УДК 621.431

COMPARATIVE ANALYSIS OF NATURALLY ASPIRATED AND TURBOCHARGED ENGINES

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The turbocharging system is an integral part of modern internal combustion engines. Nowadays, the turbocharger is no longer just a tuning element but is used by automakers as an essential component of the internal combustion engine. Initially, turbocharging was used in high-performance sports car engines. Its application in mass-produced vehicles was limited due to poor drivability (turbo lag). Over time, turbocharging began to be adopted in small and medium-power gasoline engines to improve efficiency and increase specific power (while reducing engine size) [1].

Unlike diesel engines, modern gasoline engines often use mechanically driven superchargers due to their better responsiveness during transient conditions. Additionally, some small-displacement gasoline engines employ combined (twin-charging) systems. Variable geometry turbochargers have limited use in gasoline engines due to the high exhaust gas temperatures and the costs associated with this technology. Today, turbocharging is used in new gasoline engines with smaller displacements and fewer cylinders to reduce harmful emissions and fuel consumption. In a turbocharging system, the compressor is driven by a turbine powered by the energy of the engine exhaust gases, as shown in Fig.` 1 [1].

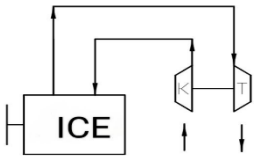

Figure 1 – Turbocharging scheme

During engine operation, exhaust gases flow through the exhaust valves into the turbine (T) and cause it to rotate. The turbine wheel is mechanically connected to the compressor wheel (K). In the compressor, air drawn from the environment is compressed to boost pressure. The compressed air then enters the engine cylinder through the intake valve. The turbocharging unit, consisting of the gas turbine and centrifugal compressor, is commonly referred to as a turbocharger [1]. Conduct a comparative analysis of naturally aspirated and turbocharged engines. For this study, we shall consider some estimated parameters and their values for the turbocharged VW BWA 2.0 TFSI engine [2] and the naturally aspirated VW BVY 2.0 FSI engine [3] in the Table 1.

Table 1 – Comparative Analysis of Turbocharged and Naturally Aspirated Engines

Estimated parameter	BWA 2.0 TFSI	BVY 2.0 FSI
Engine type	In-line, 4-cylinder	In-line, 4-cylinder
Working volume, cm^3	1984	1984
Max. power, h.p. at rotational speed	200 6000	150 6000
Fuel consumption	7,6-10.5	6.8-12
Engine weight	155	140
Torque, n*m at rpm.	280/5000	200/3500
Compression ratio	10.5	11.5
CO_2 emissions, g/km	198	208
Turbocharging	KKK K03	Not available

The research shows that with identical displacement, dimensions, and compression ratio, a turbocharged engine emits less CO_2 while providing higher power output and greater torque. Thus, a turbocharged engine is superior to a naturally aspirated one with the same basic parameters, but it comes with disadvantages, including higher maintenance requirements.

References

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