2nd VegOil

Demonstration of 2nd Generation Vegetable Oil Fuels in Advanced Engines

Workpackage 5

Engine Demonstration

Deliverable N° 5.4:

Test report stage 3B

Publishable summary

Version: 1

Denkendorf, February 29, 2012

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This publication has been produced with financial support of the European Commission in the frame of the FP7 Seventh Framework Programme under the grant agreement N° TREN/FP7EN/219004/"2ndVegOil".

Table of content

List of acronyms

Avg.	Average
DPF	Diesel particle filter
ECU	Engine Control Unit
FRCUMA	Fédération Régionale des CUMA Rhône-Alpes
HCI	Hydrocarbon injection (fuel injected into the exhaust stream for the active re-generation of the DPF)
IBMER	Instytut Budownictwa, Mechanizacji i Elektryfikacji Rolnictwa *(now ITP)*
IBC	Intermediate bulk container
IBDI	regineering, Ingenieurbüro Duft Innerhofer
ITP	Instytut Technologiczno-Przyrodniczy *(formerly IBMER)*
JDWM	John Deere Werke Mannheim
MFDA	Multi Functional Diesel Additive
OPh	Operating hours
PRV	Pressure Relief Valve
PTO	Power Take Off
Q.A.	Quality Assurance
RPM	Revolutions Per Minute
SCRi®	Seclective Catalytic Reduction integrated
SN	Serial number
Std	Standard mode
VWP	Vereinigte Werkstätten für Pflanzenöle
WP	Work package
2G-PVO-RS	2nd Generation – Pure Vegetable Oil – based on Rape Seed oil

1 Summary

- Focus on exhaust after treatment components and durability
- Target to achieve sufficient engine power with diesel and 2G-PVO-RS
- Filter functionality (Milestone 5.5)

2 Test parameters

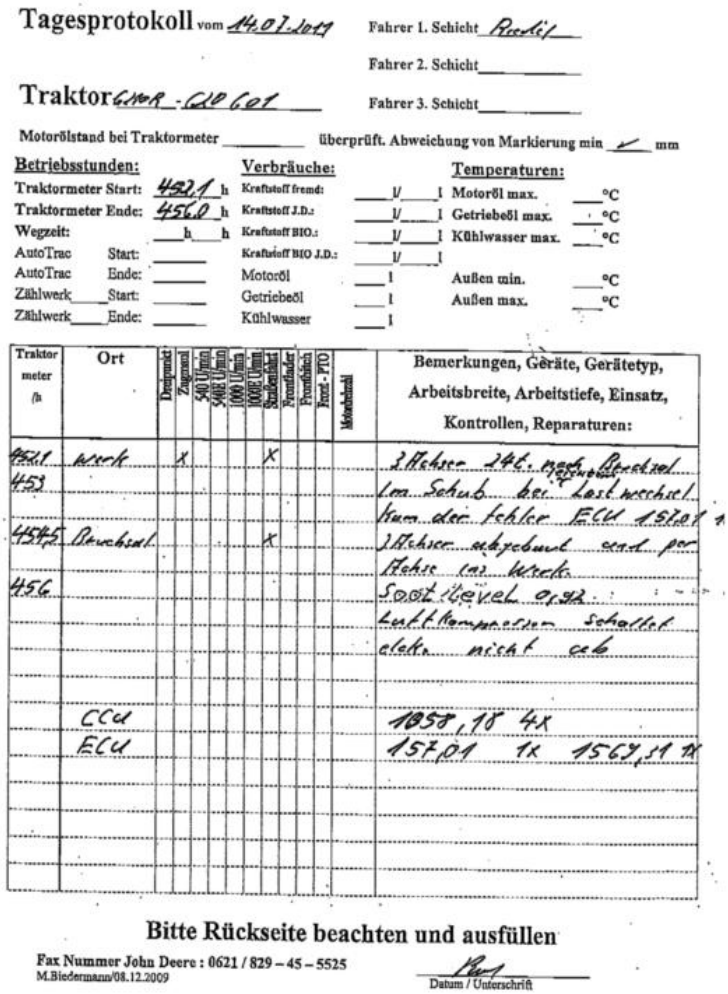
2.1 Testing environment

For testing the converted vegetable oil capable tractors, a stationary dynamometer in a fully instrumented test cell was used, as well as a mobile PTO dynamometer.
The stationary dynamometer (Schorch DQ7319X) can brake up to 3100 Nm at speeds from 132 to 2667 rpm, with a maximum power of 480 kW. In the test cell, all relevant engine parameters are recorded via John Deere internal monitoring software. Tested tractors are also instrumented with additional sensors which are monitored by the test cell control and information system.
The mobile PTO dynamometer (PPC 2000 by Technical Training Equipment) was used due to capacity constraints. It runs up to 3500 rpm with a maximum torque of 2300 Nm at 1000 rpm. Its maximum power is 340 kW.

2.2 Documentation

2.2.1 Logbooks

For documentation of the tractor field testing activities, the JD internal documentation system was used. All activities, fuel consumption, failure codes (DTC) et cetera were documented by the tractor operators on a daily basis. Workshop activities are also listed in these logbooks. The logbook entries are filed to a database daily and can be retrieved for various reports afterwards.



Tagesprotokoll vom 14.07.2011 Fahrer 1. Schicht Riedl

Fahrer 2. Schicht

Traktor 6140R - 620601 Fahrer 3. Schicht

Motorölstand bei Traktormeter _____ überprüft. Abweichung von Markierung min ✓ mm

Betriebsstunden:		Verbräuche:		Temperaturen:	
Traktormeter Start:	452.1 h	Kraftstoff fremd:	___l/___l	Motoröl max.	___°C
Traktormeter Ende:	456.0 h	Kraftstoff J.D.:	___l/___l	Getriebeöl max.	___°C
Wegzeit:	___h___h	Kraftstoff BIO.:	___l/___l	Kühlwasser max.	___°C
AutoTrac Start:	_____	Kraftstoff BIO J.D.:	___l/___l		
AutoTrac Ende:	_____	Motoröl	___l	Außen min.	___°C
Zählwerk Start:	_____	Getriebeöl	___l	Außen max.	___°C
Zählwerk Ende:	_____	Kühlwasser	___l		

Traktor meter /h	Ort	Dreipunkt	Zugpendel	540 U/min	540E U/min	1000 U/min	1000E U/min	Stabilisator	Frontlader	Frontlifter	Front - PTO	Motoröl	Bemerkungen, Geräte, Gerätetyp, Arbeitsbreite, Arbeitstiefe, Einsatz, Kontrollen, Reparaturen:
452,1	werk		X					X					2 Achsen 24t. mech. Bremsventil
453													im Schub bei Lastwechsel
													kann der fehler ECU 157.01
454,5	Reifenwechsel							X					1 Achse abgebaut und per
													Achse zur Werk
456													Soot level 0,92
													Luftkompressor schaltet
													elektr. nicht ab
	CCU												1058,18 4x
	ECU												157.01 1x 1567,19 1x

Bitte Rückseite beachten und ausfüllen

Fax Nummer John Deere : 0621 / 829 – 45 – 5525
M.Biedermann/08.12.2009

Datum / Unterschrift

Figure 1 Example of a logbook sheet (JD field test department)

2.3 Test tractor ID-17

The tractor L06210RT9P620601 was converted for vegetable oil fuel as described in Deliverable No 5.3. The power curves are displayed in chapter 3.2.

2.4 Test planning

For the stage 3B engine demonstration the tractor was operated by the JD field test department. It was utilized for different field work and also checked on the PTO dynamometer. These checks were also used to evaluate and improve the regeneration of the DPF system with vegetable oil fuel.

3 Test results

3.1 Statistics

Table: field test data ID-17 (May 2011– August 2011)

Tractor:	JD 6210R, ID-17, L06210RT9P620601
Partner, operator:	ETIC, JDWM
OPh in field test:	244 h
Documentation of OP modes:	244 h (100%)
Avg. load level:	60% (in percentage of mode 1-15 OP hours)
Balancing of load:	0% Low load 63% Mid load 27% High load 9% mode 16 (in percentage of total documented OP hours in field test)
Tested fuels:	RS: 3468 l DK: 100 l
Fuel consumption:	15 l/OPh
Tested fuel additive:	JD Biodiesel Protect 100
Tested engine lubricant:	E9

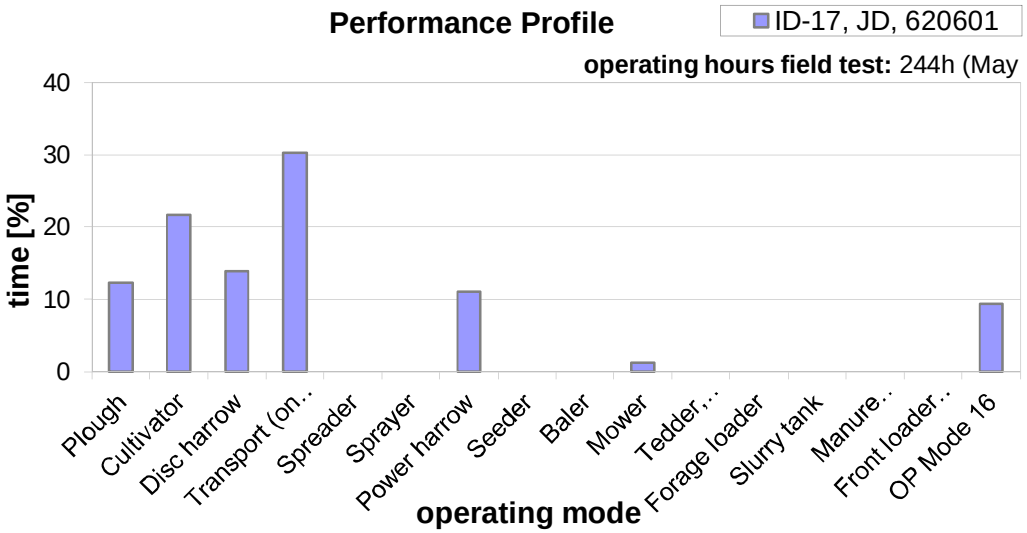


Figure 2 Performance profile of tractor L06210RT9P620601

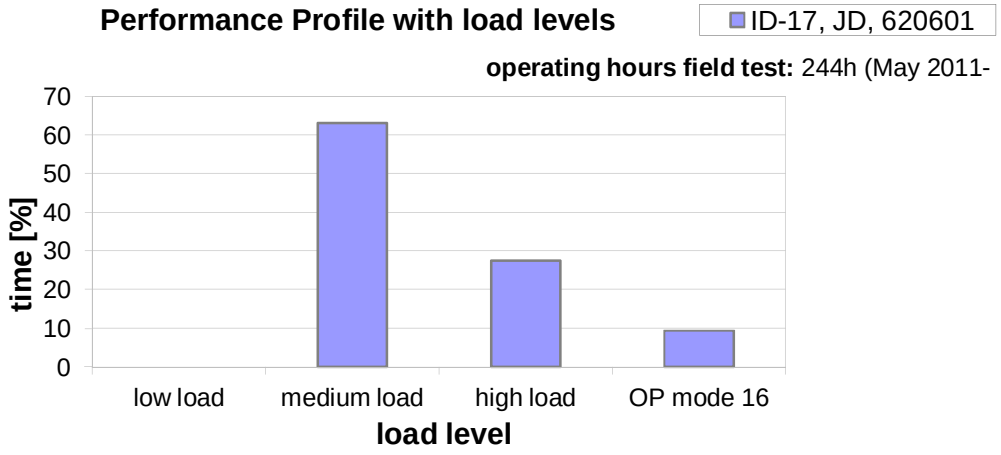


Figure 3 **Load levels of tractor L06210RT9P620601**

3.2 PTO results

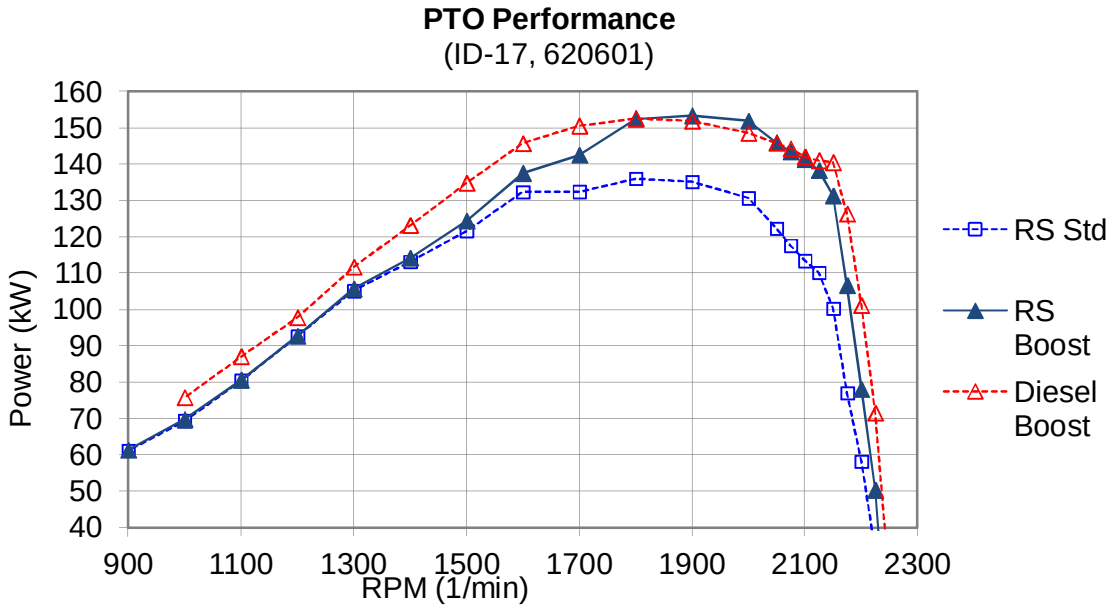


Figure 4 **PTO performance of 620601 with diesel and 2G-PVO-RS**

3.3 Special monitoring during field test

During the stage 3B field test some special monitoring measures were taken to evaluate the different stages of the engine development. A data logger was installed which stored all available CANbus messages during tractor operation. Additionally installed thermocouples in the exhaust system and HCI fuel system helped to characterize the different stages of the stage 3B vegetable oil engine development and improvement, especially regarding the DPF regeneration. After each regeneration the DOC and DPF were also monitored visually with an endoscope. The monitoring showed that after a few regenerations unburned vegetable oil

had accumulated on a protection shield in front of the DOC, as well as on the DOC itself. This could be removed by high load (high temperature) operation in front of the PTO dynamometer for approximately 2.5 hours.

4 Conclusion and outlook

The field tests showed that there are significant differences between the engine component temperatures in the test cell and on the tractor. Therefore the technology developed in the test cell needs to be tested and further improved, maybe even redesigned for engines used under real conditions.

During the field test and engine demonstration described above the problems with the low pressure fuel supply system could be solved by a simple mechanical measure. Its effectiveness needs to further be evaluated under cold conditions.

The active DPF regeneration requires further modifications for vegetable oil fuel. The next emission stage 4 will be introduced in 2014, which means that the current DOC/DPF technology is still about to be changed. Therefore it was considered not to further work on the DPF regeneration with vegetable oil fuel, as the whole system is still due to changes. Instead the next step was approached and an SCR system installed on the stage 3B tractor to build the first stage 4 vegetable oil tractor prototype. This work will be discussed in the 2nd VegOil deliverable No 5.6.