

2nd VegOil

Demonstration of 2nd Generation Vegetable Oil Fuels in Advanced Engines

Workpackage 5 Engine Demonstration

Deliverable N° 5.5: One stage 4 compliant demonstration vehicle

Publishable summary

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List of acronyms

DOC	Diesel Oxidation Catalyst
DPF	Diesel Particle Filter
ECU	Engine Control Unit
FLRS	Full load rated speed
HCI	Hydro Carbon Injection
JD	John Deere
JDWM	John Deere Werke Mannheim
SCRi	Selective Catalytic Reduction
SCRi®	Selective Catalytic Reduction integrated
S/N	Serial Number
VWP	Vereinigte Werkstätten für Pflanzenöltechnologie

RS, RO, 2G-PVO-RS 2nd Generation – Pure Vegetable Oil – based on Rape Seed Oil





1 Summary

Based on one JD tractor, which was converted to EU stage 3B, the stage 4 conversion was developed. The aim was to reach emission limits according EU stage 4 while running on 2nd Generation Vegetable Oils.

Therefore the existing 3B tractor was modified. Finally power curves were measured at John Deer test stands to check the engine performance of the stage 4 version as well.

Compared with the Euro stage 3B version, the stage 4 conversion includes a Selective Catalytic Reduction (SCR) system as well as an update in terms of ECU software for 2ndVegOil usage additionally. Furthermore the preheating system for the use of 2ndVegOil differs slightly from the 3B version.

The tractor was operated exclusively by John Deere in Mannheim.



2 Conversion of the tractor

The mechanical conversion to stage 4 is based on the 3B version. Therefore the description of 3B conversion was added with stage 4 relevant information as follows.

The tractor was converted to run with vegetable oils by VWP at the John Deere Werke Mannheim. Several non standard units had to be implemented or changed, like preheating system, ECU software, fuel lines, fuel filters and fuel pressure pumps.



Figure 1: JD tractor, converted to Euro stage 3B and 4

2.1 Preheating system

A new preheating control unit was developed for the 3B engine conversion. Now the complete fuel preheating system is integrated in only one device. Hence benefits results of having less wiring efforts with less sources of error. The system could be used for stage 4 version as well.

preheating
activate
button with
control
lamp



Figure 2: cockpit of the stage 3B and 4 tractor, steering wheel panel



Figure 3: Mr. Dotzer (VWP) installing the preheating controller

2.2 Engine control software

One of the main functions of the engine control unit (ECU) is to control the fuel injection in terms of timing and amount. To perform on high power levels and modern emission levels it is indispensably to modify the engine software too. The development of ECU software is one of VWP's core competencies. An ECU software update had to be done for the stage 4 conversion.



Figure 4: multi functional display and control panel, right side of driver seat

2.3 Fuel lines

Due to its physical characteristics, pure plant oils (PPO) as 2ndVegOil need partly fuel lines of enlarged diameters compared to diesel fuel lines. Additionally the stage 3B and 4 engine needs fuel for the regeneration of the DPF. Due to the complexity and interactions between the engine and DPF system, initially only diesel fuel was injected for DPF regeneration purposes (HCI unit). Hence an additional fuel tank was installed on the converted stage 3B tractor. So the engine can be tested either with diesel or 2ndVegOil during the DPF regeneration.

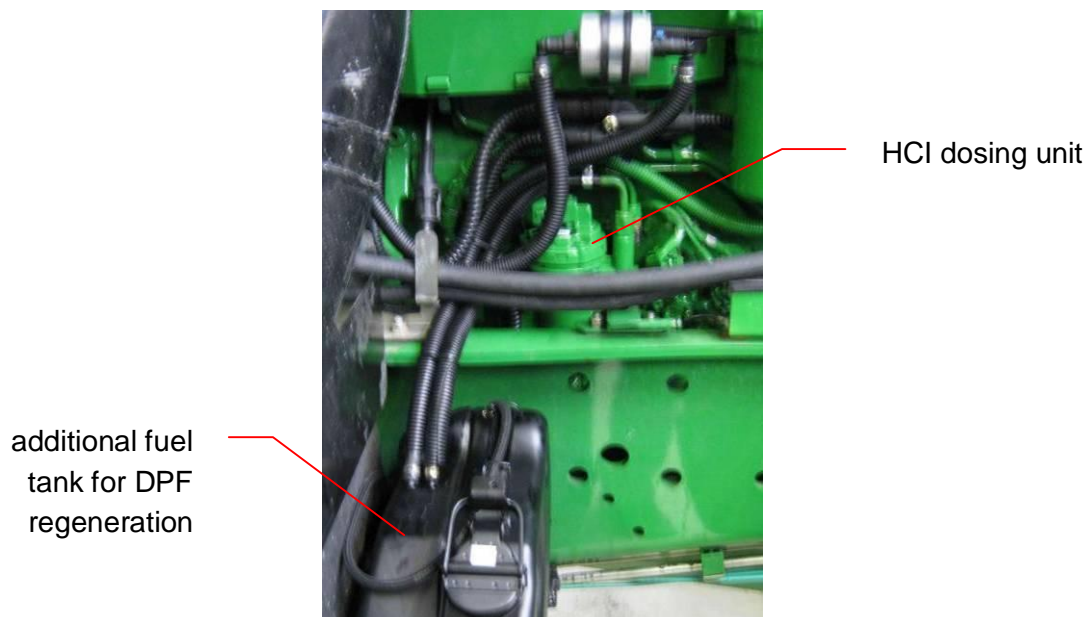


Figure 5: additional fuel tank, right side of the tractor

2.4 Fuel filters

There are two fuel filter elements. The low pressure fuel pump contains a fuel filter element, which is not appropriate for the use of 2G-PVOs. It had to be removed and displaced by a filter with more filter area. Therefore an adapter was soldered to the fuel pump. The main parts of the fuel pump are an electric motor with fuel pump, a filter mesh and its housing.



Figure 6: pre pressurization pump with pre fuel filter, mounted in front of the engine air cooler (concerted stage 3B and 4 tractor)



Figure 7: main fuel filter, mounted left side of the tractor



Figure 8: tractor engine oil filters



3 Validation and verification

3.1 Power and torque measurements

The measured full load of the Euro stage 4 converted engine will be measured during the field test. The results will be reported in deliverable D5.6.

3.2 Emission tests

The emissions of the Euro stage 4 converted engine will be measured during the field test. The results will be reported in deliverable D5.6.





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