TRACTOR ENGINE MODES SETTINGS AND THEIR INFLUENCE ON OPERATION ECONOMY

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ABSTRACT

Main goal of this work was to measure fuel consumption of tractor engine in various engine RPM. Measurement was carried out on CASE IH Puma 225 CVX tractor with aggregation with Agrimega 250 fully loaded semitrailer. Measurement was realized on road infrastructure in traffic flow close by Hustopeče city. Achieved results showed significant influence in settings of tractor engine mode on its fuel consumption. Also proper settings of engine mode have considerable effect on operation economy of used machine.

Key words: fuel consumption, engine RPM, engine performance

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INTRODUCTION

Tractor is fundamental energetic and transport instrument in agriculture. Tractor aggregation with agricultural machinery significantly affects performance-energy parameters of carried out operations. Nowadays technological trends leads to growth of carried out operations performance with labor productivity increase in order to comply with agronomics deadlines. These requirements require user's knowledge of the tractors and fuctional nodes of the machine. Without this knowledge, efficiency of machine operation couldn´t be reached. High performance and low fuel consumption are main parameters of efficiency of machine operations. In the acquisition of new machinery, fuel consumption is main criterion.(Bauer F. 2013, Syrový O. 2008)

Main goal of this work is to review influence of engine RPM settings and fuel consumption at various loading conditions.

MATERIAL AND METHODS

CASE IH PUMA 225 CVX tractor was used for above described experiment. Used tractor is shown in Figure.1. Semitrailer Agrimega 250 is shown in Figure.2. Semitrailer was loaded with gravel of total mass 16 000kg. Measurement was realized on road infrastructure in traffic flow close by Hustopeče city. During the measurement traffic rules were observed.

Measurement was separated into 4(8) sections. These sections formed the test circuit. Each circuit was measured with different setting of engine RPM. In total, 5 options were measured:

- Option no.1 : Without engine RPM limitations
- Option no.2 : Maximum engine RPM limited on 1900
- Option no.3 : Maximum engine RPM limited on 1500
- Option no.4 : Engine RPM range - 1450 – 1900
- Option no.5 : Engine RPM range - 1400 – 1600

Technical parameters of CASE IH PUMA 225 CVX:

Tractor manufacturer: Case IH, model: Puma 225 CVX, tractor number: ZABH52110, year of manufacture: 2010, engine running hours: 1250.

Engine: 6 cylinder with turbocharger, water cooled, Common Rail fuel system, engine displacement 6724 cm^3, nominal power ECE R120 169 kW, with Power Management 185 kW, maximum torque 950 [N.m], with Power Management 1025 [N.m].

Transmission: CVT, 4x4 live axle with spring suspension

Fig. 1 CASE IH PUMA 225CVX

Technical parameters of Agrimega 250 semitrailer:

Vehicle type: NS25, manufacturer: ZDT s.r.o. Nové Veselí, type of construction: chassis with removable extensions. Number of axles: 3, steering axles 2 – trailing. Total mass 25 000 kg, load capacity 20 550 kg.

Fig.2 Agrimega 250 semitrailer

All measured data were collected from CAN – BUS. All data were processed on external computer in LabVIEW 2012 environment produced by National Instrument Company. During measurement sampling frequency of 10 Hz was used.

Tractor weighing:

Tractor weighing was realized on level-road weight. First, the tractor was weighted, after that tractor and semitrailer was weighed with and without cargo.

Tab. 1:Wweight of tractor, semitrailer, cargo, total weight

Component	Weight (kg)
Tractor	8500
Semitrailer with cargo	24040
Cargo	16000
Total weight	32540

RESULT AND DISCUSSION

The lowest fuel consumption was reached with option no.5 – fig.3 Value of fuel consumption reach 13,03 l. Low amount of fuel consumption was reached also with option no.3. At this option fuel consumption reached value of 13,20 l per circuit.

The highest value of fuel consumption was reached with option no.2. In this case engine RPM was limited on 1900 RPM. Average fuel consumption in this case reached value of 14,22 l per measured circuit.

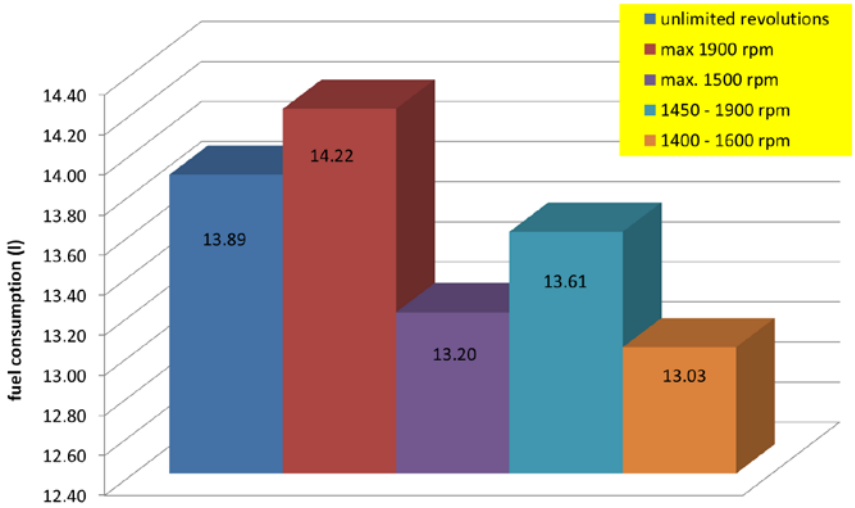

Fig.3 Fuel consumption per circuit – all options

If we examine difference between lowest and highest value of average fuel consumption, result is 2,99 $l.h^{-1}$. With average price 36,50 Kč per 1 liter of diesel fuel, financial difference is 109 Kč per hour. This shows fact that right choice of engine mode can save fuel. For example of 8 tractor´s working hours, financial savings will be 873 Kč per day.

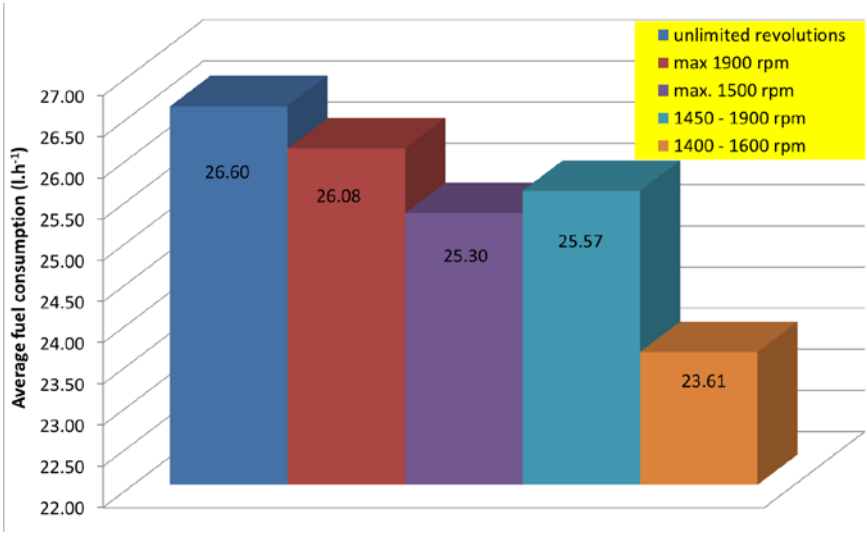

Fig.4 Fuel consumption in liters per hours of all options

Measurement confirmed observed phenomenon. A setting of engine RPM range has considerable influence on fuel consumption. Differences in fuel consumption have significant financial impact. Lowest value of fuel consumption can be achieved in specific engine mode. At this mode engine operates in area of highest value of engine torque. In this mode, lowest fuel consumption is achieved but maximum engine power isn´t reached. This cause declining of transport performance, however transport performance decrease is almost negligible. (Novák P. 2010)

CONCLUSION

Results of measurement show fact that tractor operator should know all optional settings of engine modes. In the acquisition of new machinery, fuel consumption is main criterion. Fuel consumption significantly affects operating costs of the machine. Besides operating costs, fuel consumption is closely related with amount of produced emissions. Amount of exhaust gases, which could be emitted by tractor engine, is strictly legislatively limited. Due to this fact, engine manufacturers are forced to invent new technologies for reducing of exhaust gases. Modern tractor engine is equipped by range of systems for gas exhaust reduction for adherence to legislative regulations determined by Economic commission of Europe. One of the solutions is electronic engine management. This system effectively reduces fuel consumption and inevitably emissions production. Lower fuel consumption brings not only inferior emissions production but also lowering of greenhouse gas CO2 which is product of complete combustion.

REFERENCES

Bauer, František. *Traktory a jejich využití.* Praha : Profi Press, 2013. 978-80-86726-52-6.

Syrový , Otakar. *Doprava v zemědělství.* Praha : Profi Press, 2008. 978-80-86726-30-4.

Novák, Pavel, 2010, *Využití palubních počítačů pro stanovení parametrů traktorových souprav. Disertační práce (*nepubl., dep. knihovna MENDELU v Brně), MENDELU v Brně, Brno, 147 s.