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Performance Evaluation of Single Cylinder Four Stroke S. I. Engine Using Turbocharging System

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***Abstract*— Now a day's whole world facing the problem of reducing the fuel. So there is need to reduce fuel consumption. In a conventional IC engine exhaust gases carry a considerable heat away. To recover the waste heat, various methods are being adopted. One of them is turbo charging. In this project an attempt has been made to explore the various chances of exhaust heat energy recovery methods in bike. The heat Energy carries in the exhaust gases are recovered in different methods. Thus the principle of electro turbo generation has been adopted for waste heat recovery In order to use the aforesaid combination of waste energy recovery systems a matrix has also been suggested. Due to the increase of bikes, petrol consumption and emission rate increases. In this project to use the exhaust gas to rotate a turbine thereby rotating a compressor for supplying compressed air to intake. A turbocharger increases the charge air enters the cylinder. In this project we used a 100cc engine for our analysis. Modification of exhaust using the turbocharger exhaust gases removes the turbocharger. Turbocharger is mounted in front of the engine near the exhaust manifold for reduce heat losses and improve the efficiency.**

***Keywords*—Turbocharger, Exhaust modification, S.I, Engine, Total fuel consumption.**

I. INTRODUCTION

A turbocharged engine can be more powerful and efficient than a naturally aspirated engine because the turbine forces more intake air, proportionately more fuel, into the combustion chamber than if atmospheric pressure alone is used. The next important reason for the search of effective, 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. In the project also use catalytic convertor for control the emission. In turbo charging, the turbocharger is being driven by a gas turbine using the energy in exhaust gases. The main parts of turbocharger are turbine wheel, turbine housing, turbo shaft, comp. wheel, comp. housing & bearing housing. A four stroke S.I. Engine is an engine that uses gasoline as fuel.

II. NEED

Increased engine power output in the region of 50% increase.Improved fuel consumption on improved pressure balance across the engine. During half throttling about 93% of motorbikes were found emitting HC within the prescribed national standard. 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 super charged 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 auto motive 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.

III. CONCERN ABOUT TURBOCHARGING

The ultimate reason that we are interested in Turbocharging system for increase efficiency and output power of SI. Engine. All we the concern about Turbocharging system because of following reasons. Today Need to reduce use of fuel all over world. 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.

IV. WORKING OF TURBOCHARGER

The kinetic energy of exhaust gases is fed back to the engine and used beneficially to control emission and improve performance. The users always demand higher quality of power. In turbocharging system some basic criteria are use of turbocharger on S. I. Engine for more output as same fuel

input both with and without turbocharger. The compressor consists of a finned wheel that spins at high speed in a specially shaped housing called a volute. Air is drawn into the center of the compressor wheel and accelerated as it is flung to the outside of the wheel. The volute channels and slows the air which causes its pressure to increase. Increasing the pressure means you can now have more air in a given space, such as the space inside a cylinder. The amount by which the air is compressed is called boost.

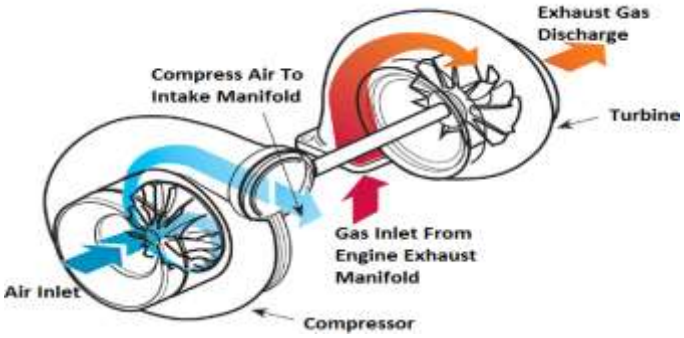

Fig.1 Turbocharger working of exhausts gases.

The shaft usually runs in plain bearings which need constant lubrication. Oil under pressure must be pumped through the central core constantly. When it is turning the shaft is essentially 'floating' on a cushion of oil. The oil also helps remove heat generated by friction. Without proper lubrication a turbocharger will very quickly fail. The core of the turbocharger may also contain passages through which cooling water is circulated. At the opposite end of the shaft from the compressor is the turbine wheel. The turbine wheel is also contained in volute housing but in this case hot exhaust gases from the engine are fed in from the edge of the housing and flow out from the centre of the wheel. The flow of hot gas causes the wheel to accelerate to the very high speeds the compressor needs to provide a lot of boost. Once the gases have passed the turbine wheel they flow through the normal exhaust system of the engine. Because too much boost can actually be damaging to an engine a way of limiting the turbine wheel speed is often needed. One way of doing this is with a waste gate. The waste gate allows the hot exhaust gases to bypass the turbine wheel. Instead of driving the turbine the gases simply flow through an alternate passage in the turbocharger directly into the exhaust.

V. Engine Specification

For the project work I had work with 100cc bike of single cylinder four stroke spark ignition engine. The specifications of bike are in following table.

An engine of a given size turbocharged engine can be more powerful and efficient than a naturally aspirated engine because the turbine forces more intake air, proportionately more fuel, into the combustion chamber than if atmospheric pressure alone is used. Its purpose is to increase the volumetric efficiency of the combustion chamber. Various new technologies have been introduced to assist the turbo charging of internal combustion engine so that the volumetric efficiency may improve more. The turbine inlet receives exhaust gases from the engine causing it to rotate. This rotation in turn drives the compressor, which compresses the ambient air and delivers it to the intake manifold of an engine at higher pressure, resulting in greater amount of air entering the cylinder. There are two ways of increasing the power of an engine. One of them would be to make the fuel-air mixture richer by adding more fuel. This will increase the power but at the cost of fuel efficiency and increase in pollution levels prohibitive. The other would be to somehow increase the volume of air entering into the cylinder and increasing the fuel intake proportionately, increasing power and fuel efficiency without hurting the environment or efficiency. This is exactly what Turbochargers do; increasing the volumetric efficiency of an engine in a naturally aspirated engine, the downward stroke of the piston creates an area of low pressure in order to draw more air into the cylinder through the intake valves. The ability to fill the cylinder with air is its volumetric efficiency.

Table 1 Engine Specification

Engine:	
Engine Displacement	99.8 CC
Engine Type	Air cooled, 4 stroke
Number Of Cylinders	1
Valves Per Cylinder	2
Max Power	7.6 PS @7500 rpm
Max Torque	7.5 Nm @5000 rpm
Bore x Stroke	51.0 x 48.8 mm
Fuel Type	Petrol
Starter	Kick

VI. EXPERIMENTAL SETUP

The output of the engine exhaust gas is given to the input of the turbine blades, so that the pressurized air 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.

a) Component Use

For this project I had use mini turbocharger, 100cc bike Tvs centra of Single cylinder four stroke SI Engine, Oil line and Air hose. Single cylinder four stroke SI Engine bike having maximum power of 7.6PS @7500rpm and maximum torque is 7.5Nm @5000rpm. This engine consist 51.0mm Bore and 48.88mm stroke.

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 . The layout of turbocharged engine with parts is shown in Figure 5.2 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. 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 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.

Fig.2 Bike 100cc Single cylinder four strokes SI Engine

Today, the turbocharging 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.

b) Installation of Turbocharger

There are two types of choices in a carburetor turbo setup: "suck-through" or "blow through". The suck through or draw through set up involves mounting the carburetor before the turbine inlet usually in front of the impeller mouth. This means that both fuel and air are drawn into the turbo already mixed and then blown into the inlet manifold. This is by far the simplest way to setup a turbo as; the carburetor doesn't need to be especially modified turning quit essay. The main disadvantage are that you can't use any intercooling with such a setup, as it is dangerous to run air fuel mixture through as an intercooler core.

Fig 3 Installation of Turbocharger.

The reason for this is that fuel can condense inside the intercooler core and stay there. If you then have an engine back fire the intercooler can explode. As a result water injection is about the only option for cooling the charger air with this setup. This also corresponds to a blow-off valve because instead of just venting pressurized air, it would be releasing a fuel/air mixture which is very dangerous. The blow-through arrangement, logically enough, means the carburetor is mounted after the turbo compressor, so the turbo only draws in air and then blow it through the carburetor, which adds the fuel. The good things are than an intercooler and also a blow off valve can be used with such setup.

Fig 4 Installation of Turbocharger on bike

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 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.

VII RESULT

a)Trial and Testing

Readings are taken as the sample tasting method. the process is carried out by taking different quantity of fuel and running the vehicle at steady state condition. The readings of performance are considered as the average of the vehicle.

Table 2 Difference Trial And Testing Without And With Turbocharger

SR. NO.	FUEL QUANTITY	TRIAL NO.	WITHOUT TURBOCHARGER	WITH TURBOCHARGER	INCREASE IN AVERAGE	RESULT
1.	50 ml	1	3.10 km	3.45 km	0.35km	0.34 km
		2	3.13 km	3.50 km	0.37 km	
		3	3.15 km	3.46 km	0.31 km	
2.	100ml	1	6.30 km	6.90km	0.60 km	0.70 km
		2	6.20 km	7.00 km	0.70 km	
		3	6.22 km	6.92 km	0.70 km	
3.	500ml	1	31 km	34.90 km	3.90 km	3.90 km
4.	1000ml	1	60 km	68 km	8 km	8 km

The trial & testing shows the average of vehicle increased by adding turbocharger to the vehicle about 7 km to 8 km per liter of fuel.

Table 3 Result of Fuel Quantity With Increase In Average

Sr. No.	Fuel Quantity	Increase In Average
1.	50 ml	0.34 km
2.	100 ml	0.70 km
3.	500 ml	3.90 km
4.	1000 ml	8 km

As we are taking the testing of vehicle with and without turbocharger the above result is obtained. For taking the above observation we used the average tube. Hence from above result table it shows the **average of the vehicle is increased by 8 km/liter.**

b) Emission Test

The levels of hazardous materials that released from a motor vehicle during combustion have been checked with the aid of emission test. Although emissions in new vehicles have been greatly reduced over the last few decades, the threat to human safety and the environment remains a great concern. The figure 6.2 shows the image of a portable engine exhaust analyzer. A

Nova portable engine exhaust gas analyzer can measure oxygen (O2), carbon dioxide (CO2), nitrogen oxide (NO), nitrogen dioxide (NO2), carbon monoxide (CO), and hydrocarbons (HC's).

The analyzer includes a gas extraction probe which is sometimes called the "cool handle" probe because it has a coiled section made of stainless steel tubing that is effective in dissipating the heat before it continues on to the analyzer. The probe handle is fitted with a built-in filter to removes soot and oil vapors from the sample gas. The probe has a retainer clip to anchor it in the vehicle exhaust pipe. A flexible tip or a bendable straight tip can be provided with the probe handle.

Fig.5 Emission Test Equipment

The exhaust emission of 100 cc SI engine is analyzed using Portable engine exhaust analyzer with and without turbocharger at 2000 rpm. The data obtained for emission test with and without turbocharger is shown in the table 6.3. Emission test measurements taken by engine exhaust analyzer shows variation in the readings with and without turbocharger. It is so clear from the readings that the emission rate of different harmful gases can be reduced using the installation of turbocharger in petrol engine. Turbocharger helps in proper combustion of fuel in engine cylinder and reduces the amount of unburnt fuels. It is done so by allowing compressed air flow in to the carburetor of petrol engine and allows proper mixing of air with fuel and thus favours complete combustion. This reduces the production of harmful gases in engine cylinder.

Table 4 Emission measurement with and without turbocharger

Gases	Without turbocharger	With turbocharger
CO % Volume	1.97	1.30
CO2 % Volume	2.10	1.80
O2 % Volume	19.20	22.10
NO % Volume	44	28
HC PPM Volume	172	144

It can be seen from the table 6.3 that the amount of harmful gas in the combustion product gets reduced with the implementation of turbocharger. Turbocharger reduces pollution by exploring maximum amount of energy from fuel via combustion. It rectifies the problem of unburnt fuels. Emission test shows the need of turbocharger in two wheelers for the reduction of emission which causes pollution and hazards to the environment.

VIII. CONCLUSION

A lot of research, work & study have been done by many researchers in the field of bike exhaust system for improve performance and efficiency and it help to control emission of exhaust system with added mini catalytic convertor on exhaust system of S. I. Engine. Thus we have developed a method to increase the efficiency of the SI Engine and at the same time to control the Emissions from the engine. The various plots drawn from the results of load test show the significance of turbocharger in power generation, fuel economy and emission. A turbocharged engine will have more break thermal efficiency than existing engines. This work is an attempt to minimize our dependency on foreign oil and reduce the tail pipe emission from automobiles. We have use Turbocharger 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 SI engine and at the same time to control the Emissions from the engine exhaust. This type of engine will be more efficient than others. It is also good with regard to economical considerations and engine volumetric efficiency. This work is an attempt to reduce the tailpipe emission from automobiles and increase the average of bike 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.

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