

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Special Issue 13, December 2015

## Air Preheating in Two Wheelers

V.Pram Kumar<sup>1</sup>, V.Moovandhan<sup>1</sup>

Dept. of Mechanical Engineering, Sasurie College of Engineering, Tirupur, Tamilnadu, India<sup>1</sup>

**ABSTRACT:** In this project paper, we modified the air intake into the cylinder in a single cylinder, two stroke air cooled engine (two-wheeler TVS-50XL 50 cc bike) to increase the fuel efficiency. At normal condition, the vehicle which is taken for our project, gives 45 to 50 Km, per liter of petrol. The fuel economy can be achieved up to 50 to 65 Km per liter by pre-heating of air to a particular temperature causes an increase of 10 Km per liter of petrol. The pre-heating 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 and 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.

### I. 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.

### II. 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 required to heat the combustion air .In addition fuel is burned more completely and the combustibile 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.

#### TYPES OF AIR PRE-HEATER (HEAT EXCHANGER)

The Air pre-heater are mainly divided in to two groups according to their working features a) Recuperative pre-heaters b) Regenerative pre-heaters. It is proposed to apply the items "Recuperative "to the heat transferring method (continuous flow) and Regenerative to the heat charging and discharging (periodic flow) method.

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

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Special Issue 13, December 2015

## 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 exchangers
- Counter flows exchanger

## III. DESIGN OF AIR PRE - HEATER SUITABLE TO AUTOMOBILE TWO WHEELER

### SELECTION OF MATERIALS

The materials for tubes shall be decided first. Tubes should have very good thermal conductivity. It should also be resistant to chemical as well as erosion. Some materials that can be considered are copper, brass, aluminum and steel. Copper has good heat conduction characteristics, but it is not recommended because of its high cost. Also copper is susceptible for easy corrosion.

- 1) Regarding thermal conductivity aluminum has good thermal conductivity and it is much greater than that of steel.
- 2). Aluminum is also highly resistant to corrosion attack. Steel has good weld ability.
- 3).Aluminum is light in weight and also has a bright appearance. Steel is much stronger than aluminum and could also with stand high temperature.

Considering merits of both the metals, steel is best suited for the purpose. But galvanized iron is chosen, as it is available in tube lengths in any diameter and to any required length. Also galvanized iron has very good corrosion resistance property. Further its cost is less and it can weld to G.I sheet or steel sheet

### SELECTION OF HEAT EXCHANGER MATRIX

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

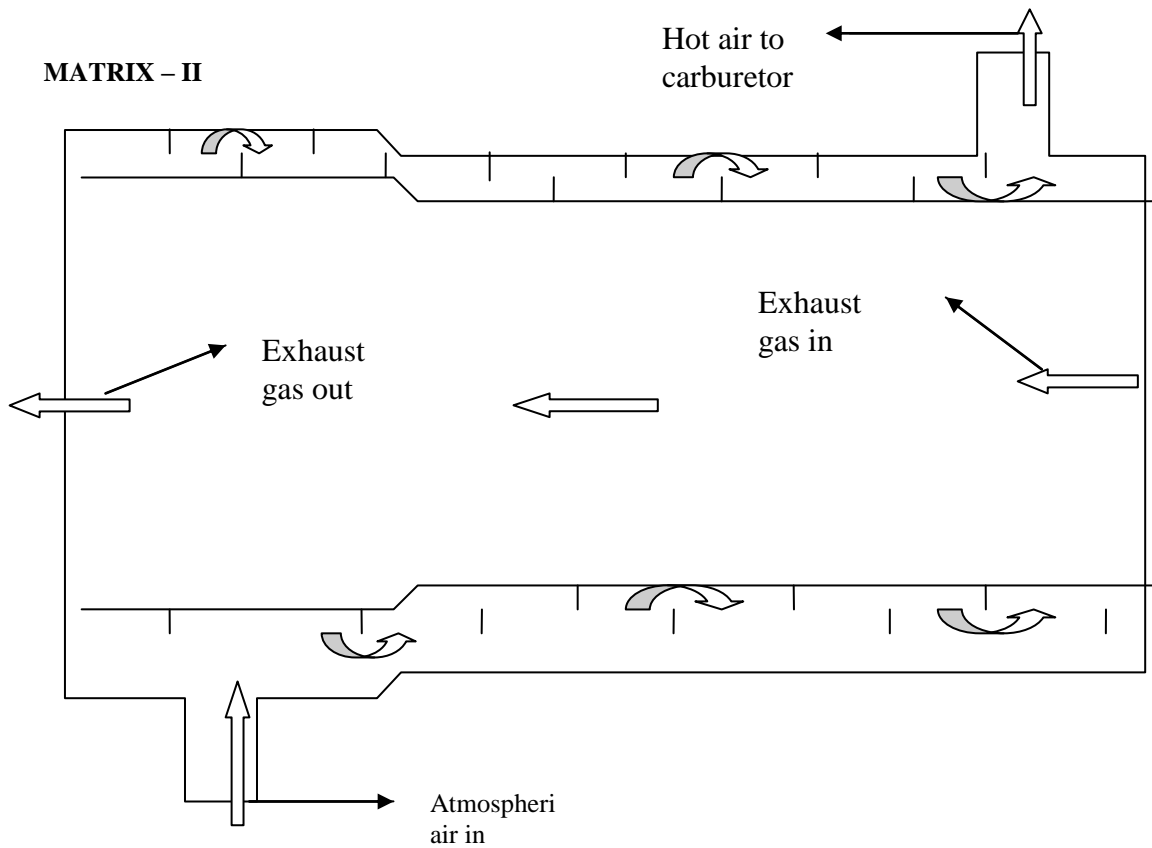
#### MATRIX – I

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.

## International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Special Issue 13, December 2015

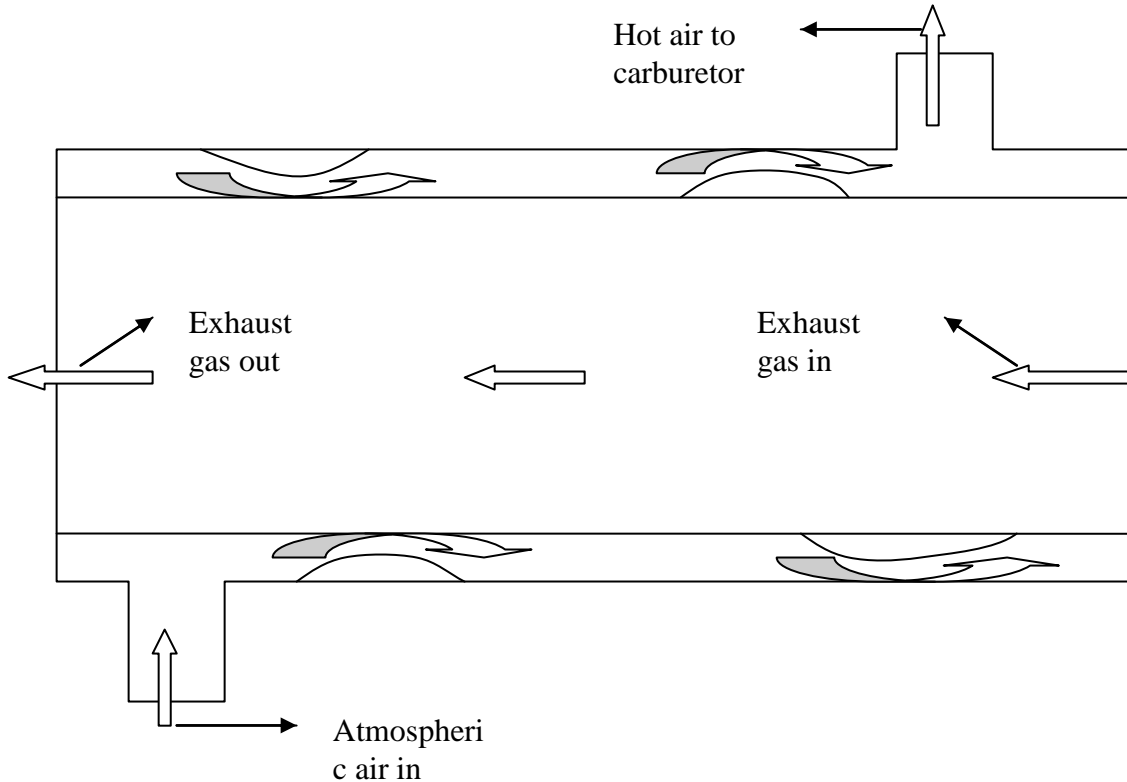


This is another type of heat exchanger in which the air passed through a spiral path. It is also a good type of matrix. Because turbulent flow will occur when air is flowing through the spiral path. In this type we can get an effective heat transfer. This has no great fabrication or brazing difficulty. So, this matrix is selected.

## International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Special Issue 13, December 2015



#### IV. CONSTRUCTION AND WORKING PRINCIPLES OF THE SYSTEM

The heat exchanger is located in the engine exhaust pipe. The exhaust pipe consists of a muffler and stay plates etc. The heat exchanger is made up of 18 SWG M.S Plate. Two tubes of length 230 mm and diameters 40 mm and 25 mm are concentrically enclosed at their ends. The inner tube is inserted tightly on the muffler tube. A spiral baffle plate arrangement is made in between the two concentric tubes so as to make a spiral path to the incoming air. So that the heat transfer to the air can be increased. Moreover the air is flowing in counter direction to the exhaust gas; thereby effective heat transfer can be achieved.

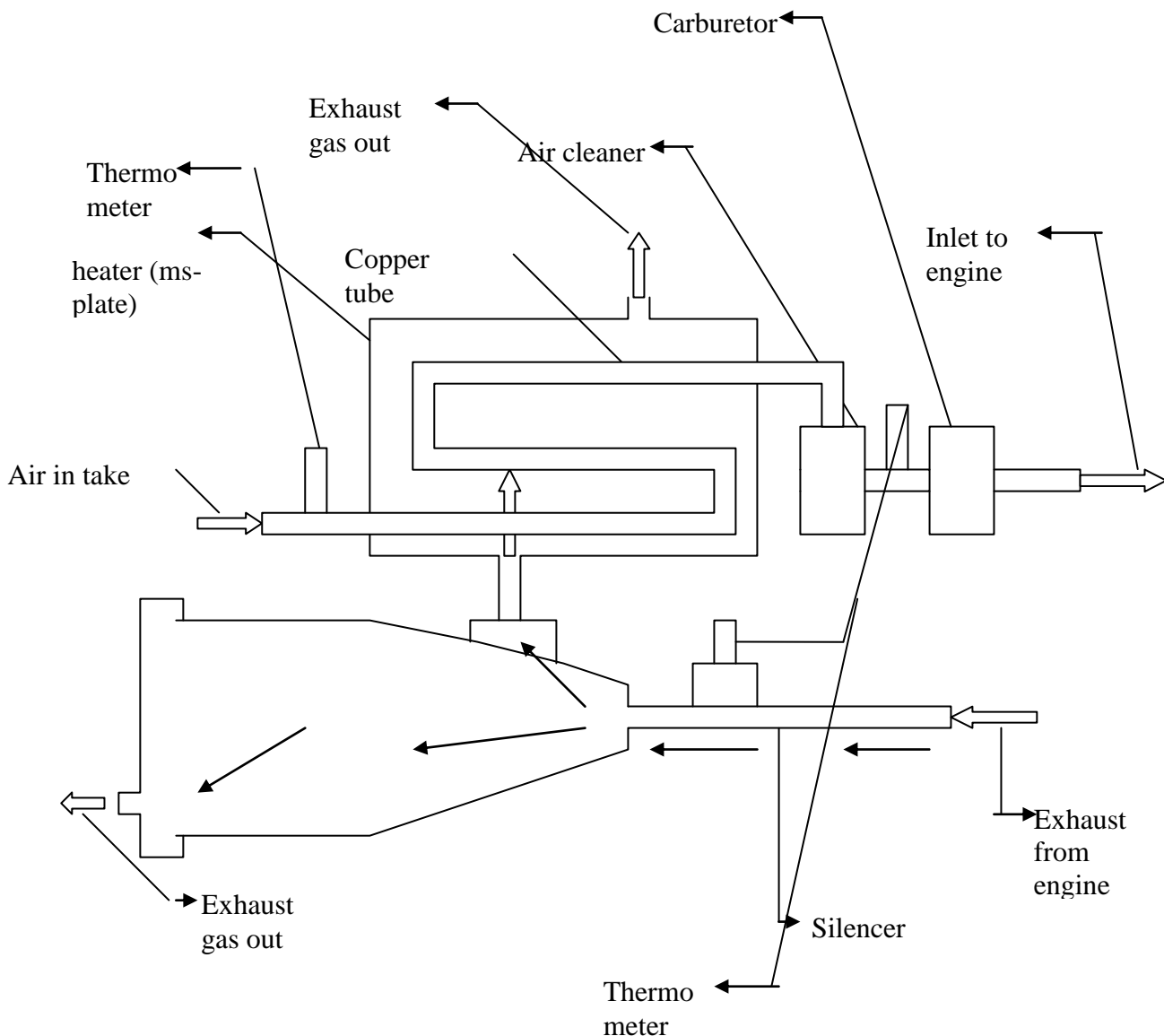
## International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Special Issue 13, December 2015

The heat exchanger inlet is fitted with a pre filter. The outlet is connected to a by-pass mechanism through a hosepipe. The by-pass mechanism consists of a butterfly valve and a thermal relay. The butterfly valve is operated by the thermal relay which depends on the temperature of the hot gas flowing through it from the heat exchanger. The by-pass mechanism is connected to the carburetor intake. The temperature of the air entering to the carburetor can be maintained constant for a particular degree centigrade. When the temperature of air is increased above the predetermined value the thermal relay opens the butterfly valve and allows the atmospheric air to mix with the heated air from the heat exchanger. So the hot air is diluted with temperature of the hot air to the carburetor can be maintained at a particular level. An adjustable screw, which is used to pre-test the thermal relay for the required temperature.

### TEMPERATURE MEASURING INSTRUMENT SET-UP



## International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

**Vol. 4, Special Issue 13, December 2015**

A milli voltmeter is used to measure the temperature at various points, i.e. temperature of air at inlet & outlet of air pre-heater. The readings can be noted by the deflection of the pointer in Millie-voltmeter.

One end of the thermocouple is connected to the Millie voltmeter while the other end is connected at require points on exhaust tube to measure the temperature. The thermo couple wire are perfectly insulated by glass fiber sleeves.

### FABRICATION AND PERFORMANCE TEST ON MODIFIED TWO WHEELER

In the exhaust pipe of TVS 50XL 50cc bike, a drill of 20 mm is drilled and a pipe is inserted on it. Then the pre-heater arranged is fitted on the top of the pipe. The fitting of the pipe & pre heater is done by welding process.

In the pre-heater arrangement, a mild steel pipe of dia 75mm and length 100mm is taken. Inside this a copper tube of dia 10mm and length 200mm is fitted in the form of spiral shape. Then the side of MS pipe is covered with two end plates. Final finishing process is done with the help of grinding process. Then the outlet of the pre-heater is connected to the filter, and then the filter is connected to the carburetor.

### MATREIAL SPECIFICATION

S. No.	Description of materials	Specification	Nos.
1	M.S. Pipe	100mm	1
2	M.S. End plates	75mm 75mm	1 1
3	Rubber hose	6.4 X 600 mm	1
4	Thermocouples	Copper and copper constantan	4
5	Copper tube	Die 10mm Length 200mm	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 Millie voltmeter.
- The engine was started and kept at its ideal speed.
- Simultaneously the deflection changes in the Millie voltmeter were also checked.

### 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:

1. The measuring jar filled with exactly 100 cc of petrol from the tank by removing tube connection to the carburetor.
2. Then the jar was hanged on the handle bar conveniently with the help of the plastic holder.
3. 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.
4. The carburetor was connected to the measuring jar by means of a plastic tube without making any inconvenience to the rider.
5. The breather tube of measuring jar was checked.

## International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

**Vol. 4, Special Issue 13, December 2015**

6. The odometer reading and the initial temperature of various thermocouples were noted down.
7. The vehicle was started and attains a speed 30 Km/hr.
8. The vehicle was driven for the entire 100 cc of fuel including the fuel in the carburetor.
9. The odometer reading and the various thermocouple readings were noted down.
10. The above procedure was repeated for 35 Km /hr & 40 Km/hr speeds.

### 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.

### TEST No. III

The test is performed once again at 30 Km/hr & 40 Km/hr without the air pre heater. After the test is conducted, the test now performed with air pre heater. The average value obtained at various speed is tabulated

### TEST READING FOR 100CC OF PETROL TEST NO 1 & 2

### V. RESULTS AND CONCLUSION

Speed per hour	Atmospheric temperature (Inlet)	Temp of air at air cleaner (outlet)	Exhaust Gas Inlet temp	Exhaust Gas Outlet temp	Test No1 (without Air pre-heater)	Test No2 (with Air pre-heater)
At 30 Km/hr	30	36	163	54	4.5	5.5
	30	36	165	55		
	30	36	165	55		
At 35 Km/hr	30	37	172	62	5.0	6.0
	30	38	175	63		
	30	38	175	63		
At 40 Km/hr	30	40	180	68	4.5	5.5
	30	41	180	70		
	30	41	185	70		

The two wheeler, TVS 50XL used for the testing purpose. Normally gives, fuel consumption of 35 to 40 Km per liter of petrol in city riding conditions and 45 to 50 Km for long riding provided that the vehicle is driven at constant speed without changing frequently, at an optimum speed of 30 to 35 Km/hour.

During the test no 1, the vehicle gave 4.5 Km for 100 cc of petrol and 5.5 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 4.5kms to 5.5kms i.e. 45km / liter to 55 km/liter's it is obvious that the raise in temperature causes 10 km more than that of actual consumption per liter of petrol.

Results have shown that the vehicle gives maximum fuel at 35 km/hr. But on the other hand it gives less efficiency at 30 km/hr. It is further decreased at 40 km/hr. The vehicle may give more fuel efficiency at 35 km/hr than at 30 km/hr .But it was not so, because the amount of air flowing through the preheated is insufficient at higher speeds. In fact the vehicle had stalling effect at 40 km/hr. Using large size heat exchanger in the exhaust pipe can rectify this.

Moreover the vehicle used for testing is not suitable for city riding and below 10km/hr riding. Since it needs a pre -heating of 5 to 8 km and the specified temperature at the particular speed also should be maintained for maximum fuel efficiency. These conditions are possible only in long ridings. But placing the air pre-heater closer to the engine

## International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

**Vol. 4, Special Issue 13, December 2015**

exhaust port can rectify this. The temperature of exhaust gas at the engine exhaust port reaches a maximum of 175 c within 3 minutes at a speed of 40 km/hr. This may be sufficient to raise the air temperature flowing through the air pre-heater immediately. It is clear that the fuel efficiency is 10 km/lit, more than that of the actual consumption.

This reduces the expenses as well as fuel saving of an individual and nation. The following approximate calculation gives an idea that how for this system is beneficial for an individual, if a vehicle will be run for 22 km/day (say) with and without this system.

### WITHOUT ATTACHMENT

Distance travel/day = 22 KMS  
 Distance traveled /month = 22 X 30 = 660 Km  
 Consumption/ liter = 46 km (average)  
 No. of liters /month = 660/46=14.3 liters  
 Cost of 1 liter of petrol = Rs.65  
 Cost of 15.7 liters of petrol = 65 X 14.3 = Rs.930

### WITH ATTACHMENT

Distance travel/day = 22 KMS  
 Distance traveled /month = 22 X 30 =660 Km  
 Consumption/ liter = 56 km (approximately...)  
 No. of liters /month = 660/56=11.7 liters  
 Cost of 1 liter of petrol = Rs.65  
 Cost of 15.7 liters of petrol = 65 X 11.7 = Rs.761  
 Saving / month = Rs.930 – 761 = Rs.169

From the above calculation it is clear that, by investing an amount of Rs.1500/- for fabricating this system saves Rs.169/- 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 attachmen

### REFERENCES

1. **HEAT AND MASS TRANSFER**  
S.C.AROA & DOMKUNDWAR
2. **ENGINEERING HEAT TRANSFER**  
C.P.GUPTA & RAJENDRA PRAKASH
3. **AUTOMOTIVE MECHANICS**  
WILLIAM H.CROUSE & DONALD L.ANGLIN
4. **INTERNAL COMBUSTION ENGINES**  
V.L.MALEEV  
**HEAT TRANSFER DATA BOOK**  
C.P.KOTHANDARAMAN & SUBRAMANIYAN