

Poznan University of Technology
Division of Internal Combustion Engines

REPORT

CO₂ emission research in dual fuel Scania R450 Euro 6

Research done under the direction of:

Professor Jerzy Merkisz D.Sc., Eng.

Poznan, October 2013

Listing of abbreviations and designations:

ASC – Ammonia Selective Catalyst

CO₂ – carbon oxides

DOC – Diesel Oxidation Catalyst

DPF – Diesel Particulate Filter

EGR – Exhaust Gas Recirculation

Euro – European provisions for toxicity of exhaust gases

GPS – Global Positioning System

LPG – Liquefied Petroleum Gas

NDIR – Non-Dispersive Infrared

PEMS – Portable Emissions Measurement System

SCR – Selective Gas Reduction

Table of contents

Listing of abbreviations and designations: 2

1. Research Methodology 4

 1.1. Characteristics of the measuring stretch..... 4

 1.2. The test vehicle..... 4

 1.3. Apparatus used for the research 5

2. Measurements 7

3. Conclusions 8

1. Research Methodology

1.1. Characteristics of the research road stretch

CO₂ emission research has been done at the road stretch, with total length of 56 km (Figure 1). The research started and ended on national road no. 11 (droga krajowa nr. 11) at the entrance to Poznan in the direction of Katowice. The main criterion of selected measuring stretch was ability to conduct the research in circumstances mapping urban, non-urban and highway driving. Urban driving was realized in Kórnik. Non-urban driving was realized partly on the national road no. 11 (droga krajowa nr. 11) and provincial road no. 434 (droga wojewódzka nr. 434). Highway driving was realized on the stretch of expressway no. 11 (droga ekspresowa nr. 11). Such a measuring stretch is mapping the daily route covered by trucks designed for long-distance freight.

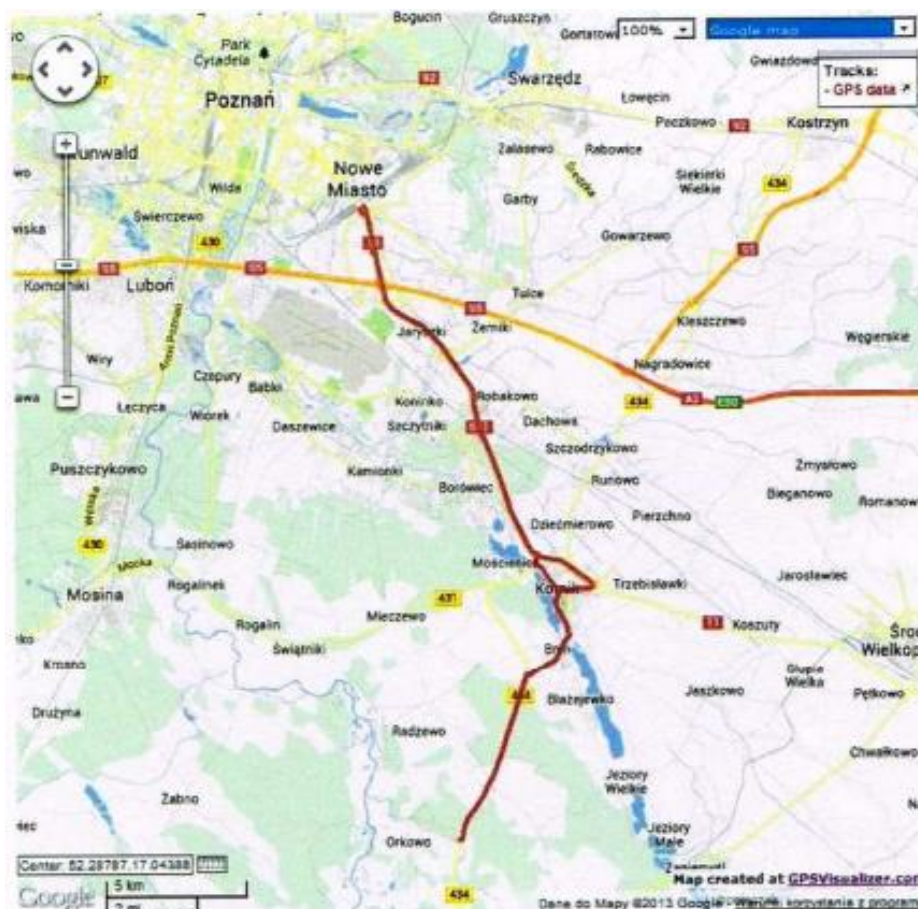


Figure 1. The measuring stretch used to research

1.2. The test vehicle

The object of the research was a tractor-trailer Scania R450 (Figure 2) with 4x2 axle configuration (Table 1). The vehicle has an internal combustion engine with a power of 331 kW (450 HP), that generates a 2350 Nm torque, meeting the EURO VI standard. The vehicle has advanced exhaust gases purification system, which includes EGR, DOC, DPF, 2 SCRs and 2 ASCs.

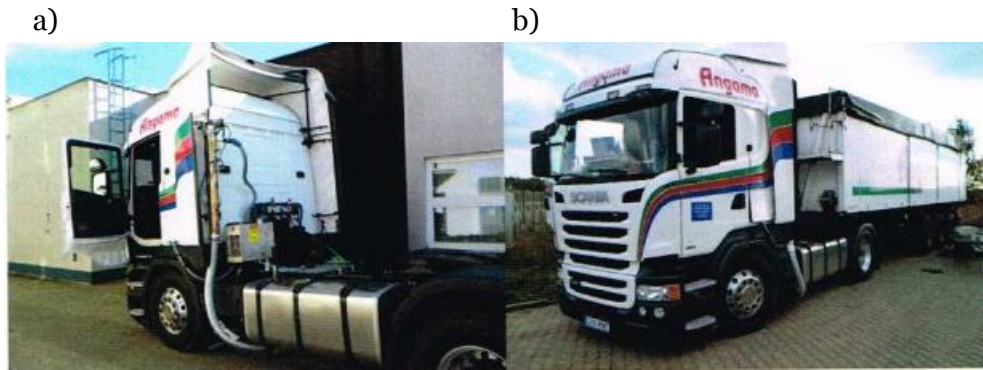


Figure 2. The vehicle used for research during: a) installation of research apparatus, b) measurements of CO₂ emissions in road conditions

Table 1.

Parameter	Value
Engine capacity	12,7 dm ³
Number/arrangement of cylinders	6/straight
Maximum power	331 kW @ 1900 RPM
Maximum torque	2350 Nm at 1000 ÷ 1300 RPM
Emission standard	Euro VI
Exhaust gases purification systems	EGR, SCR, DOC, DPF, ASC
Gearbox	Automatic 12+1
Tractor axle configuration	4x2
LPG injection system	SOLARIS DIESEL

In addition, the vehicle is LPG converted with Solaris Diesel (Figure 3). Gas injection was carried into intake manifold (between the air filter and turbocharger compressor) using two injectors. LPG tank has been placed in the location of the standard tank.

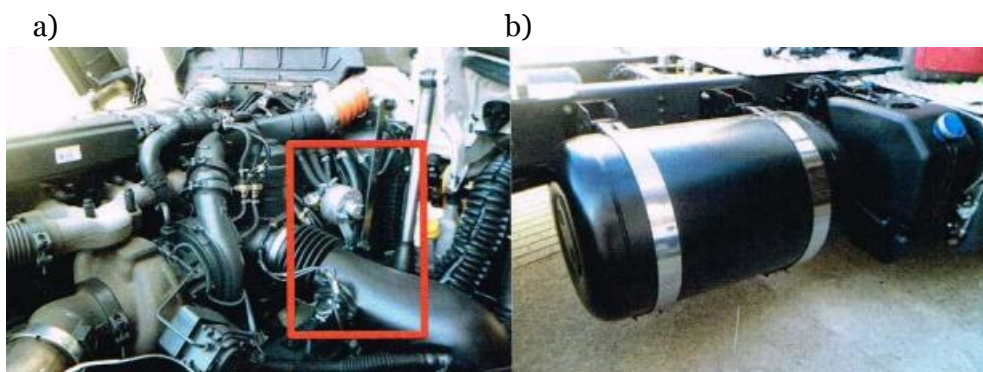


Figure 3. LPG conversion system used in the vehicle: a) evaporator with the injectors (marked with red frame), b) LPG tank

1.3. Apparatus used for the research

For the measurement of fuel consumption and CO₂ emissions was used mobile instrument SEMTECH DS from PEMS group (Figure 4). Measuring the concentration of CO₂ was made using NDIR analyzer. CO₂ concentration range is 0-20% (accuracy ±3%). The instrument had its own meteorological station allowing measuring pressure, temperature and humidity. The instrument also had GPS and enabled communication with vehicle diagnostic system. Measurement of the mass flow of

exhaust gases was done by using the flowmeter operating on the principle of Pitot tube with a diameter of 5”.



Figure 4. SEMTECH DS (a) and a flowmeter to measure the mass flow of exhaust gases installed in exhaust system of the test vehicle (b)

2. Measurements

Below CO₂ road emissions results are shown, which were obtained during the research, in two configurations:

- a) Engine powered by Diesel
- b) Engine powered by mix of Diesel and LPG

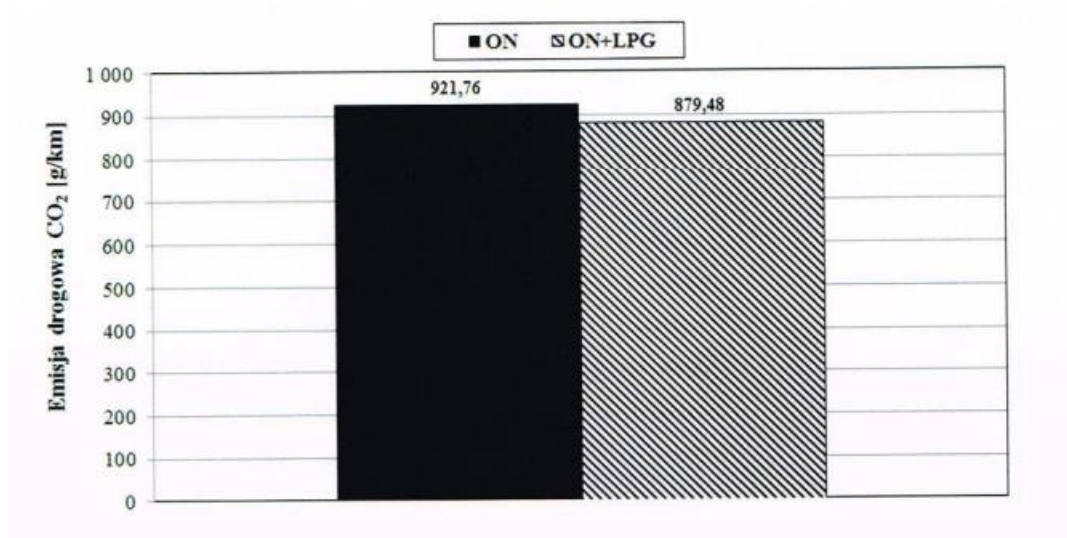


Figure 5. Values of the emission of CO₂ obtained during the measurement

3. Conclusions

On the basis of conducted research the fuel consumption obtained from measurements has been indicated (figure 6). Vehicle running on Diesel had a 5% higher fuel consumption than vehicle running on a mix of Diesel and LPG.

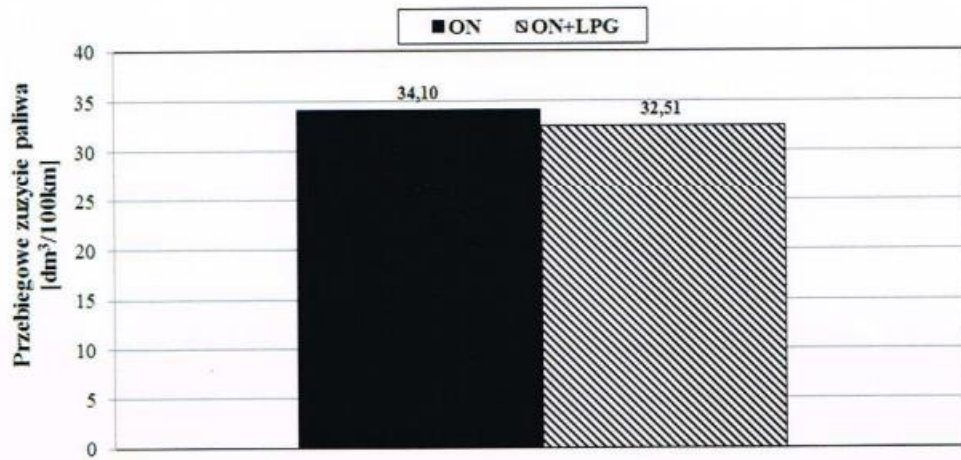


Figure 6. Values of mileage fuel consumption obtained during the measurement