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# PERFORMANCE OF VEHICLE USING TWIN TURBOCHARGER

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## ABSTRACT

***Several turbocharger units can be used for engine boosting in series or parallel arrangements in which they are phased in and out according to the operating conditions of the engine. This technology has the potential to facilitate downsizing of automotive engines in order to yield benefits in terms of their transient performance, the fuel consumption and emissions output. This review investigates the benefits and drawbacks of series and parallel Turbocharging arrangements. Since the effectiveness of using the boosting technology crucially depends on the control scheme applied, developments in the modeling and control approaches used in single-stage, series and parallel Turbocharging are also examined. In comparison with single-stage Turbocharging, using several turbochargers in series or parallel can provide a faster transient response without compromising the fuel consumption, while also having the potential to provide higher boost pressures. Novel non-linear and robust control approaches have demonstrated improvements in performance and robustness over traditional approaches used in commercial engine control relying on separate control loops for the different engine variables.*** **[1]**

## 1-INTRODUCTION

1.1 Aim of the project

In this technical paper report the theoretical analysis of a turbocharger is done. The different parts of a turbocharger are studied here and are described completely. The main aim of this project is as follows-
Theoretical analysis of the Compressor & turbine
Theoretical analysis of the water air radiator And Analysis of the Intercooler

1.2 Turbocharging

Turbocharging is basically one type of Supercharging. The purpose of supercharging is to increase the mass of air trapped in the cylinders of the engine, by raising air density. This allows more fuel to be burnt, increasing the power output of the engine, for a given swept volume of the cylinders. Thus the power to weight and volume ratios of the engine increases. Since more fuel is burnt to achieve the power increase, the efficiency of the engine cycle remains unchanged.

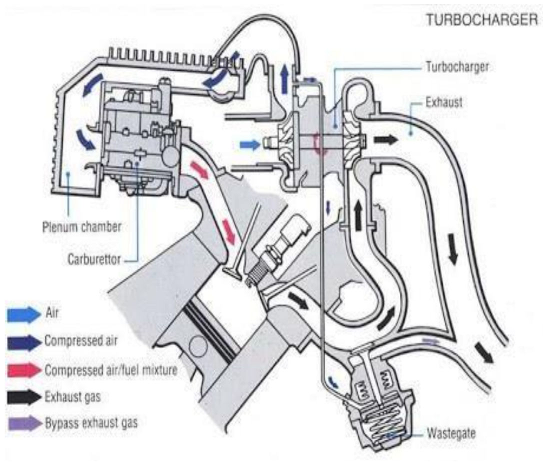
A compressor is used to achieve the increase in air density. Two methods of supercharging can be distinguished by the method used to drive the compressor. If the compressor is driven from the crankshaft of the engine, the system is called 'mechanically driven supercharging' or often just 'supercharging'. If the compressor is driven by a turbine, which itself is driven by the exhaust gas from the cylinders, the system is called 'Turbocharging'. The shaft of the turbocharger links the compressor and turbine, but is not connected to the crankshaft of the engine (except on some experimental 'compound' engines, see Chapter 3). Thus the power developed by the turbine dictates the compressor operating point, since it must equal that absorbed by the compressor.

**Advantages of Turbocharger over Supercharger**

The advantage of the turbocharger, over a supercharger, is that the power required to drive the compressor is extracted from exhaust gas energy rather than the crankshaft. Thus Turbocharging is more efficient than mechanical supercharging.

In contrast to turbochargers, superchargers are mechanically driven by the engine. Belts, chains, shafts, and gears are common methods of powering a supercharger, placing a mechanical load on the engine. For example, on the single stage single speed supercharged Rolls-Royce Merlin engine, the supercharger uses about 150 horsepower (110 Kilowatts). Yet the benefits outweigh the costs; For the 150 hp (110 kW) to drive the supercharger the engine generates an additional 400horsepower, a net gain of 250 hp (190 kW). This is where the principal disadvantage of a supercharger becomes apparent; The engine must withstand the net power output of the engine plus the power to drive the supercharger.

Another disadvantage of some superchargers is lower adiabatic efficiency as compared to turbochargers (especially Roots type superchargers). Adiabatic efficiency is a measure of a compressor's ability to compress air without adding excess heat to that air. Even under ideal conditions, the compression process always results in elevated output temperature; However, more efficient compressors produce less excess heat. Roots superchargers impart significantly more heat



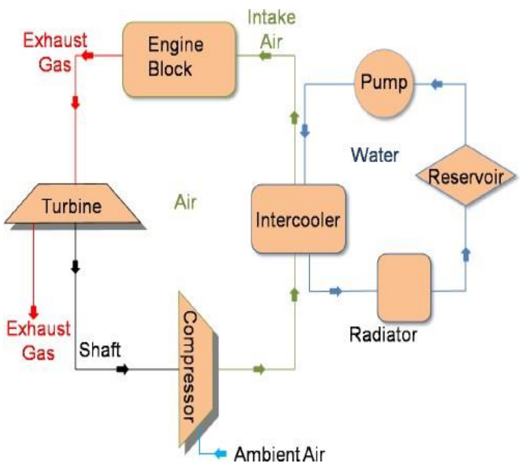




Figure : Turbocharging

to the air than turbochargers. Thus, for a given Volume and pressure of air, the turbocharged air is cooler, and as a result denser, containing more oxygen molecules, and therefore more potential power than the supercharged air. In practical application the disparity between the two can be dramatic, with turbochargers often producing 15% to 30% more power based solely on the differences in adiabatic efficiency (however, due to heat transfer from the hot exhaust, considerable heating does occur).

## 2- ANALYSIS OF A TURBOCHARGER.

2.1 Working principle of a turbocharger:

The turbocharger's compressor draws in ambient air and compresses it before it enters into the intake manifold at increased pressure. This results in a greater mass of air entering the cylinders on each intake stroke. The power needed to spin the centrifugal compressor is derived from the kinetic energy of the engine's exhaust gases.

Compressing the air increases its temperature, which lowers the density of the charge air and creates a less efficient cycle and loss of power. The higher temperatures can also have detrimental effects on the materials and structure of the engine. To counteract this issue the compressed air needs to be cooled in order to achieve maximum power and maintain the structural integrity of the pistons. A heat exchanger, or intercooler, is installed between the compressor and engine inlet to cool the charge air. There are two different types of intercoolers, air-air and air-water (these two types are discussed later).

The turbine of a turbocharger imposes a flow restriction in the exhaust system, and therefore the exhaust manifold pressure will be greater than atmospheric pressure. If sufficient energy can be extracted from the exhaust gas, and converted into compressor work, then the system can be designed such that the compressor delivery pressure exceeds that at turbine inlet, and the inlet and exhaust processes are not adversely affected. The process of compression raises temperature as well as pressure. Since the objective is to increase inlet air density, charger air coolers (heat exchangers) are often used to cool the air between compressor delivery and the cylinders, so that the pressure increase is achieved with the maximum rise in density. **[5]**

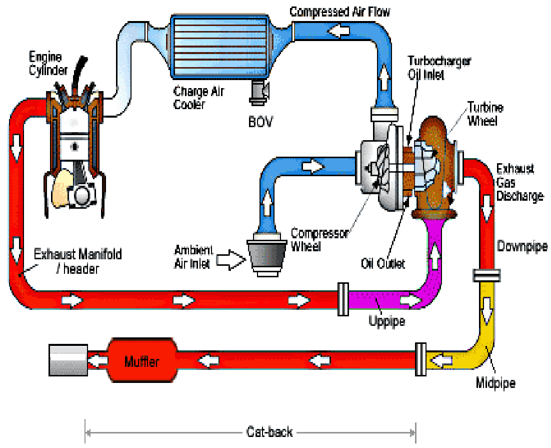



Figure : Process of Turbocharging

## 3-Design of Twin Turbocharging

Successful design of a turbocharged diesel engine is highly dependent on the choice of system for delivering exhaust gas energy from the exhaust valves or ports, to the turbine, and its utilization in the turbine. Virtually all the energy of the gas leaving the cylinders arrives at the turbine. Some is lost on the way, due to heat transfer to the surroundings, but this is unlikely to exceed 5% unless water cooled exhaust manifolds are used, and will usually be much less. However, the design of the exhaust manifolds between the exhaust valve and turbine influence the proportion of exhaust gas energy that is available to do useful work in the turbine. An important parameter is the pressure in the exhaust system. Various Turbocharging systems have been proposed to rationalize the apparently conflicting requirements. **[6]**

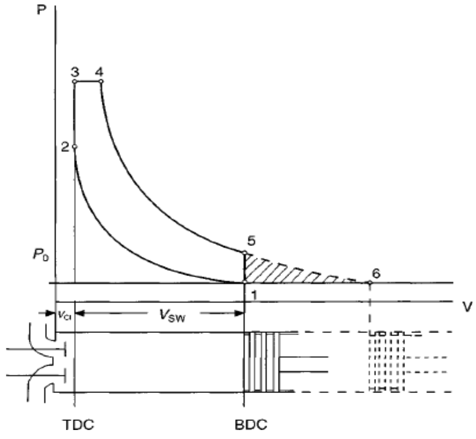



Figure : Ideal Engine Cycle.

## 4- Advantages of Twin Turbocharging

Twin-turbo refers to the turbocharger configuration in which two identical turbochargers function simultaneously, splitting the Turbocharging duties equally. Each turbocharger is driven by half of the engine's spent exhaust energy. In most applications, the compressed air from both turbo is combined in a common intake manifold and sent to the individual cylinders. Usually, each turbocharger is mounted to its own individual exhaust/turbo manifold, but on inline-type engines both turbochargers can be mounted to a single turbo manifold. Parallel twin turbos applied to V-shaped engines are usually mounted with one turbo assigned to each cylinder bank, providing packaging symmetry and simplifying plumbing over a single turbo setup. When used on inline engines, parallel twin turbo are commonly applied with two smaller turbo, which can provide similar performance with less turbo lag than a single larger turbo. Some examples of parallel twin-turbo inline engines are Nissan's RB26DETT, BMW's N54 and Volvo's B6284T and B6294T. **[8]**
The Maserati Biturbo, introduced in 1981 and featuring an aluminum 90-degree SOHC V6, was the first production car with a twin-turbo charged engine. Other examples of V formation engines with parallel twin-turbo include Mitsubishi's 6A12TT, 6A13TT and 6G72TT; Nissan's VG30DETT and VR38DETT; and Audi's 1997-2002 S4 (B5), 1997-2005 A6, and 2003-2017 RS6. **[1]**

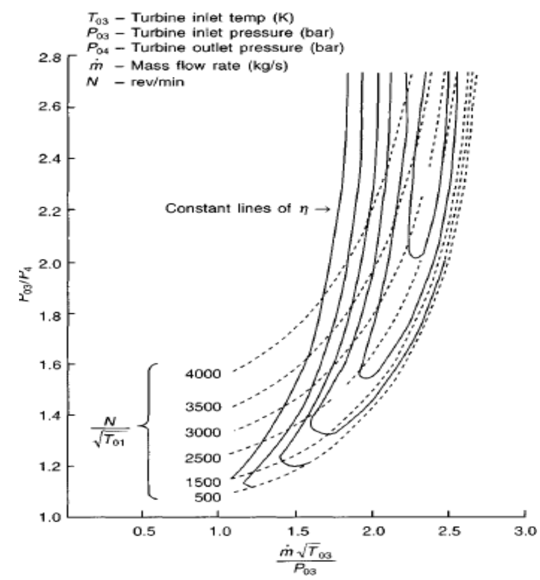



Figure : Flowchart for thermal efficiency.

## 5- Conclusion

The following technical paper was based on the pure study of the performance of the vehicle after the use of twin Turbocharging process. The overall performance of the twin Turbocharging, its advantage and log backs are described in the report. The Engineers are still working to improve the efficiency of the turbochargers so that the fuel can be saved and the performance of the vehicle can boost up rapidly. The various research institutes have the hand in developing the twin Turbocharging systems and are also working to improve the time cycles of engine and performance of twin turbochargers with the help of various modern techniques. The paper was to elaborate the idea of twin turbocharging process which are used not only to boost up the vehicle speed, but also the consumption of waste emission and recovery of the unburnt fuel. **[12]**

## 6-Refrences

1) twinturbochargers: anylsis
2) performance of Turbocharging; Wikipedia
3) reaseach papers on Turbocharging and supercharging.
4) Research gate: Turbo charging process.
5) Abstract for Turbocharging process. Autosearch.com
6) Handbook of automobile engineering.
7) [12]researchgate: waste emission recovery processes.