# Design and Analysis of Air Pre Heater in Two Wheeler

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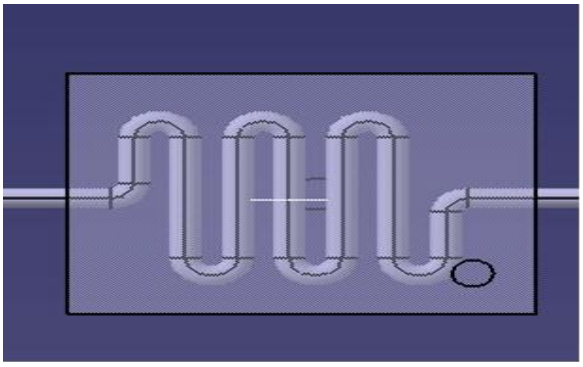
***Abstract -*** In this project paper, we modified the air intake into the cylinder in single cylinder, two stroke air cooled engine (two-wheeler SUZUKI MAX R100 bike) to increase the fuel efficiency. At normal condition, the vehicle which is taken for our project, gives 35 to 40 Km, per liter of petrol. The fuel economy can be achieved up to 40 to 45Km per liter by pre-heating of air to a particular temperature causes an increase of 5 Km per liter of petrol. The preheating of intake air is achieved by introducing an air pre-heater in the exhaust pipe of the vehicle. The air inlet to the engine is fed through the air pre-heater in counter action for effective heat transfer. So for this type of system has not been introduced in two wheelers, this may be very useful to two wheelers without any complication maintenance. But the pre-heater design depends on the exhaust pipe fitted to the particular two-wheeler. The design is simple, cheap and does not give any trouble to the engine.

## 1. INTRODUCTION

The concept of increasing the fuel efficiency of petrol engine in this project, is to pre-heat the intakes air which is flowing through the carburetor. The humidity in the atmospheric air affects the petrol vaporization in the carburetor. Therefore, by preheating the inlet to the carburetor for a considerable amount, the vaporization can be ease and in turn complete combustion is achieved. Moreover by reducing the water vapor to the engine, the steam formation in the engine can be reduced. This prevents the pitting of the engine, piston and exhaust pipe. The pre-heating of inlet air to the engine can be achieved by fixing a heat exchanger in the exhaust pipe. The atmospheric air is sucked through the heat exchanger to the carburetor. The air, which is flowing through the heat exchanger, gets heated by the engine exhaust gas, this reduces the water vapor in the inlet air and the temperature of the air is raised. The temperature raise cause complete combustion in the engine. It can be achieved because of the pre heater setup.

### *1.1. Air – Preheater:*

An air-preheated is nothing but a heat exchanger in which heat is transferred from a hot fluid to air for useful utilization of energy. Pre-heating the air, save the fuel that would otherwise require to heat the combustion air .In addition fuel is burned more completely and the combustible materials lost is less. While designing an air-preheated the laws, which govern this process, should be well understood and thus should be used in this design, construction, testing and operation of the equipment.



#### *1.1.1. TYPES OF AIR PRE-HEATER*

The Air pre-heater are mainly divided in to two groups according to their working features, they are

i) Recuperative pre-heaters
ii) Regenerative pre-heaters

i) RECUPERATIVE:

The two fluids performing the exchangers of heat in exchanger can flow

(a) With each order in the same direction (parallel flow) or in opposite directions (counter flow) and

(b) At right angles to one another (cross flow) with both types of flow, a single or a multi-pass arrangement is possible.

ii) REGENERATIVE:

The regeneration type H.E consists of heat conducting member, which is exposed alternatively to the hot exhaust gases and the cooler air or any other fluids. The heat capacity member is made of a metallic mesh or matrix, which is rotated slowly and continuously exposed to hot and cold medium.

Some of the commonly employed heat exchanger types are discussed below:

- Double pipe heat exchanger
- Double pipe extended surface exchangers
- Shell and tube heat exchanger
- Counter flows exchanger
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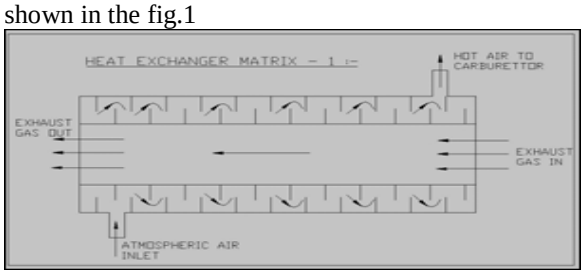
*1.2. Selection Of Heat Exchanger Matrix:*

The matrix selection for the best exchanger should be convenient for fabrication and should be effective.

*1.2.1. Matrix – I*

This type of staggering and overlapping assembly can be used for heating the air. This type provides good passage way for air. But it is difficult to fabricate such a small heat exchanger like this. So this is rejected. It is shown in the fig.1

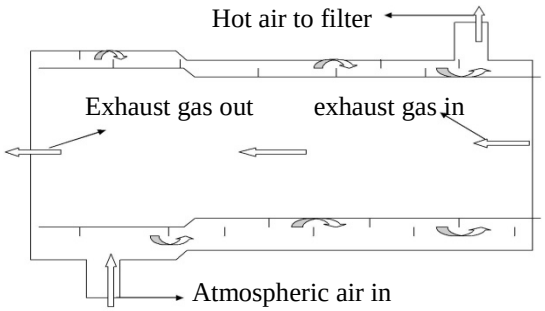



*1.2.2. Matrix – Ii*

This is another type of heat exchanger in which the air passed through a spiral path. It is also a good type of matrix.

Because turbulent flow will occur when air is flowing through the spiral path. In this type we can get an effective heat transfer.

This has no great fabrication or brazing difficulty. So, this matrix is selected. The matrix diagram is shown in the fig .2.




Here the air can flow easily across the heated tube and absorbs some amount of heat and then enters into the filter and carburetor.

*CONSTRUCTION AND WORKING PRINCIPLE*

*3.1. CONSTRUCTION:*

The heat exchanger consists of copper coiled tube connected to exhaust pipe with the help of steel pipe at the both end of copper tube. The heat exchanger is made up of 18 SWG M.S Plate.

The steel pipes have a diameter of 60mm and length 25 mm. The copper tube has a diameter of 58mm. A hole is provided in the heat exchanger box at its bottom for incoming atmospheric air and another hole is provided at back of the heat exchanger pipe for passing air to the filter.

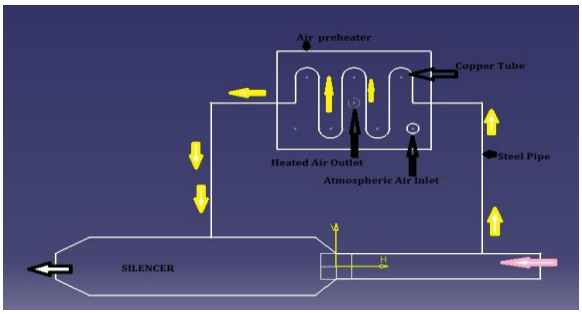
*3.1.1. Two Wheeler Air Pre-Heater- Material Selection:*

The first problem is selecting suitable materials to serve the design purpose. The material should also be locally available. It should be best studied and also cheap in cost. The materials for baffle plates and tubes shall be decided first. Baffle plates and tubes should have very good thermal conductivity. It should also be resistant to chemical corrosion as well as erosion. Some of the materials that can be considered are copper, brass, aluminum and steel. The various factors which determine the choice of material are discussed below.

*3.3. WORKING PRINCIPLE:*

The main aim of "PREHEATING AIR IN TWO WHEELER" is to increase the efficiency of the engine. This is achieved by fixing heat exchanger setup, in which the exhaust gas is main source to heat the atmospheric air before entering into filter. Here some amount of flue gas from silencer enters to the heat exchange pipe (steel pipe) which is connected to air pre heater where the copper tube is placed.

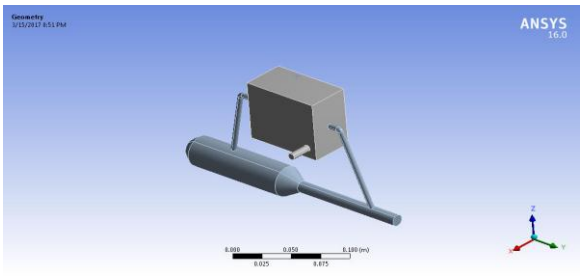
The copper tube gets heated here because of flue gas, when the atmospheric air flows through this pre heater it get heated to some amount and this heated air flows through the filter. The hot air from the filter enters to the carburetor. The speed of the flame increases with an increase of intake temperature of air. Due to higher initial temperature it gives homogenous air vapour mixture that tends to increase the flame speed. It also reduce ignition lag of combustion. Due to this the efficiency of the engine is improved and the thermal efficiency is also increased. The vehicle modified will run without any complication.

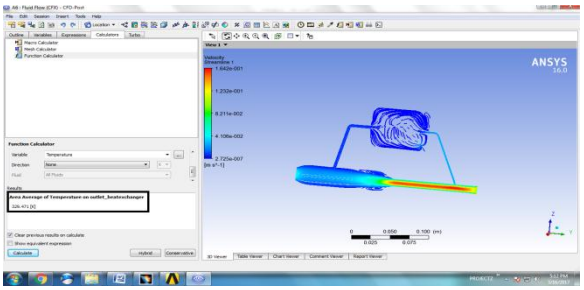



*4.3. Computational Analysis Of Air Pre-Heater:*

ANSYS CFX software is a high-performance, general purpose fluid dynamics program that has been applied to solve wide-ranging fluid flow problems for over 20 years. ANSYS CFX is more than just a powerful CFD code.

Integration into the ANSYS Workbench platform provides superior bi-directional connections to all major CAD systems, powerful geometry modification and creation tools with ANSYS Design Modeler, advanced meshing technologies in ANSYS Meshing, and easy drag-and-drop transfer of data and results to share between applications.




By using the CFD analysis software the output temperature of heat exchanger is found that about 329 k.

*5.1. PERFORMANCE TEST:*

The performance was conducted on the modified two wheeler attached with pre-heater for its fuel efficiency. The following precautions were taken, before the vehicle was ready for the test riding.

The vehicle tire pressure was checked.

The fuel was filled with petrol and lubricating oil.

The brake and clutch plies were checked for their normal operation.

The engine was started and kept at its ideal speed.

*5.1.1. TEST No. I*

The first test was conducted for its actual consumption (without air pre-heater connection) with pillion rider. The following steps were taken:

- The measuring jar filled with exactly 100 cc of petrol from the tank by removing tube connection to the carburetor.
- Then the jar was hanged on the handle bar conveniently with the help of the plastic holder.
- The connection from the fuel tank to the carburetor was disconnected and carburetor float chamber was drained completely by UN screwing the drain screw in the float chamber.
- The carburetor was connected to the measuring jar by means of a plastic tube without making any inconvenience to the rider.
- The breather tube of measuring jar was checked.
- The odometer reading and the initial temperature of various thermocouples were noted down.
- The vehicle was started and attains a speed 30 Km/hr.
- The vehicle was driven for the entire 100 cc of fuel including the fuel in the carburetor.

The above procedure was repeated for 35 Km /hr. & 40 Km/hr. speeds.

*5.1.2. TEST No. II*

The second test was performed with same pillion rider with pre heater connection. The procedure for the test no 1 was repeated .The initial and final odometer readings and temperature were noted down for all the speeds mentioned above.

The two wheeler, SUZUKI MAX R 100 used for the testing purpose. Normally gives, fuel consumption of 35 to 40 Km per liter of petrol at constant speed without changing frequently, at an optimum speed of 30 to 35 Km/hour.

During the test no 1, the vehicle gave 3.5 Km for 100 cc of petrol and 4.2 Km in test no 2 i.e. without and with air pre heater attachment. It shows the fuel consumption is more when the air flowing through the carburetor is preheated. a difference of 8 to 10 cc to atmospheric temperature raises the fuel efficiency from 4.0kms to 4.4kms i.e. 40km / liter to 45 km/liter it is obvious that the raise in temperature causes 10 km more than that of actual consumption per liter of petrol.

CALCULATION
WITHOUT ATTACHMENT

Distance travel /day =22km

Distance travel/month =22x30 =660km

Consumption/liter =35km (avg.)

No. of liters/month =660/35 =18.85 liters

Cost of 1 liter petrol =Rs.70.61

Cost of 18.85 liter of petrol =Rs.1330.9

WITH ATTACHMENT
Distance travel /day =22km
Distance travel/month =22x30 =660km
Consumption/liter =42km
No. of liters/month =660/42 =15.7 liters
Cost of 1 liter petrol =Rs.70.61
Cost of 18.85 liter of petrol =Rs.1108.5

SAVINGS PER MONTH = 1330.9 – 1108.5

= Rs.222.4

From the above calculation it is clear that, by investing an amount of Rs.1500/- for fabricating this system saves Rs.224.5/- per month for a minimum distance of 22 Km/day. So this system may be very much useful and suitable for two wheelers. In addition to that, it needs nil maintenance and will not give any complications; so far the test vehicle has covered a distance of more than 500 Km with this attachment

*7.1. CONCLUSIONS:*

This project provides an excellent opportunity to develop our skill and knowledge in planning; controlling, purchasing, machining, analyzing, coordinating, computing and various difficulties arise in installing a "IMPROVING EFFICIENCY BY PREHEATING AIR IN TWO WHEELER" unit. We feel that the project work is a good solution to bridge the gates between institution and automobile.

We have completed our project successfully within the given time. For "IMPROVING EFFICIENCY BY PREHEATING AIR IN TWO WHEELER" will be very useful in automobiles and it will be used for reducing emission of toxic exhaust's substances and will be helpful to use the fuel in economical way.

## 8. REFERENCE:

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