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Research Paper

FABRICATION AND PERFORMANCE TEST OF TURBOCHARGER FOR TWO WHEELER

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In present situation everybody in this world needs to ride a high powered, high fuel efficient and less emission two wheelers. In order to meet the requirements of the people an attempt have been made this in this project to increase the power by using the exhaust gas of the engine by passing this gas on to turbine compressor arrangement. This compressor compresses the fresh air and is sent to the carburetor. The authors have mainly aimed to increase the air: fuel ratio therefore all the requirements were fulfilled by this process.

Keywords: Air/Fuel ratio, Fuel Efficiency, Turbocharger, Gasoline vehicles

INTRODUCTION

The output of the engine exhaust gas is given to the input of the turbine blades, so that the pressurized air is produced. This power, the alternate power must be much more convenient in availability and usage. The next important reason for the search of effective, unadulterated power are to save the surrounding environments including men, machine and material of both the existing and the next fourth generation from pollution, the cause for many harmful happenings and to reach the saturation point.

TURBO CHARGER

Basic facts

To increase the power of an engine, it is possible to increase either the cubic capacity or engine speed. Another method consists of feeding it more fuel. This is the solution, known as supercharging, which is performed by the turbocharger. However, this cannot be achieved by simply increasing the quantity of petrol or diesel fuel injected during each cycle. For the engine to operate correctly, it is important for it to maintain the very precise proportioning of the air/fuel mix. If this does not happen, combustion is incomplete, which results in a sharp increase in the rate of unburned components and a fall-off in engine efficiency. Such consequences would be completely at odds with the required objective. The purpose of the turbo is therefore to feed more air into the cylinders in order to maintain the correct proportions of the mix, by "just" compressing it. This is equivalent to giving the engine a "virtual" cubic capacity higher than its real cubic capacity.

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Introduction

Turbo-charging, simply, is a method of increasing the output of the engine without increasing its size. The basic principle was simple and was already being used in big diesel engines. European car makers installed small turbines turned by the exhaust gases of the same engine. This turbine compressed the air that went on to the combustion chamber, thus ensuring a bigger explosion and

An incremental boost in power. The fuel-injection system, on its part, made sure that only a definite quantity of fuel went into the combustion chamber.

BMW was the first to use turbo-charging in a production passenger car when they launched the 2002 in 1973. The car was brilliantly packaged too and paved the way for a simply magnificent ‘Turbo Era’ in the automotive world. Swedish giant Saab took its cue from this and its ensuing 900 series was one of the most characteristic turbo cars of its time. Intercoolers the latest turbo’s they are used by most of today’s turbo-diesel engines to make the compressed air denser. It works like this - on starting, exhaust gases spin the turbine and thus activate a compressor that pressurizes the air.

This pressurized air from the turbo-charger is then sent through a duct to an air-cooled intercooler, which lowers the temperature of the intake charge and thus increases its density. The air-cooled intercoolers receive air through separate intakes and that explains the small scoops and louvers usually found on the hoods of turbo-charged cars. Modern turbo-diesel engines also make use of a temperature-sensitive, motor-driven fan which boosts airflow at low engine speeds or when the intake air temperature is high.

Computers soon started playing an even bigger role in cars. Engine management systems linked to fuel-injection systems meant getting.

More out of the engine was even easier. For example, one can buy chips that can boost power by 100 bhp for some Japanese cars, such as the Nissan Skyline. Moreover, on-road speeds were being restricted all over the world. Though most of the sports cars today are capable of doing more, they are restricted electronically not to exceed 250 kmph even in autobahn-blessed Germany.

Turbo-charging lost its edge towards the end of the 1980s and today this technology is used only in select performance cars. Porsche, for example, is all set to build a turbo-charged version of its all-new 911 (water-cooled) with added performance. Turbo engines were banned in Formula One too with the idea of restricting the performance of the cars (and thereby making them safer too). There are many who consider this a backward step in the world of Formula One, which is considered to represent the ‘tomorrow’ of automotive technology.

But if one analyses the performance of normally aspirated cars in F1 today (3,500 cc non-turbo), they perform as well, if not better, than the turbo cars of the early 1980s. So, there are no full stops in technology. While road cars and even sports and racing cars are going in for more efficient engines, better metallurgy and wilder-than-ever electronics to get their engines to perform at an optimum level without sacrificing the performance edge, turbochargers still continue to serve the same purpose they were invented for albeit more so with diesel engines. Modern turbocharger is based on the principle that if air entering in an engine is pressurized more oxygen and then adding more fuel in the engine result in high torque and more power.

EXPERIMENTAL SETUP

Today, the turbo charging of petrol engines is no longer primarily seen from the performance perspective, but is rather viewed as a means of reducing fuel consumption and, consequently, environmental pollution on account of lower carbon dioxide (CO2) emissions. Currently, the primary reason of using turbochargers is the reduced consumption and emission of harmful gases. A turbocharger, often called a turbo, is a small radial fan pump driven by the energy of the exhaust flow of an engine. A turbocharger consists of a turbine and a compressor on a shared axle. The turbine inlet receives exhaust gases from the engine causing the turbine wheel to rotate. This Rotation drives the compressor, compressing ambient air and delivering it to the air intake manifold of the engine at higher pressure, resulting in a greater mass of air entering each cylinder. In some instances, compressed air is routed through an intercooler before introduction to the intake manifold. Turbo-charging, simply, is a method of increasing the output of the engine without increasing its size. The basic principle was simple and was already being used in big diesel engines. European car makers installed small turbines turned by the exhaust gases of the same engine. This turbine compressed the air that went on to the combustion chamber, thus ensuring a bigger explosion and an incremental boost in power. The fuel-injection system, on its part, made sure that only a definite quantity of fuel went into the combustion chamber. The objective of a turbocharger is the same as a supercharger; to improve upon the size-to-output efficiency of an engine by solving one of its cardinal limitations. A naturally aspirated automobile engine uses only the downward stroke of a piston to create an area of low pressure in order to draw air into the cylinder through the intake valves. Because the pressure in the atmosphere is no more than 1 bar (approximately 14.7 psi), there ultimately will be a limit to the pressure difference across the intake valves and thus the amount of airflow entering the combustion chamber. This ability to Fill the cylinder with air is its volumetric efficiency. Because the turbocharger increases the pressure at the point where air is entering the cylinder, a greater mass of air (oxygen) will be forced in as the inlet manifold pressure increases. The additional oxygen makes it possible to add more fuel, increasing the power and torque output of the engine.

Engine Specification

Type of fuel used	:	Petrol
Cooling system	:	Air cooled
Number of cylinder	:	Single
Number of stroke	:	Two Stroke
Arrangement	:	Vertical
Cubic capacity	:	100 cc

Spark Ignition Engine

A Spark Ignition (SI) engine runs on an Otto cycle- most gasoline engines run on a modified Otto cycle. This cycle uses a homogeneous air-fuel mixture which is combined prior to entering the combustion chamber. Once in the combustion chamber, the mixture is compressed, and then ignited using a spark plug (spark ignition). The layout of turbocharged engine with parts is shown in Figure 1. The SI engine is controlled by limiting the amount of air allowed into the engine. This is accomplished through the use of a throttling valve placed on the air intake (carburetor or throttle body). Mitsubishi is working on the development of a certain type of SI engine called the gasoline direct injection engine. The fabricated turbocharger engine (Suzuki) is shown in Figure 2.

Figure 1: Schematic Diagram of Turbo-charger With Engine and Other Parts

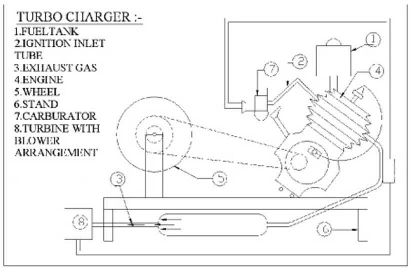


Figure 2: Fabricated Turbocharger With Engine Arrangement

METHODOLOGY

(Characterization of Exhaust Emissions from Gasoline Powered Vehicles)

Although vehicle exhaust emissions of air pollutants are generally decreasing, it has not been possible to reduce air quality problems in cities in the past 10 years. In particular, the concentrations of particulates and ozone are too high, causing severe health effects. Besides improving the local air pollution situation, the reduction in global warming due to greenhouse gas emissions is of great importance for the mobility sector, in view of increasing worldwide mobility and demand for transportation. Finally, numerous established researchers are predicting bottlenecks in energy supply for the next few decades, pointing to the importance of clean biofuels. The requirement for future motor vehicles is therefore very clear: emissions of toxic pollutants such as particulates and ozone precursors have to decrease to near zero, greenhouse gas emissions have to be reduced far more than in recent years and the introduction of biofuels has to be enabled on a large scale. Exhaust emission measurements on motor vehicles are often performed using the official European driving cycle. This is a practical test cycle for type approval purposes, but allows limited comparability with real-world driving. Few exhaust gas and particulate emission data are available from modern motor vehicles representing a real-world driving pattern. The major air pollutants include gases like carbon monoxide, sulphur dioxide, oxides of nitrogen and particulates like respirable suspended particulate matter and suspended particulate matter. These air pollutants in the atmosphere have an adverse effect on human life and are contributed by various sources. In order to protect human health, property and environment from the adverse effects of air pollution, the National Ambient Air Quality Standards have been set by the Central Pollution Control Board. The air quality standards have been developed primarily on the dose effect/dose response relationships. The standards set are an integral part of air quality management which is required to set long term as well as short-term goals for air quality improvement and formulation of strategies and implementation of various programs.

EMISSION TEST SETUP

MARS technologies Inc. is one of the newly emerging automotive emission test manufacturer in India. It have very diversified areas in which they are working like speed limiters in vehicles, 3M Retro Reflective tapes, Mars digital signage...etc.

Emission Testing Equipment

Mars Multi gas Analyzer Model MN-05

Standard Accessories

- Equipment (Multigas Analyzer)
- Power Supply Mains Cord
- RS-232 Cable
- Sampling Probe
- PC Control Software

Operation Accessories

- Sensor (5th Gas)
- Oil Temperature Probe
- RPM Sensor with Probe
- RS-485

Technical Specification

- Operating System : PIC-Micro Controller
- Display : LCD Display
- Interface : RS-232 & RS-485
- Power Supply : 230V AC. 50 Hz
  12V DC (Optional)
- Dimensions : 450mm*300mm*120mm Approx.
- Weight : 5 Kg Approx.
- Approval : ARAI, Pune

Measurement Data

- Gases Measured
- CO (Carbon Monoxide)
- HC (Hydro Carbon)
- CO_2 (Carbon Dioxide)
- O_2 (Oxygen)
- NO_x (Nitric Oxide), Optional
- Lambda Measurement

Measurements	Range	Resolution
CO	0-9.99% Vol	0.001% Vol
HC(Propane)	0-15000 ppm	1 ppm
CO2	0-20% Vol	0.01% Vol
O2	0-25% Vol	10.1% Vol
NOx	0-5000 ppm	1 ppm Vol
Engine RPM	500-6000 rpm	1 rpm
Oil Temperature	0-150° C	1°
Lambda	0.200-2.000%	0.001

Figure 3: Pollution Test Machine

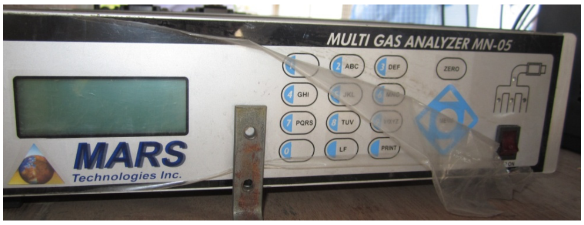


Figure 4: Pollution Test Machine's Gun

RESULT

Emission Result

The exhaust emissions of gasoline-powered vehicles for CO and Hydrocarbon were monitored using an MARS Multi gas Analyzer Model MN-05.so, here is the result of the emission test of this project.

Table 1: Comparison of Pollution With and Without Turbocharger

	Without turbo-charger	With turbo-charger
CO (%vol)	2.37	1.70
HC (ppm)	1600	1470

This is the certificate given by Andhra Pradesh pollution testing department for this project without turbocharger.

Figure 5: Certificate Without Turbocharger


COMPUTERISED POLLUTION UNDER CONTROL CERTIFICATE
Serial No. 866309
Rule 115(2) Of C.M.V.Rules 1989
AUTHORISED by Transport Department, Govt. of A.P.
All India Valid
Type of Vehicle: 2 WHEELER Fuel: PETROL
Type of Engine: 2 Stroke Catalyst: Yes
Make: SUZUKI Date: 24 Mar 2014
PTS Licence No.: AP-003-000623 Model: MAX 100 Time: 13:42:48
Vehicle Registration.No.: ENGNO:770711886910
Year of Registration: Jan 1997
Odometor Reading:
Photograph of the Vehicle
Test Result: 2 and 3 Wheelers (2/4 Stroke) Mrf before 31/3/2000
Regulation (%) Actual Reading
CO 4.5 2.37 % Vol:
HC HC 9000 1600 PPM
Certified that this Vehicle's CO Emission level confirms to the Standards prescribed under Rule 115(2) of CMV Rules 1989
Validity: 6 Months
S.S. MOBILE POLLUTION TESTING CENTER TIRUPATI - 517 501 Chittoor District.
Seal of Test station
Authorised Signature
Valid Upto: 23 Sep 2014
PREVENT POLLUTION PROTECT ENVIRONMENT, (PTSA - A.P.)
Pollution Testing Stations Association Andhra Pradesh

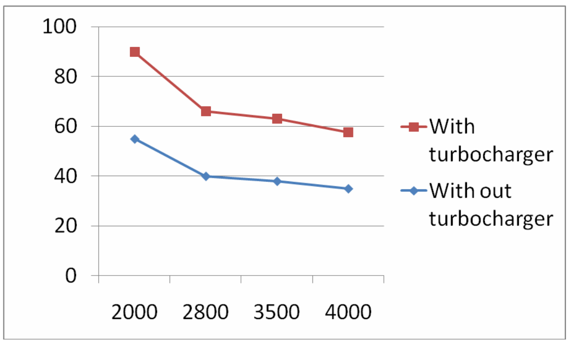
This is the certificate given by Andhra Pradesh pollution testing department for this project with turbocharger

Figure 5: Certificate With Turbocharger

Efficiency Result

The characteristic curve for Suzuki engine with and without turbo-charger (Improving efficiency) is shown in Figure 5. During full throttling about found emitting HC not within the prescribed national standard of 2000 PPM. The low percentage of scooters emitting Hydrocarbon in the said range might be attributed to the fact that all scooters tested were having two stroke engines while a few models of motor bikes had four strokes engine as well which do not require pre-mixing of mobile oil in petrol as lubricant.

Figure 7: Comparison of Time Vs RPM



Fuel consumption of 5cc petrol in secs, we can see increminent when we used the turbo charger.

ADVANTAGES

- More power compared to the same size naturally aspirated engine.
- Better thermal efficiency over naturally aspirated engine and supercharged engine, Because the engine exhaust is being used to do the useful work which otherwise would have been wasted.
- Better Fuel Economy by the way of more power and torque from the same sized engine. A century of development and refinement-for the last century the SI engine has been developed and used widely in automobiles.
- Continual development of this technology has produced an engine that easily meets Emissions and fuel economy standards. With current computer controls and reformulated gasoline, today's engines are much more efficient and less polluting than those built 20 years ago.
- Low cost - The SI engine is the lowest cost engine because of the huge volume currently produced.

DISADVANTAGES

- The SI engine has a few weaknesses that have not been significant problems in the past, but may become problems in the future.
- The engine is constantly fighting to draw air past the throttle, which expends energy.
- Limited compression ratio lowers efficiency - Because the fuel is already mixed with the air during compression, it will auto-ignite (undesirable in a gasoline engine) if the Compression ratio is too high. The compression ratio of the engine is limited by The octane rating of the engine.

- Lack of response called the Turbo Lag. If the turbo is too big, the boost will build up slowly because more exhaust pressure will be needed to overcome the rotational inertia on the larger turbine reducing throttle response but more peak power. If the turbo is too small the turbo lag won't be as big but the peak power would be lesser. So the turbocharger size is a very important consideration when deciding on it for a particular engine. Non liner rise in power and torque. Cost, Complexity: Turbocharger Spins at very high revolutions (1 lakh per minute) so proper cooling and lubrication is Essential if it not to destroy the engine.

CONCLUSION

We have designed and fabricated a prototype of the Turbocharger was implemented in Two-wheeler, In which the efficiency of the Engine can be increased .Thus we have developed a method to increase the efficiency of the engine and at the same time to control the Emissions from the engine. The experimental setup of block diagram

Is shows the arrangement of turbocharger in two-wheeler. This type of engine will be more efficient than existing engines. This work is an attempt to reduce our dependency on foreign oil and reduce the tailpipe emission from automobiles and this was an attempt to design and implement this new technology that will drive us into the future. Use of production turbo charger will reduce smog forming pollutants over the current national average. The first hybrid on the market will cut emissions of global-warming pollutants by a third to a half and later modes may cut emissions by even more.

To conclude, the benefits of turbo charging are:

- Increased engine power output (in the region of 50% increase)
- Improved fuel consumption (improved pressure balance across the engine)
- Altitude compensation
- A very high percentage of two wheel gasoline vehicles (48%) were found not complying with the prescribed National Emission Standards. The increase in Carbon monoxide and Hydrocarbon emissions by two wheel gasoline engines at accelerated engine speed was quite significant.
- About 90% of scooters and 85% of motor bikes were found emitting CO within the prescribed national standard of 4.5%. About 33% of scooters and 83% of motor bikes were found emitting Hydrocarbon within 2000 ppm.
- During half throttling about 90% of scooters and 93% of motor bikes were found emitting HC within the prescribed national standard of 2000 PPM.
- During full throttling about 52% of scooters and 47% of motor bikes were found emitting HC not within the prescribed national standard of 2000 PPM.
- It was observed that the Carbon monoxide emissions from two wheel vehicles increased from two to three times at the full acceleration engine conditions.
- It was observed that the Hydrocarbon emissions from two wheel vehicles increased From two to four times at the full acceleration engine conditions.
- By the use of turbo charging in two wheelers the power can be enhanced. A properly tuned turbo engine can produce 20% + more power compared to stock, but expect an increase in fuel consumption.

- More power compared to the same size naturally aspirated engine.
- Better thermal efficiency over naturally aspirated engine and supercharged engine because the engine exhaust is being used to do the useful work which otherwise would have been wasted.
- Automotive oil condition monitoring is far from a mature technology. As this technology progresses and becomes more popular in the automotive industry, there will be many generations of sensors developed to improve accuracy and range of capability.
- While some vehicles come standard with oil change technologies today, the majority do not. The companies developing these sensor technologies must be able to convince the automotive industry and the public of their general reliability and value. If this is successful, we may see condition-based oil changes become the latest trend in vehicle technology over the next few years.

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