TEKA Kom. Mot. i Energ. Roln. – OL PAN, 2011, 11c, 216–222

POSSIBILITIES OF APPLICATION OF MODERN SI ENGINES IN AGRICULTURE

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Summary. In the article the development of modern engines witrh spark ignition has been presented based on theiroperational parameters. Comparison with the parameters of modern engines used in agriculture has been conducted and based on the usefulness of evaluated engines has been determined.

Key words: engine, operation parameters.

INTODUCTION

Flexibility of combustion engine says aboutits ability to adapt to variable loading and rotational speed. For traction engines it is very import ant rating in regard to their operational possibilities. Great intensity of road traffic forces the use of engines intendent for automotive vehicles with large mass, which can influence on reduction of movement's smoothness as a results of slight elasticity of the engine. Numericalterm for engines elasticity coefficient. It can be determined based on the external characteristic of engine [1,2], in the way presented below :

$$E = e_M e_n = \frac{M_{o\max}}{M_N} \frac{n_N}{n_{Mo\max}}, \tag{1}$$

gdzie: e_M – elasticity of rotational moment,
e_n - extension of rotational speed,
M_{omax} - maximal rotational moment engine,
M_N - rotational moment suitable for nominal power,
n_{Momax} - rotational Speer of the Maxima rotational power,
n_N - nominal rotational speed.

The first module of the product presents the elasticity of the rotational moment and it depends on the curie of the engine's rotation moment. The course depends on such factors as : characteristic parameters of approaching arrangement, characteristic of camschaft, characteristic of power supply arrangement. Trough the change of above mentioned parameters we can influence the course of the rotational moment's curves in the direction desired by the user, in order to make the engine well

adapted to carry out its tasks. Particulare in concerns the engines in agricultural applications. The way of improvement's realization of the elasticity of the rotational moment depends on executive possibilities and analisis of probability of a given solution in case of specific engine.

The possibilities of changing the second module of the product are closely related to the changes of the first module and it depends on dislocation of position of the maximum of the rotational moment curve. From the position of that maximum depends the extension of rotational speed and influencing it we can control the engine's elasticity effectively. Taking under consideration obtained values of elasticity by the cars' engines of the newest generation it can be said that considerable more profitably were presented engines with self - ignition and direct injection for which the average value of the total elasticity came to E = 2,905 (e_M = 1,449 and e_n = 2,005), while for engines with the spark ignition it came to E = 1,647 (e_M = 1,136 and e_n = 1,450) [2,3]. The Mitsubishi Company was the first company which used the engines with spark ignition and with direct injection in model Carisima 1.8 GDI and the economical advantages of the engine work expressed by low fuel consumption as for the engines with spark ignition had decided about it. The profile of the time density of the fuel consumption is presented in Fig.1.

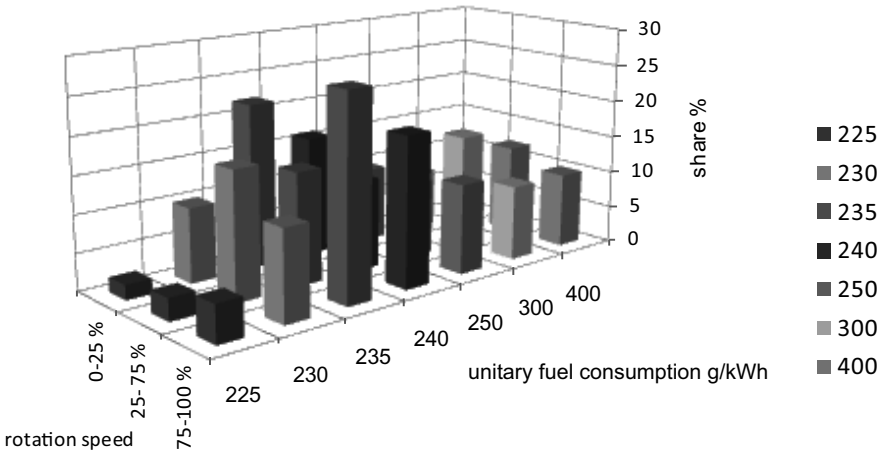

Fig. 1. The profile of the time density of fuel consumption of the Mitsubishi 1.8 GDI [4] engine

In that figure it is cleary seen, that the values of the unitary fuel consumption of describet engine are very near the values obtained by the compression- ignition engines which are powering cars. The biggest percentage share of fuel consumption is located in the range from 230 to 240 g/kWh and is low as for the petrol engines. Hoverer, the total elasticity of that was low and it came to just E = 1,582. Further searches of improvements of the engines' operating parameters with the spark ignition were directed to the area where heir economicalness and elasticity would be improved with the use of turbo supercharger. Previously, that supercharge encountered some obstacles in the form of too high exhaust gases temperatures which were influencing the vitality of turbocompressors as well their low follow up with changes the engine loading.

NEW PETROL ENGINES

Operation of the Volswagen Concern which aim is to bring to general use of the petrol engines with direct injection has brought positive results, and the series of superturbocharget engines designet TFSI (old sign) engines the pulsating drive of turbo-compressor has been used , dividing the outlet collector into two parallel parts.

The rotors of turbo-compressor having diameters equal to 37 or 41 mm, gives very low inertion, ans at the same time short response time for the exhaust gases impulses. It allows to reach the rotational speed up to 220 000 1/min, what it is not possible to achieve in turbo – compressor of truck engine.

Table 1.Parameters of petrol engine' work with the direct injection of Volkswagen Concern

1.	Model	1,4 FSI AUX	1,4TFSI CAXC	1,4 TSI BLG	2,0 TFSI AXX	3,0 V6 TFSI
1.	Type	In - line	In – line	In – line	In - line	V - type
2.	Namber of cylinder	4	4	4	4	6
3.	D	76,5 mm	76,5 mm	76,5 mm	82,5 mm	84,5 mm
4.	Namber of valves	16	16	16	16	24
5.	V_{ss}	1390 cm^3	1390 cm^3	1390 cm^3	1984 cm^3	2995 cm^3
6.	ε	12	10	10	10,5	10,5
7.	N_e/n	63 kW 5000 1/min	92 kW 5000 1/min	125 kW 6000 1/min	147 kW 5700 1/min	213 kW 5000 1/min
8.	M_o/n	130 Nm 3500 1/min	200 Nm 1500 1/min	240 Nm 1750 1/min	280 Nm 1800 1/min	420 Nm 2500 1/min
9.	Supercharging	–	Turbo	Turbo + mech Eaton	Turbo	Turbo + Mech Roots
10.	Dim.L.O.	95/98	95/98	98	95/98	95/98

Permanent progress in constructional solutions of turbocharget petrol engines of VW/Audi Concern can be traced based on corporation of unit power (its incrase) of that engines, what is presented in Fig.2, and the elasticity of the engines describet in Table 1,has been presented in Table 2.

Table 2.Flexibility of the Volkswagen Group petrol engines

1.	Model	1,4 FSI AUX	1,4TFSI CAXC	1,4 TSI BLG	2,0 TFSI AXX	3,0 V6 TFSI
1.	e_M	1,079	1,137	1,205	1,136	1,031
2.	e_n	1,428	3,333	3,428	3,333	2,000
3.	E	1,542	3,789	4,130	3,786	2,063

The values of the unitary fuel consumption of the discussed group of petrol engines within the form of the time-density profile, presented on figures 3 and 4, what allowed for furher consid-

eration over comparison of their working parameters with the parameters of compression – ignition engines used in agriculture.

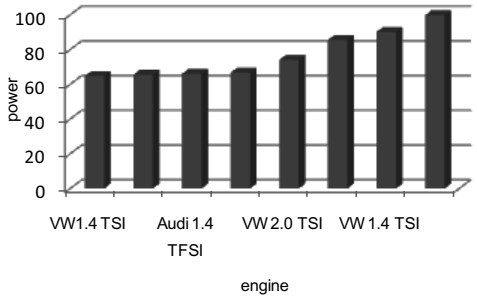

Fig. 2. Unitary powers petrol engines VW/Audi kW/dm^3

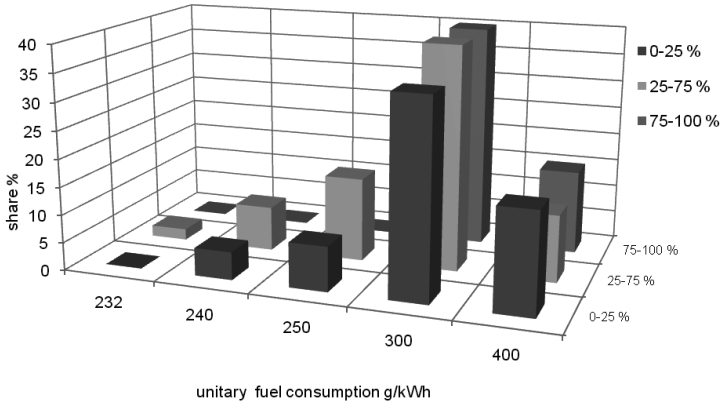

Fig. 3. The time-density profile of the Opel 1.6 16V engine in the form of bar set-up

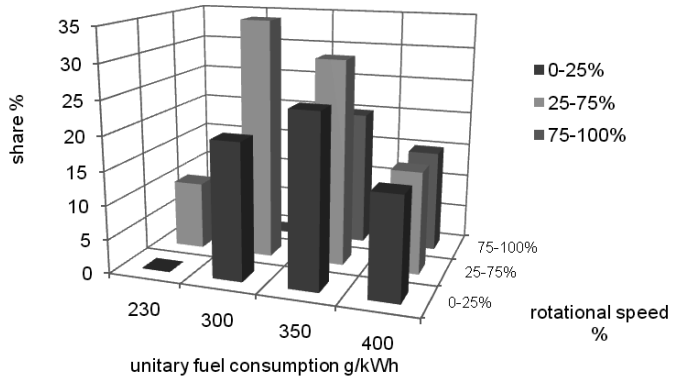

Fig. 4. Time-density characteristic of VW 1.0 engine In the form of bar set-up

WORKING PARAMETERS OF AGRICULTURAL ENGINES

As the evaluation criterion assumed the engines' elasticity, while for older models its values were given in table 3.Based on the datas given in Table 3, we can say that the average elasticity of the agricultural engines of modern petrol engines which is equal to 3,062. In regard to the elasticity of rotational moment that comparison looks much better, because it was better for older agricultural engines (1,195) in comparison with the elasticity of the rotational moment of petrol engines equal to 1,118, and that parameter is very crucial during the operation of the agricultural engines.

Table 3.The elasticity of the agricultural engines [5]

Engine	**Average value of e_M**	**Average value of e_n**	**E**
Ursus S-312C	1,146	1,223	1,401
Ursus S-4002	1,054	1,334	1,406
Ursus AD3.152	1,162	1,615	1,876
Ursus AD3.152 UR	1,168	1,607	1,877
Ursus A4.236	1,098	1,538	1,689
Ursus A4.248	1,160	1,428	1,656
New Holland 1.85	1,330	1,769	2,352
Renault Ceres 95	1,239	1,437	1,780
Same Silver 90	1,286	1,786	2,296
Steyr 9086	1,291	1,534	1,980
Valmet 865	1,092	1,448	1,581
Zetor 8540	1,313	1,571	2,062
Average	**1,195**	**1,524**	**1,830**

For better picture of evalued situation, the working parameters of tractors manufactured by wide – world known company John Deere have been presented. It's the company which produces tractors engines with power level ranging from 59 kW to 254 kW. These are not very strained engines in comparison to the engines with spark ignition enclosed in figure 2, because the volumetric power indicator for them ranges from 20,29 to 35,84 kW/dm^3, but the politics of the company is directed for large durability of these engines but not their straining.

Table 4. Elasticity of John Deere agricultural engines [6]

Engine	$\mathbf{e_M}$	$\mathbf{e_n}$	**E**
John Deere 6620SE	1,693	1,533	2,595
John Deere 6330	1,366	1,277	1,745
John Deere 6320	1,336	1,533	2,048
John Deere 66920SE	1,513	1,437	2,174
Average	**1,484**	**1,445**	**2,140**

Comparing modern compression – ignition engines used in agriculture, it can be noticed significant incrase of elasticity of the rotational moment for up to 24 %, upon insignificant decrease of elasticity of the rotational speed, it gives the rise of total elasticity for about 17 %. As an example, the characteristic of one of the engines describet in Table 4 has been presented below. The improvement of the elasticity of tractors engines is clear, ther is no doubt about it, however still the evaluation of their work economicalness must be made, which is lower than the compression – ignition engines of road vehicles, but for petrol engines very modern ones, as it was shown before, still is pretty far way to catch up with the tractors engines.That difference is estimated on the level between 15 and 25 %. The attention is paid to fact of constant unitary consumption g_e (*Fig.5*) on the external characteristic on the considerable useful space of rotational speed, what is much more essential indicator in relation to the tractor engines, for sure more important than their elasticity.

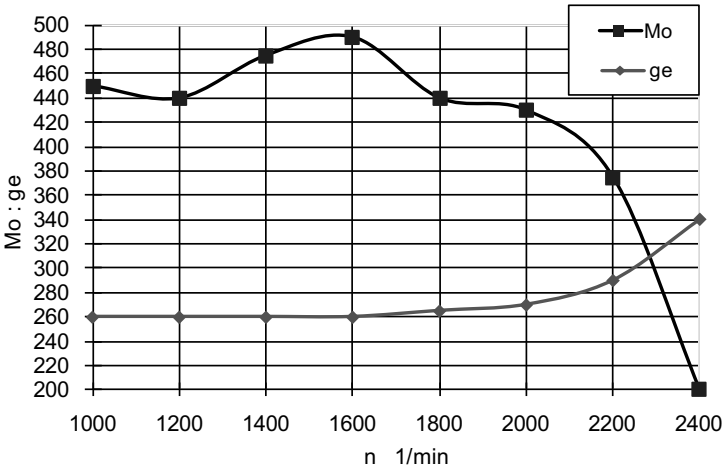

Fig. 5. The external characteristic of John Deere 66 920 SE engine

CONCLUSIONS

Presented review of operating parameters of supercharget petrol engines with the spark ignition, despite huge construction progress , impinging on the exploational indicators does not induce to propaganda their use as a drive of agricultural vehicles. Different operational conditions do not

require a large elasticity of engines which is required because of traffic on public roads. In agricultural vehicles, greater pressure is put on the ability of implementing work (rotational moment and eventually increase of the coefficient of its elasticity) as well as work economicalness expressed by low fuel consumption. Because of that, those two parameters were taken under consideration while conducting this analysis.

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MOŻLIWOŚCI ZASTOSOWANIA NOWOCZESNYCH SILNIKÓW ZI W ROLNICTWIE

Streszczenie. W artykule przedstawiono rozwój nowoczesnych silników o zapłonie iskrowym w oparciu o i ch parametry operacyjne. Przeprowadzono prównanie z parametrami współczesnych silników stosowanych w rolnictwie i na tej podstawie określono przydatność ocenianych silników.

Słowa kluczowe: silnik, parametry operacyjne.