

Reducing Particle and CO₂ Emissions of heavy duty Vehicles by Technology of "In situ variable mixing" of Diesel and Biofuels.

*bioltec's General Approach
and Test Results using Ethanol
by MAN AG, Engine Development, Nürnberg*

Dipl.-Phys. Wolfram Kangler, Head of Development, bioltec systems GmbH



Kurzvorstellung bioltec®

bioltec® at a glance



- bioltec® bietet **Komplettlösungen** zum Betrieb von Diesel-Nutzfahrzeugen und –Aggregaten mit alternativen Treibstoffen
- Gründung 2004, Umsatz 2007: 2,1 Mio Euro
- 100% Eigenkapitalfinanzierung
- Produktentwicklung zu 100% im Hause
- Ingenieurbüro mit verlängerter Werkbank, Vertrieb
- mehrere internationale Patente und Anmeldungen
- automotive-zertifizierte Partner für Produktion
- 3000 umgerüstete Fahrzeuge in Europa (Pöl, Fett)
- ca. 250 zertifizierte Qualitätspartner-Werkstätten in D aller Marken
- international tätig in Österreich, Schweiz, Irland, Spanien, Niederlande, Tschechien
2007: Brasilien
- Innovationspreis Eurocargo 2006
- System mit der höchsten Markenakzeptanz
- bioltec® provides system solutions for operating commercial diesel engines on alternative fuels
- founded 2004, sales 2007: 2.1 Mio Euro
- 100% owned by the partners
- all engineering 100% in house
- production outsourced, salesmen
- several international patents and pending applications
- production at automotive certified partners
- 3000 converted trucks in Europe (PPO, Grease)
- ca. 250 certified Quality Partners (especially trained workshops) in Germany, all major brands
- international activities: Austria, Switzerland, Ireland, Spain, Netherlands, Czech Republic 2007: Brazil
- Innovation award Eurocargo 2006
- broad acceptance of OEM manufacturers

bioltec® - höchsten Marken- und Herstellerakzeptanz
bioltec® - highest level of OEM-approvement



Empfohlenes System / recommended by
MAN (MTBD)



Empfohlenes System von / recommended by
DAF-DVV



Werksnachrüstung von / OEM-supplier of
KOMATSU-Forest



DaimlerGroup-Feldtest
/ partner of DaimlerGroup



Mercedes-Benz



There are different ways to substitute diesel...



- Rape-Oil
on DIN V 51605



- Palm-Oil
- Soy-Oil
- Jatropha-Oil



- Animal Fats (internal recycling-processes)
- Conditioned used grease (biodiesel)



- Bioethanol
- Sugarcane,
- Wood, Straw, etc.
- Maize, Cerals

Diesel is no longer the primary used fuel: Substitution by alternative oil- or grease-based fuels

→ particles PM: – 45%
→ CO2 (regenerative) : – 90%

→ Carbon hydrogens: – 30%
→ Carbon monoxide: – 35%

- Trucks and buses
- Agricultural machinery
- Construction machinery

cost-saving

- Local energy supply/
electric power
- cogeneration plant

regional value creation

- Company-owned vehicle fleets.

**Reducing Emissions by
using Bioethanol as
additive**
→ Particles PM: –60%

- Trucks, buses
- Underground Mining
- Tunneling

reduced emissions

Target- and user-groups

logistics companies
fleet operators
local public transport
disposal companies
city-owned-companies
farming
fuel Producers
construction companies
mining
electricity producers



Businesscase for using alternative fuels depends on:

Total fuel consumption during life cycle of vehicle, additional invest, and cost savings per liter substituted

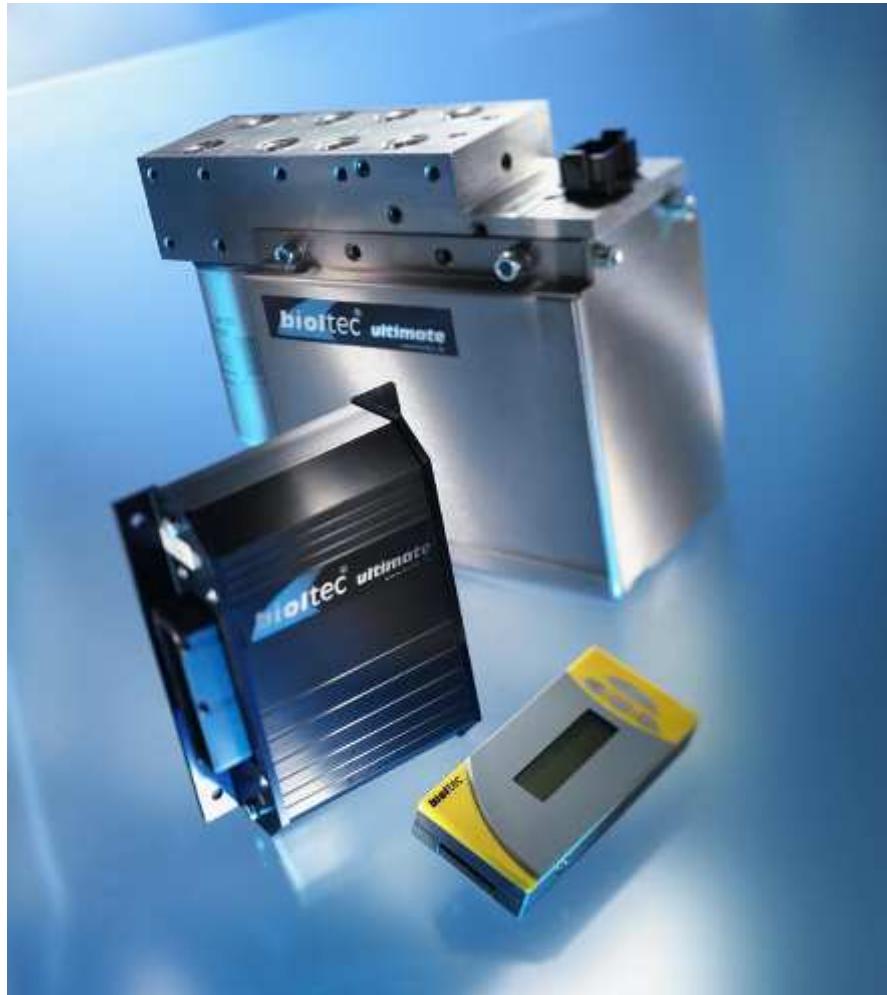
E.g. Heavy duty truck vs. passenger car

| | | |
|---|---------|---------|
| average fuel consumption: litres/100km | 35 | 8 |
| total milage per vehicle: km | 600.000 | 250.000 |
| Total fuel consumption per life: litres | 210.000 | 20.000 |
| netto saving (0,20€/liter) | 42.000€ | 4.000€ |
| CO2 saving (1,6kg/liter) | 336 To | 32 To |

fields of application

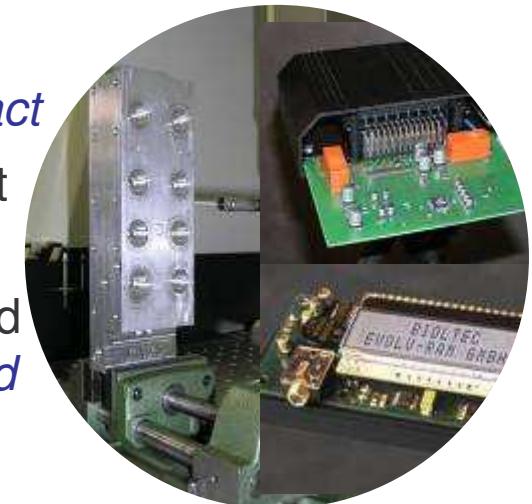
transportation
building trade
passenger traffic/
Internal transporting
agriculture/
forestry
Power generators
cogeneration plant

bioltec®— die einzige vollintegrierte Lösung am Markt
bioltec® - *the sole fully-integrated solution*



bioltec® ULTIMATE

- Vollautomatische Funktion
fully automatic function
- Last- und temperaturabhängige Regelung
load- and temperature-controlled
- Betriebssicherheit durch 2-Tank-Technologie
maximum reliability by bifuel-technology
- Automatische Kraftstoff-Qualitätskontrolle
automatic quality control of fuels
- Modulbauweise
modular and compact
- Parametrisierbarkeit
parameterizable
- Automotive-standard
automotive-standard



bioltec® ermöglicht drastische Emissionsverbesserungen
massive improvements of emissions with bioltec®



Fuel Efficiency Management

- volle **EURO 5** – Kompatibilität
full compatibility to highest emission standards (EURO5)
- **NOx-Sensor** uneingeschränkt nutzbar
full compatibility with Nox-emissions sensors
- nachgewiesene Verbesserung des Gesamtabgasverhaltens:
proved optimization of emissions

Partikel / *particle emissions*: - **45%**

- Einziges Umrüstungssystem weltweit mit nachgewiesener Mutagenitätssenkung um 75% im Vergleich zu Diesel
sole technology worldwide with proved lowering of mutagenicity of emissions by 75% compared to Diesel

Mutagenität / *mutagenicity*: - **75%**

A white document cover with blue text. At the top is the bifa logo (blue dots) and the word "bifa". Below that is "Umweltinstitut" and "Komplettlösungen für Ihren Ertrag". In the center is the title "ERGEBNISBERICHT". At the bottom left is "Thema:" and at the bottom right is "Prüfung der Mutagenität von Inhaltstoffen partikulärer Abgasbestandteile im Ames-Test".



the unique bioltec®-technology
easy to mount – compact - modular



Fuel Efficiency Management



Co-Generation Plant, bioltec® variofuel

TECPAR - Instituto de Tecnologia do
Paraná, Curitiba

... warum also Ethanol mit bioltec®? ...why ethanol with bioltec®?



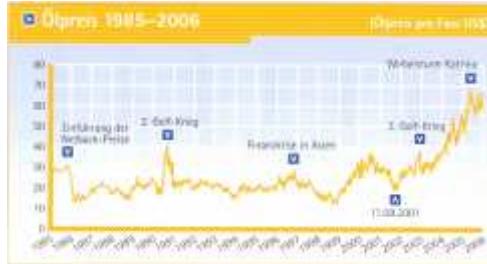
Energy ressources are regionally available



agricultural production



Protects environment
saves CO2-emissions



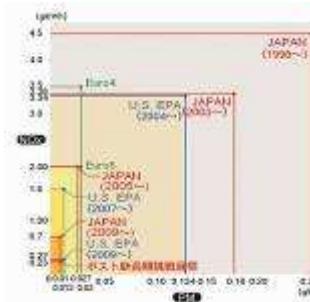
independent from oil chart
... saves money!



gives work locally



technology can be exported



reduces emissions



Technological USP for OEM



independet from oil import



Ethanol + Sauerstoff → Kohlendioxid + Wasser

| Emissionen | |
|--|--|
| 1. Russemissionen: Soot Emissions | ↓ Reduktion der Schwärzungzahl von 11%-70% Bosch number reduced 11% to 70% |
| 2. Partikelemissionen PM particulate Matter | ↓ Reduktion bis zu 46% möglich =Mutagenitätsverbesserung |
| 3. CO | ↓ Reduktion bis zu 28% |
| 4. Stickoxide (NOx) | ↓ Reduktion von bis zu 10% möglich |
| 5. CO2 | ↓ „0“ 80% CO2-neutrale Emission in der Gesamt-Ökobilanz |

- Im Gegensatz zu anderen alternativen Treibstoffen wird Ethanol die Einführung von **EURO6** in Dieselfahrzeugen **unterstützen**.
Ethanol helps to achieve present and coming emission limits!

Former Tests in standard Diesel engines:

20% blend only with additives

fixed blendings of
Ethanol and Diesel



- up to 20% Ethanol blend tested in the 1980s
 - Fazit: Durability of engine is not decreased
 - **Additives are necessary to get a stable emulsion**
 - ➔ Emissions are critial
 - crucial points:
 - **maximum blend at 20%** ➔ should be more
 - phase separation of Diesel/Ethanol in tank
 - Durability tested by DaimlerGroup in Brasil, Volvo, John Deere in USA shows no significant problems due to ethanol.
-
- up to now a general limit at 20% blend was faced
 - additives are necessary which cause corrosive and aggressive emissions
 - additives make the fuel more expensive

E95 in one tank
Scania-Bus



- Scania-Hybrid-Bus presented causing high interest world wide
- **up to now ca. 600 Busse** in Stockholm, 1 in Germany, 1 in Sao Paulo
- engine strongly modified (no operation on Diesel any more)
(Compression 18:1 → 28:1, modified Injectors, modified calibration, sealings and filter exchanged)
- **high costs conferred to Diesel bus**
- **5% - Additiv blending (ignition improver)**
- E95 (containing additives) is a new type of fuel: tax? handling?
- Additives mostly are strongly interfering to health (e.g. 2-Ethyl-Hexyl-Nitrat , Keropur by BASF → causes HNO₃ corrosive to engine and exhaust system)
- ➔ **no sustainability and small range of application but high interest in newspapers and public discussion.**

New development based on bioltec®'s patented technology of variable fuel blends

Technical challenge

bioltec®-solution

Low boiling temperature and high vapour pressure of Ethanol

Cooling, temperature control, separating and condensing modules

Phase separation of Diesel / Ethanol

In situ mixing, apparatus for generating an emulsion with high homogeneity

Maximum of Ethanol during operation

Detecting of load condition and preparing the appropriate blending depending on calibration table

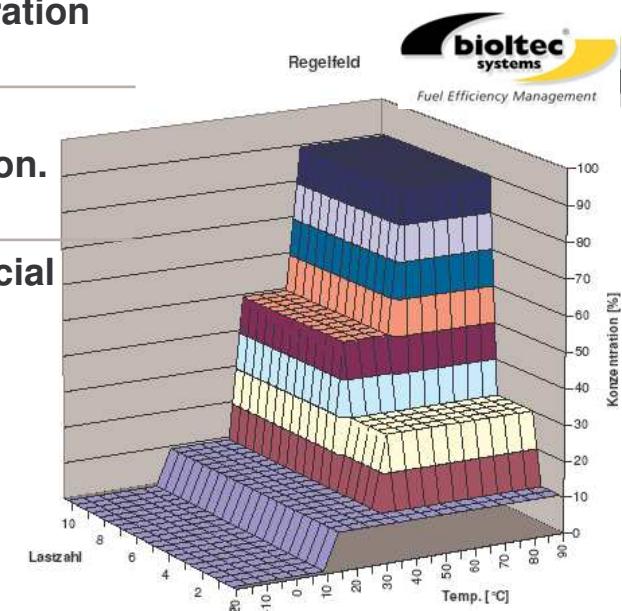
Fitting to type of engine and application

Bioltec® fuel management with bioltec® communication, diagnostics and calibration.

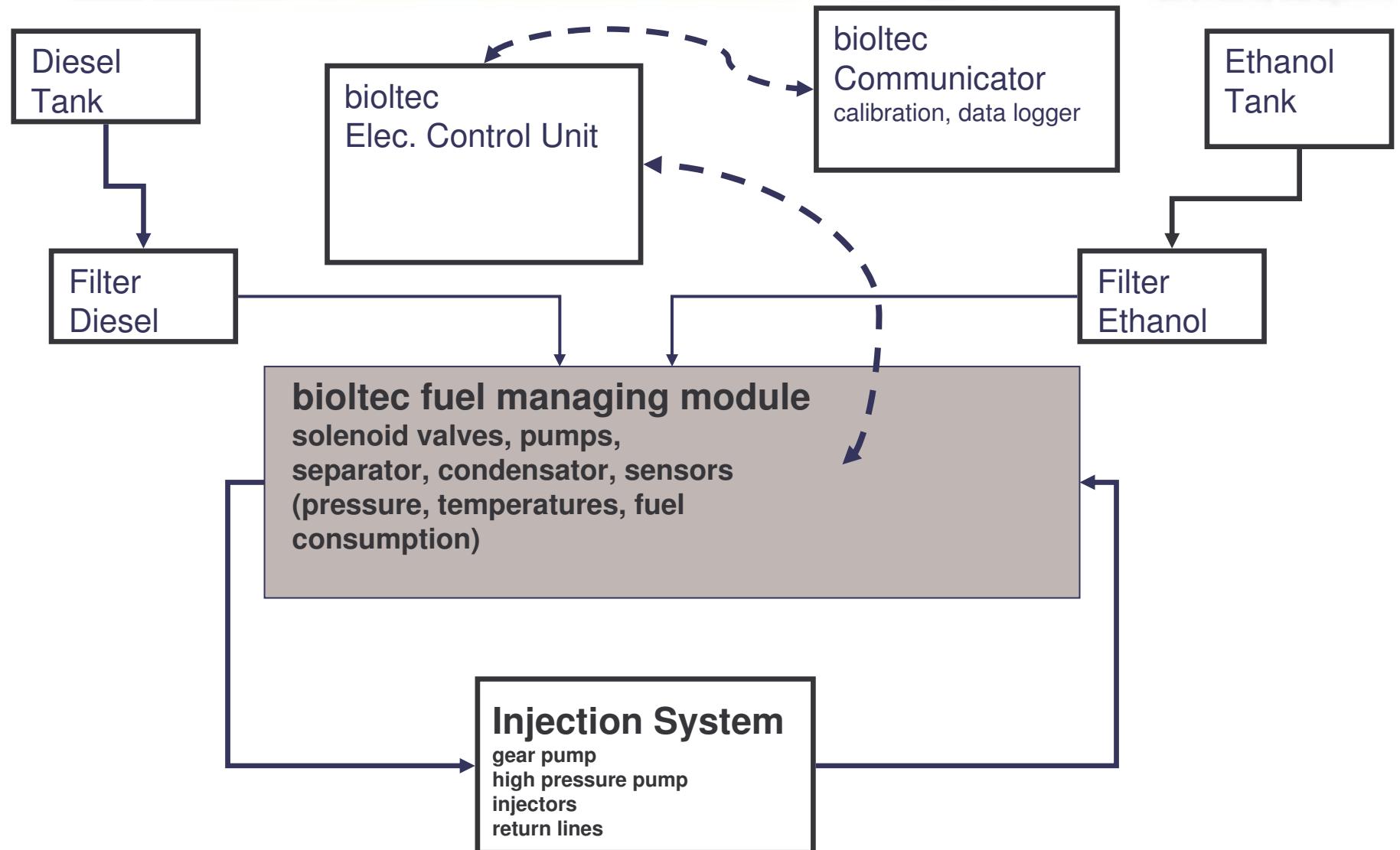
Durability

Bioltec® systems are fabricated with special components.

→ bioltec® prototype series is ready for use



Setup: schematic



konkrete Umsetzung (die bioltec Module) physical realization (bioltec modules)



konkrete Umsetzung (verschiedene Motorenkonzepte)
testing (different injection systems)



**Mercedes W210
E220 CDI**

**Mercedes
Axor 1843**

MAN D20 Euro 4

Sattelzugmaschine

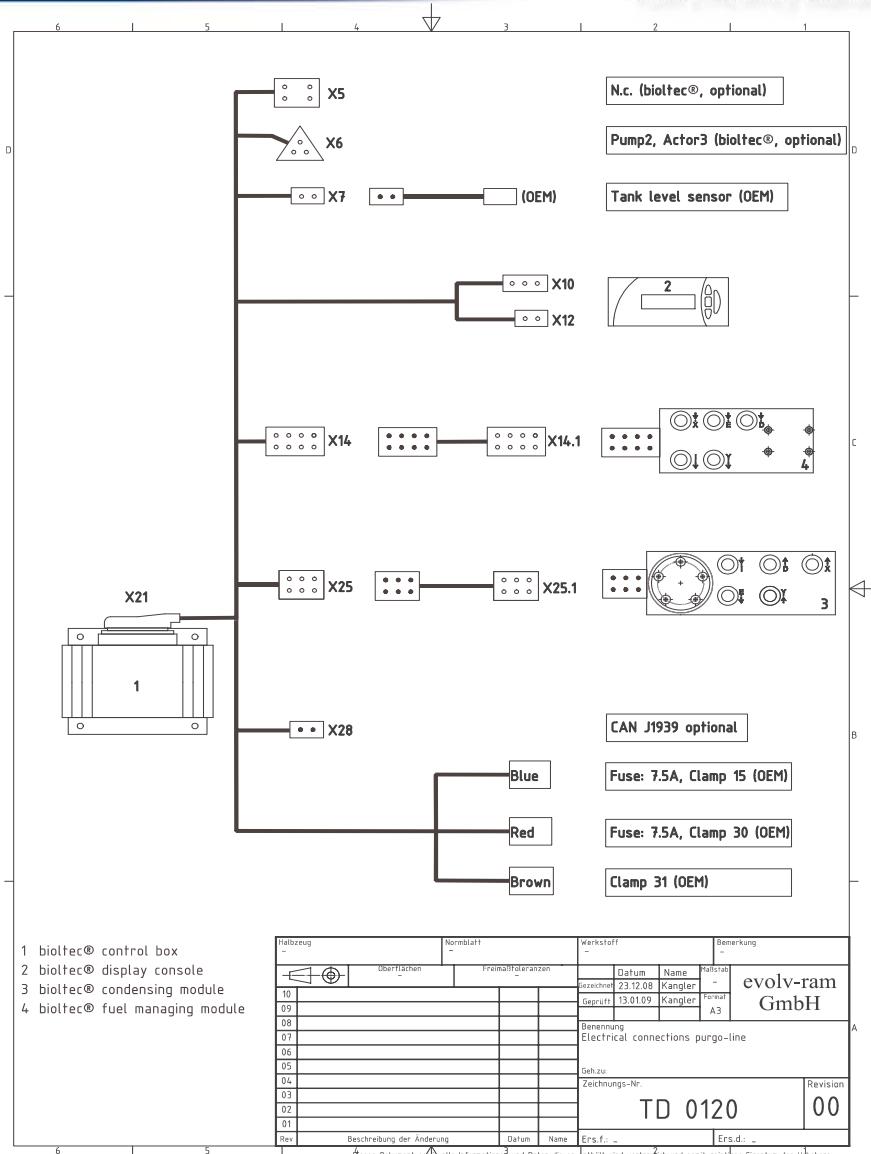
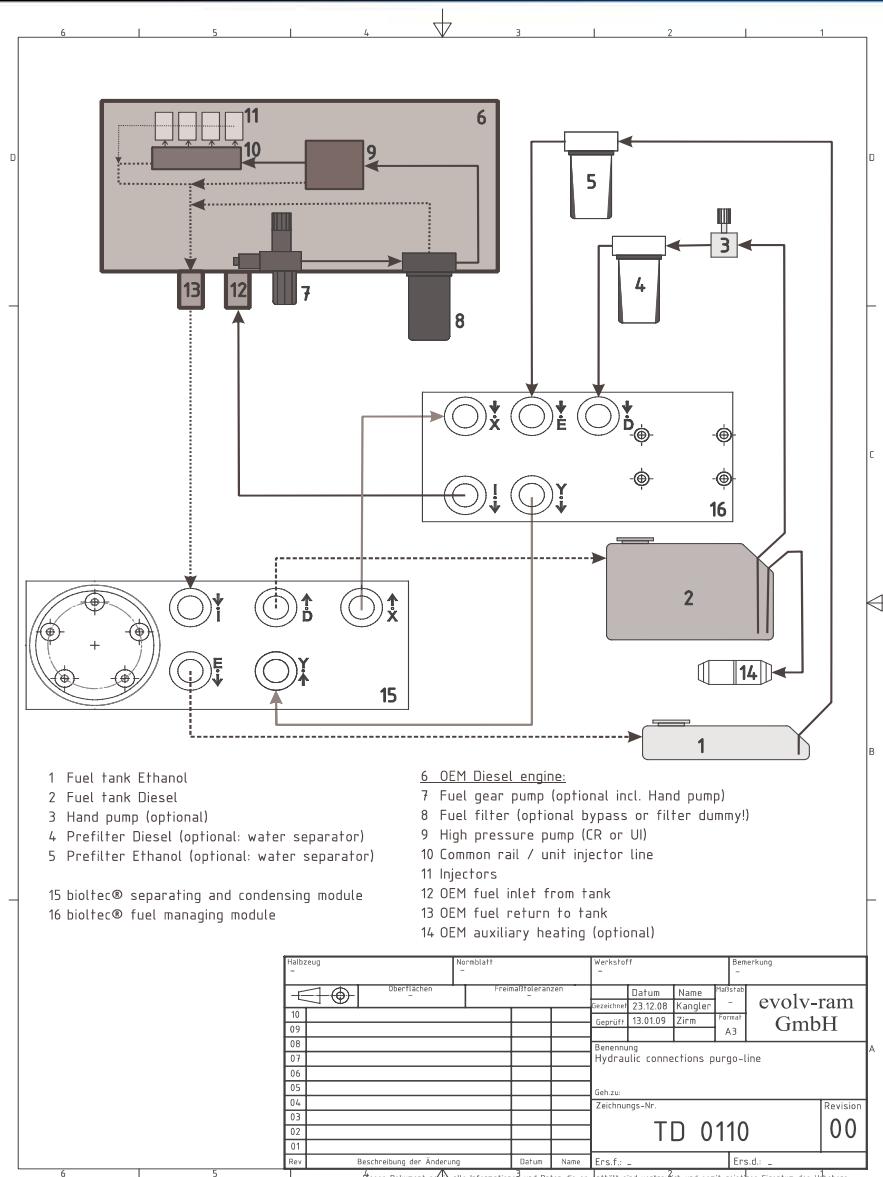
Im realen Strasseneinsatz mit
bis zu 70% E85 getestet



Setup: hydraulic connection



Fuel Efficiency Management





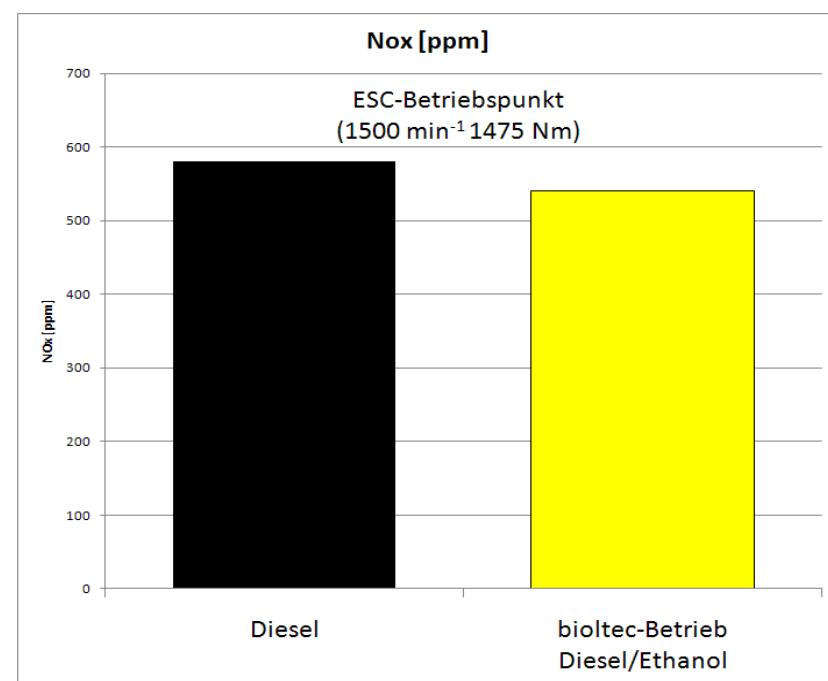
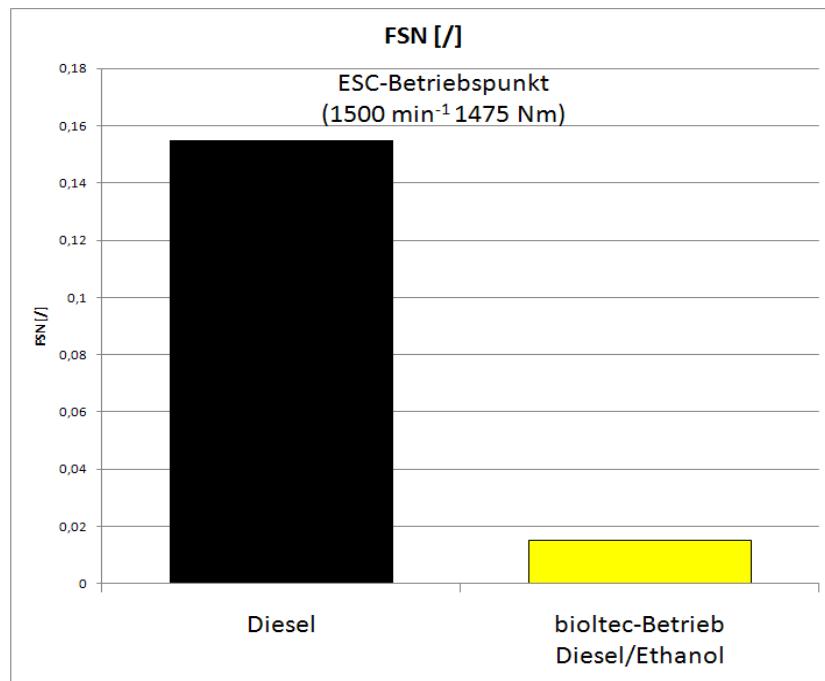
Ethanol als Treibstoffalternative für Dieselmotoren
Ethanol as alternative fuel for Diesel engines

-

Prüfstandsuntersuchungen der MAN AG
mit der bioltec®-Technologie

***Results of dynamometer tests at MAN AG, Nürnberg
with bioltec®-technology***

Untersuchungen mit AGR



Versuchsträger: D2066 LF 31 Euro4 mit 440PS

- Die bioltec-Technologie ermöglicht den Betrieb von Dieselmotoren mit variablen Diesel-Ethanol-Gemischen.
- Betrieb mit *festen* Diesel-Ethanol-Mischungen ist dagegen nicht praktikabel (insbesondere Leerlauf und Niederlastbetrieb).
- Leistungserhalt durch Anpassung der variablen Ethanol-Mischungen durch das bioltec-System möglich
- Die Standard-Einspritzeneinstellungen haben sich auch als optimal für den Diesel-Ethanol-Betrieb mit bioltec-Technologie erwiesen.
- Tendenziell gleiche NOx-Emissionen im Vergleich zum Dieselbetrieb.
- Extrem niedrige Gesamtpartikel-Emissionen im bioltec-Ethanol-Betrieb: drastische Reduzierung der Schwärzungszahl und Halbierung der Partikelmasse



Test engine: D2066 LF 31 Euro4, 440hp

- With bioltec-Technology Diesel engines can be operated on variable Ethanol-Diesel blends.
- Fixed Ethanol-Diesel blends are not suitable (e.g. Idle mode and low load)
- maximum power of engine is achieved by variable Ethanol blends via bioltec System
- Standard calibration of ECU has turned out to be best even for operating with Ethanol via bioltec-technology.
- NOx-Emissions are at the same level conferred to Diesel.
- Extremely low particle matter in bioltec-Ethanol mode: drastically reduced smoke number
- 50% of PM.



bioltec® *Fuel Efficiency Management*

optimizing ecology and economy

bioltec systems GmbH



...bioltec® worldwide



MAN Latin America (at Fenatran, Sao Paulo, 2009)



...bioltec® inside