel needs flow improvers. In former time problems by mixing of Biodiesel containing different flow improvers had been reported. In co-operation of Biodiesel producers and additive producers the problem was solved, and the present additives on the market are compatible.

In the eyes of some Biodiesel users in former time the property "oxidation stability" was no essential parameter, but depositions in injection pumps speak another language. Long term studies and repeated surveys have shown that a good value of the oxidation stability at the producer level is not a sufficient act to fulfil the requirements at the customer level. Only by use of additional antioxidants at the producer level the oxidation stability meets final the specification.

By their work the AGQM has developed a system of measures for the quality management. These measures reach from the production over the intermediate storage and transportation to the pump station. Important measures are:

- Concept of the quality management
- Unannounced checks of the product
- QA audit
- Round robin tests
- Advanced training for QA and laboratory staff
- Special information about the handling with Biodiesel
- Licence agreement (sign) for public filling stations

This QM concept contains some additional requirements compared with the standard to protect the customer.

Often is asked, if deviations from the specification level really lead to problems or damages. The response from the practical use of Biodiesel shows that some parameters are very

evident. Their violation leads to serious damages in the fuel system of the car, and also an “only” blocked filter can effect consequential damages.

The executed surveys in the last year had shown an improved quality of Biodiesel.

On the other hand “acceptance” is not only a question of quality but also one of corresponding technical regulations and laws. One – for Biodiesel important - technical regulation and one also important by-law had been issued in 2004. In the field of water relevant components some work is to do for the future.

Although a lot of work is done we get a lot of new questions in the future, e.g.:

- Which kind of after treatment systems are or can be made compatible with Biodiesel?
(Subquestion: Can a change of the specification of the fuel help us?)
- Is there a possibility to lower the emissions by improving of the product?
- Are other ester fuels (better?) suitable for internal combustion engines?
- Use of the special Biodiesel properties (e.g. lubricant properties) to improve the fuels of the next generation

But: All chances can only be achieved by a stable and secure quality of the Biodiesel.

AGQM will stay a reliable partner in this field.

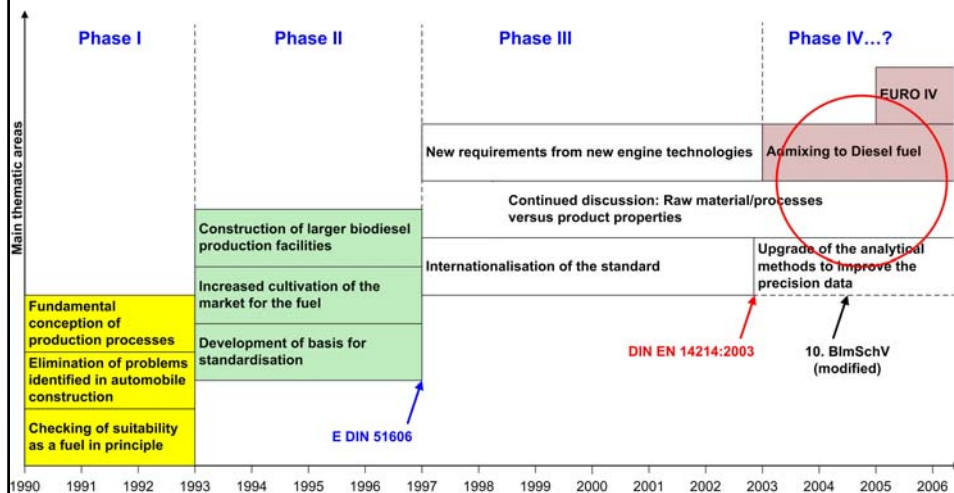
Biodiesel Fuels Between Acceptance and Quality

- ✓ Phases of the development of Biodiesel
- ✓ Actual market situation (B 100 market, market for admixed Biodiesel)
- ✓ Requirements for alternative fuels – benefits for DK and Biodiesel
- ✓ Adaptation of technical regulations and laws
- ✓ Causes for problems with biodiesel
- ✓ Examples: Consequences of the violation of the standard limits
- ✓ Introducing and Results of a QA system

Arbeitsgemeinschaft Qualitätsmanagement Biodiesel e.V.



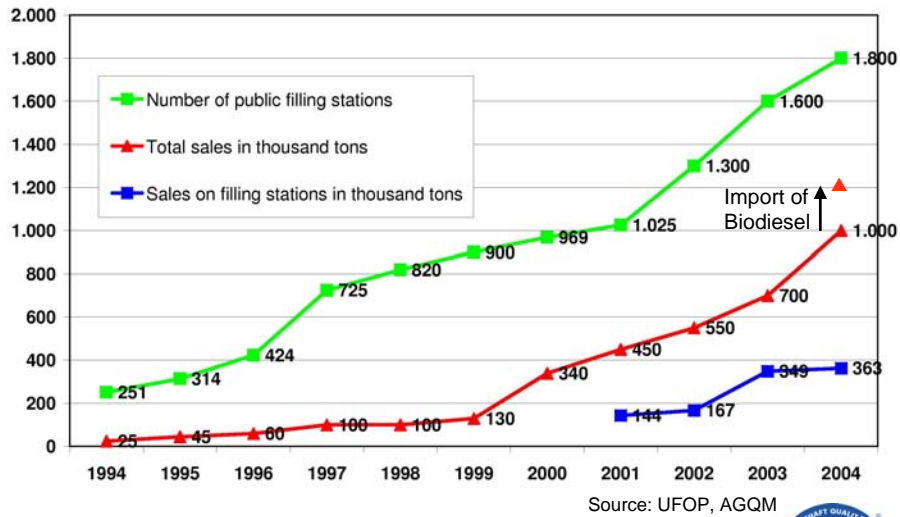
Phases of development of the Biodiesel fuel



Arbeitsgemeinschaft Qualitätsmanagement Biodiesel e.V.



Biodiesel sales in Germany



Arbeitsgemeinschaft Qualitätsmanagement Biodiesel e.V.

Fuels, January 12 - 13, 2005

Biodiesel Fuels Between Acceptance and Quality



3

Special benefits (+) or handicaps (-) for different Diesel fuels

	DK (EN 590)	Biodiesel (DIN EN 14214)
Biodegradability	-	+
Energy content	base	(-)
Lubricant properties	base	++
Cold stability	+	+
Oxidation stability	+	(-)
Quality check by the government	+	+
Availability	++	+
Emissions: CH		+
Emissions: particle mass		+
Emissions: NOx		-
Emissions: other (= non limited)	base	+
Special equipment/material need		-
Special service requirements		-
Price		+

Arbeitsgemeinschaft Qualitätsmanagement Biodiesel e.V.

Fuels, January 12 - 13, 2005

Biodiesel Fuels Between Acceptance and Quality



4

Possible causes for problems or damages while using Biodiesel

Damages or problems may be caused by

- inapplicable car technology (materials, improper interaction of components)
 - ▶ origin: **car producer**
- missing special knowledge about Biodiesel
 - ▶ origin: **trader, customer**
- improper quality
 - ▶ origin: **producer, trader**
- (recently not well detected problems)

Arbeitsgemeinschaft Qualitätsmanagement Biodiesel e.V.

Fuels, January 12 - 13, 2005

Biodiesel Fuels Between Acceptance and Quality



5

Influence of different flow improvers

Former (possible) situation:

(Quality according specification)

Biodiesel + Additiv I

Biodiesel + Additiv II



Product doesn't match the specification

- ▶ Cooperation between Biodiesel producers and additive producers organized by AGQM

Today:

- ✓ **3 basic types of proven flow improvers in the market**
- ✓ **Mixtures of Biodiesel with different flow improvers (from the proven types) don't lead to a degradation of the Biodiesel properties.**

Arbeitsgemeinschaft Qualitätsmanagement Biodiesel e.V.

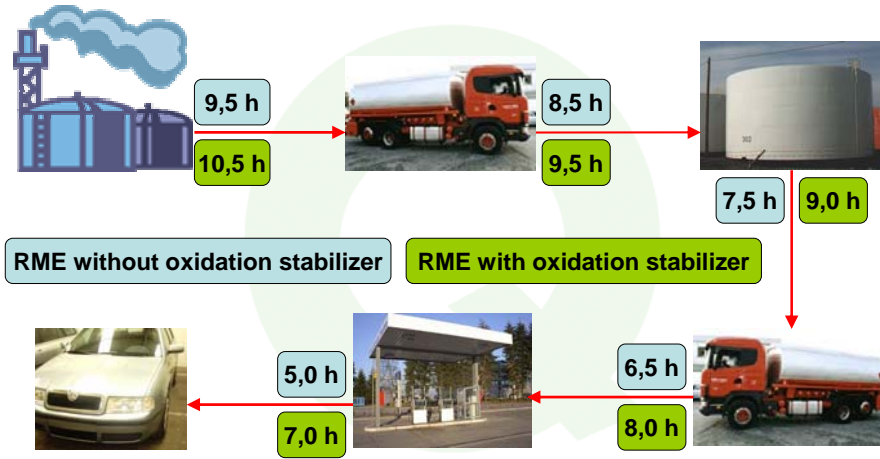
Fuels, January 12 - 13, 2005

Biodiesel Fuels Between Acceptance and Quality



6

Disturbance of the oxidation stability by transportation and storage (example)



Arbeitsgemeinschaft Qualitätsmanagement Biodiesel e.V.

Fuels, January 12 - 13, 2005

Biodiesel Fuels Between Acceptance and Quality

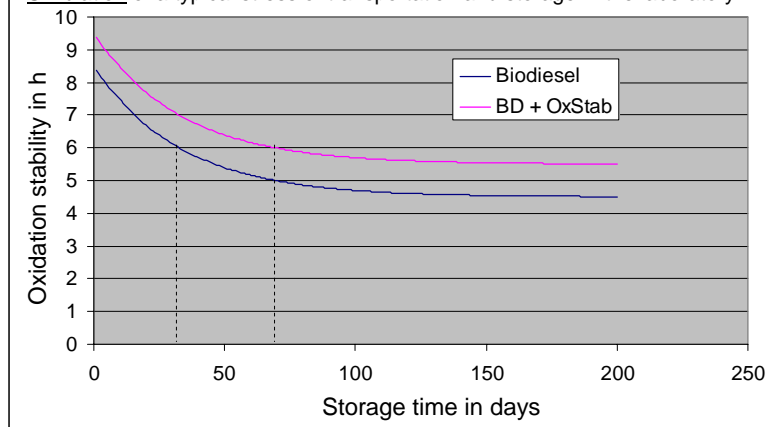


7

Study of the influence of antioxidants

Background:

Simulation of a typical stress of transportation and storage in the laboratory



Arbeitsgemeinschaft Qualitätsmanagement Biodiesel e.V.

Fuels, January 12 - 13, 2005

Biodiesel Fuels Between Acceptance and Quality



8

Measures for quality management

Step	Concept of the quality management	Un-announced checks of the product	QA-audit	Round robin tests	Advanced training for QA and laboratory staff	Special inform. about handling of Biodiesel	Licence agreement (sign)
Production	✓	✓	✓	✓	✓		
Intermediate storage	✓	✓	✓				
Transportation/Trade						✓	
Pump station		✓				✓	✓

Arbeitsgemeinschaft Qualitätsmanagement Biodiesel e.V.

Fuels, January 12 - 13, 2005

Biodiesel Fuels Between Acceptance and Quality



9

Basic information for handling with Biodiesel

www.agqm-biodiesel.de

Arbeitsgemeinschaft Qualitätsmanagement Biodiesel e.V.

Fuels, January 12 - 13, 2005

Biodiesel Fuels Between Acceptance and Quality



10

QM-Concept: additional requirements

<ul style="list-style-type: none"> ▶ related subjects: <ul style="list-style-type: none"> - Production (including raw materials) - Loading - Transportation - (Intermediate) storage 	<ul style="list-style-type: none"> ▶ Requirements exceeding the DIN EN 14214 ▶ will be adapted on new requirements permanently
--	--

Property	Unit	Limits		Responsible:	Method
		min.	max.		
Water content	mg/kg		220 300	Producers All members	EN ISO 12937
Total contamination	mg/kg		20	All members	EN 12662
Oxidation stability, 110 °C	h	6*		All members	EN 14112
CFPP: 19/10 to 28/02 (in leap years to 29/02)	°C		-20	Producers	EN 116
Fatty acid profile	% (m/m)	like rape seed		For selling at public pump stations	EN 14103

Arbeitsgemeinschaft Qualitätsmanagement Biodiesel e.V.

Fuels, January 12 - 13, 2005

Biodiesel Fuels Between Acceptance and Quality



11

Identification of Biodiesel



Arbeitsgemeinschaft Qualitätsmanagement Biodiesel e.V.

Fuels, January 12 - 13, 2005

Biodiesel Fuels Between Acceptance and Quality



12

Evaluation: effect of the violation of limits (I)

Property (DIN EN 14214)	Effect / Evaluation
Density at 15 °C	Incorrect injection amount of fuel (?)
Kinematic viscosity at 40 °C	Pumping problems (fuel pump, injection pump)
Flash point	May cause „dangerous good“
Cold filter plugging point (CFPP)	Problems in cold periods (also in autumn!)
Sulfur content (mass ratio)	RME: value is always kept
Coke residue (mass ratio)	Result of a to high content of glycerol/glycerids and/or double/multiple C-C-bonds
Ignitability (cetane number)	RME: the value is kept always
Sulfate ash (mass ratio)	If alkaline/earth alkaline content OK => also OK
Water content (mass ratio)	Corrosion, clouding (mixtures DK/FAME), fall out
Total contamination (mass ratio)	Filter plugging, also harmful for injection pump
Copper corrosion	RME: the value is kept (but: acid number...)

Arbeitsgemeinschaft Qualitätsmanagement Biodiesel e.V.

Fuels, January 12 - 13, 2005

Biodiesel Fuels Between Acceptance and Quality



13

Evaluation: effect of the violation of limits (II)

Property (DIN EN 14214)	Effect / Evaluation
Oxidation stability (induction time)	Filter plugging, deposition of polymers in case of mixtures DK/FAME
Acid number	Corrosion
Methanol content	No recent problem
Mono-, di- and triglycerids	Triglycerids = primary loading: rape seed oil?
Free glycerol	Formation of coke (also in case of glycerids)
Total glycerol	Calculated parameter
Iodine number	Formal, more information: fatty acid profile
Phosphor content	No recent problem
Alkaline content (Na + K)	Filter plugging
Earth alkaline content (Ca + Mg)	Filter plugging (effect higher than alkaline!)
(Fatty acid profile)	Multiple diagnostics

Arbeitsgemeinschaft Qualitätsmanagement Biodiesel e.V.

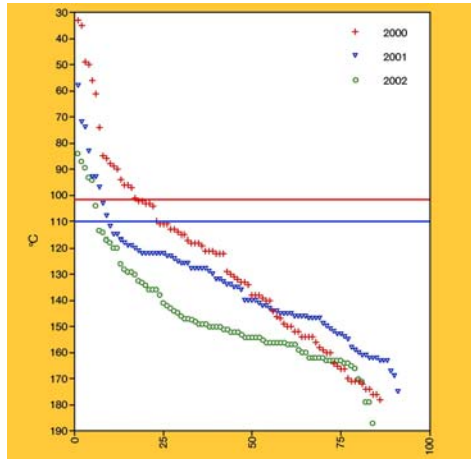
Fuels, January 12 - 13, 2005

Biodiesel Fuels Between Acceptance and Quality



14

Results of surveys (I)



Flash point according
E DIN 51606 („old“ method)

Violation of the limits:

year	number of samples	formal errors %	P+ %
2000	85	42,3	18,8
2001	91	9,9	7,7
2002	84	7,1	5,9

P+ = precision data used

Arbeitsgemeinschaft Qualitätsmanagement Biodiesel e.V.

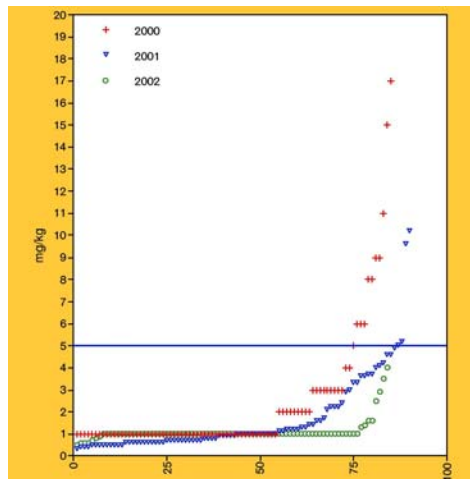
Fuels, January 12 - 13, 2005

Biodiesel Fuels Between Acceptance and Quality



15

Results of surveys (II)



Na + K according
DIN EN 14214 (5 mg/kg)

Violation of the limits:

year	number of samples	formal errors %
2000	85	11,8
2001	91	3,5
2002	84	0

Arbeitsgemeinschaft Qualitätsmanagement Biodiesel e.V.

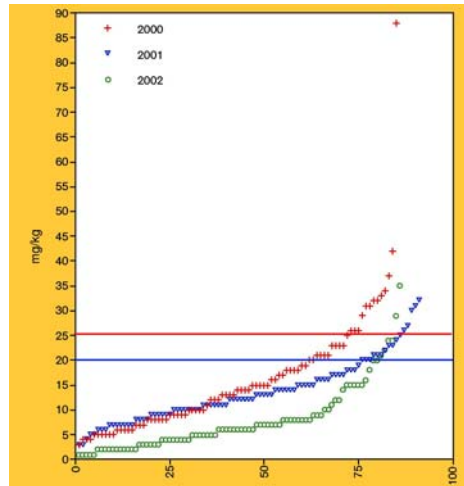
Fuels, January 12 - 13, 2005

Biodiesel Fuels Between Acceptance and Quality



16

Results of surveys (III)



Total contamination
according
E DIN 51606 (20 mg/kg)

Violation of the limits:

year	number of samples	formal errors %	P+ %
2000	85	24,7	14,1
2001	91	14,3	5,5
2002	84	7,1	2,4

P+ = precision data used

Arbeitsgemeinschaft Qualitätsmanagement Biodiesel e.V.

Fuels, January 12 - 13, 2005

Biodiesel Fuels Between Acceptance and Quality



17

Development of technical regulations and laws in Germany (selected)

- Technical regulations for substances hazardous to water for filling stations
issued 2004
- Modified by-law for identification and quality of fuels (including biofuels) [10. BImSchV]
issued 2004
- Development of the permission requirements of water relevant components for filling stations
in the works
- Development of the standard for water/oil separators for a secure work with Biodiesel and other Biofuels
in the works

Arbeitsgemeinschaft Qualitätsmanagement Biodiesel e.V.

Fuels, January 12 - 13, 2005

Biodiesel Fuels Between Acceptance and Quality



18

Summary

- Biodiesel is a highgrade fuel, admittedly with some different properties compared to Diesel – but standard engines are optimized for Diesel...
- To get acceptance is a bilateral process:
 - better adaptation of the engine *and*
 - development of the fuel

Base: stable quality of the „construction element“ fuel

- Use of special Biodiesel properties (e.g. lubricant properties) to improve the fuels of the next generation

Don't lose the synthesis power of the nature and the special properties of FAME!

Arbeitsgemeinschaft Qualitätsmanagement Biodiesel e.V.

Fuels, January 12 - 13, 2005

Biodiesel Fuels Between Acceptance and Quality



19

Contact:

Arbeitsgemeinschaft Qualitätsmanagement Biodiesel e.V.
Reinhardtstraße 18
10117 Berlin
Tel.: +49 (30) 31 90 44 33
Fax: +49 (30) 31 90 44 35
e-Mail: j.haupt@agqm-biodiesel.de

Arbeitsgemeinschaft Qualitätsmanagement Biodiesel e.V.

Fuels, January 12 - 13, 2005

Biodiesel Fuels Between Acceptance and Quality



20