# MODERN SYSTEMS OF TURBOCHARGING AS A METHOD TO IMPROVE ON ECOLOGY OF A DIESEL ENGINE'S WORK

**Jerzy Jaskólski, Marcin Szczepka**

*Krakow University of Technology, Institute of Vehicles and IC Engines, Jana Pawła the II Av.37*
*PL 31-864 Cracow, tel.: +48 126283684, e-mail: jaskolsk@usk.pk.edu.pl*

**Paweł Mikoda**

*Politechnika Śląska, Katowice ul. Krasińskiego 8*
*e-mail pawmiko@poczta.onet.pl*

***Abstract***

*It is known, that one of the most important imperfections of combustion engine is incomplete use of fuels energy. Even the newest constructions of internal combustion engines, in the best cases, use only half of energy supplied in fuel. Rest of energy is emitted to environment as heat. It is also very important that nowadays this energy becomes more and more expensive what is felt by all users of motor vehicles. Then researches on development of an internal combustion engine, especially works on improving its general efficiency, have great importance for all of us. Higher efficiency of an engine means less charges for our wallets and less pollutions for environment enough burdened by the human evolution. For that reasons, both economical and ecological ones, improving of general efficiency of an engine is very important. Investigations on the test bed confirmed correctness of TF2 turbocharger and its adjustment parameters selection for 4CT107/A7 engine, turbocharging system with precise adjustment lets diesel engine achieve parameters comparing or exceeding parameters of spark ignition engine.*

***Key words:*** *general efficiency of an engine, reduction of pollutions' emission, turbocharging, diesel engine*

## 1. Methods of reducing harmfulness of pollutions' emission

The most important difficulties connected with pollutions reduction which we meet during exploitation of vehicles powered by ZS engines are:

- emission of particulate matter (PM) based on carbon ,
- emission of nitrogen oxide (NOx),
- *shock loads* in the *piston-crank* system.

On the other side, the most popular methods of reducing emission in the modern diesel engines are:

- using fuel systems with a direct *injection,*
- increasing pressure of an *injection* (*pump-injectors, common rail),*
- applying of precision electronics' systems of control an *injection*,
- recirculation with cooling of exhaust gases,
- improving on a quality of fuel,
- using of catalysator,
- applying turbocharging with intercooler.

## 2. Laboratorial explorations of 4ct 107 engine

The aim of investigations carried out on a test bed in the laboratory of diesel engines in Cracow University of Technology there were a comparison and an analysis of achievements of 4CT107/A7 engine charged by turbocharger with wastegate and a variable geometry of a turbine's nozzle. Turbocharger marked TF2 with a variable geometry was selected for the engine in earlier work and on the contrary turbocharger marked B65-1 with *a wastegate* was standard equipment of this engine. There were also executed explorations of a non-charged engine without any changes in regulations' parameters to analyze parameters of the engine without a turbocharger.

The comparison and the analysis of output was made on the base on outside and partial characteristics of engine first with B65-1 turbocharger and then with TF2 turbocharger. The test of the non-charged engine consisted in taking off an outside characteristic.

Originally in the engine, control of boost parameters was realized by *wastegate* steered by *pneumatic pressure actuator.* Control's system of wastegate in B65-1 turbocharger and angle of vanes of a turbine's nozzle in TF2 turbo-compressor during tests was controlled by *pneumatic pressure actuator*. Boost pressure opened wastegate when it reached 1.2 [MPa]. Control of turbine's nozzle was proceeded in a fluent way, a diagram of turbine's nozzle vanes angle in a function of a charging pressure shows Fig. 1. Maximum boost pressure was 1.2 [MPa].

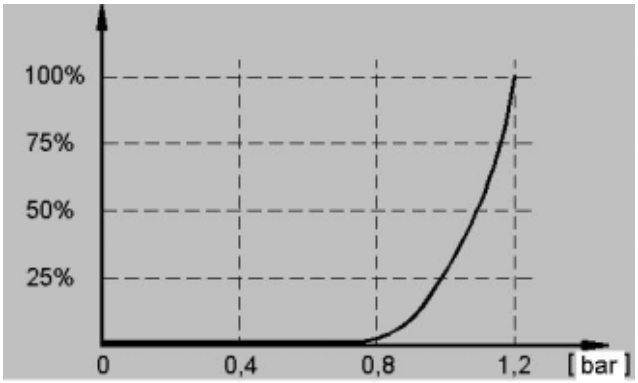


*Fig. 1. Angle of turbine's nozzle vanes in a function of a boost pressure*

The test bed

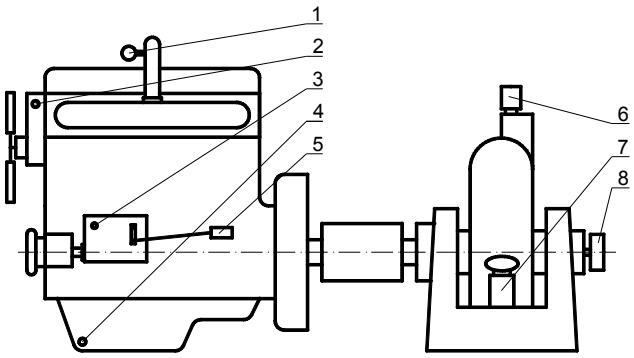


*Fig. 2. A scheme of the test bed*

*1- boost pressure measurement, 2- engine's coolant temperature measurement, 3- fuel consumption measurement, 4- oil temperature measurement, 5– injection pump adjustment, 6- engine's brake adjustment, 7- brake's force measurement, 8- engine's speed measurement*

The test bed is shown on the picture below.

*Fig. 3. The test bed*

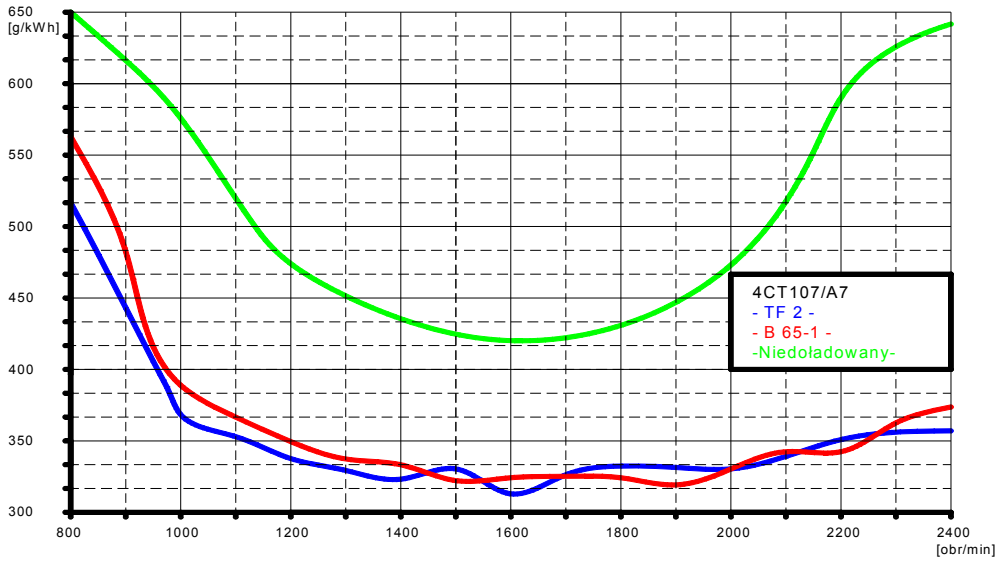


*Fig.4. Results of tests of 4CT107/A7 engine*

Results of tests of 4CT107/A7 engine equipped with conventional and variable geometry turbochargers corroborate opinion that output of engine equipped with VGT can be significantly increased by using more efficient methods of control.

On the other hand, tests of uncharged engine which is not prepared for working without turbocharger shows us possibilities of using it in breakdown conditions. Also influence of adjustment parameters can be estimated.

## 3. Conclusions

Investigations on the test bed confirmed correctness of TF2 turbocharger and its adjustment parameters selection for 4CT107/A7 engine. During tests it was proven, that most of engine's parameters were improved.

Therefore, turbocharging system with precise adjustment lets diesel engine achieve parameters comparing or exceeding parameters of spark ignition engine. What is important: improving of output is connected with decreasing of pollutants emission so EURO4 norm can be fulfilled.

## References

[1] Chłopek Z., *Ochrona środowiska naturalnego*, WNT, Warszawa 2002

[2] Kordziński Cz., Środulski T., *Silniki spalinowe z turbodoładowaniem*, WNT, Warszawa 1970,

[3] Mysłowski J., *Doładowanie silników*, WKŁ, Warszawa 2002,

[4] Merkisz J., *Ekologiczne problemy silników spalinowych*, Tom I i II., Poznań, Wydawnictwo Politechniki Poznańskiej 1999,

[5] Wajand J.A., Wajand J.T., *Doładowanie tłokowych silników spalinowych*, WNT, Warszawa 1962,

[6] Wajand J.A., Wajand J.T., *Tłokowe silniki spalinowe – średnio- i szybkoobrotowe*, WNT, Warszawa 1993,

[7] Wisłocki K., *Systemy doładowania szybkoobrotowych silników spalinowych*, WNT, Warszawa 1991,