

# Study of Cold Starting Problem in Scooty Pep+

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## Abstract

In some vehicles there are problem of cold starting and overheating. For the experiment we have selected Scooty pep+. In Scooty pep+ it have 88-CC single cylinder air cooled petrol engine. The major problem in this model is, 1). Cold Starting 2). Transmission systems produce heat. Due to these problems a good Scooty pep+ cannot exist in market. In the winter season the vehicle can't start easily. Due to cold starting problem, the vehicle emits more NO<sub>x</sub>, hydrocarbon (HC) and carbon monoxides (CO). Which can reduce the efficiency and life of vehicle? In this project we will solve the problem of cold starting in vehicle by modification of engine. For the problem of the overheat produce, we will do the material coating on the piston by the material which have less thermal co-efficient so that heat cannot easily dissipate to the transmission. To increase the combustion characteristics we will use different spark plug with different spark intensity.

**Keywords-** Cold Starting Problem, Spark Ignition Engine, light-duty vehicle (LDV)

## I. INTRODUCTION

An internal combustion engine is a heat engine where the combustion of fuel occurs with an oxidizer in combustion chamber that is an integral part of working fluid flow circuit. The term internal combustion engine usually refers to an engine in which combustion is intermittent, such as the more familiar four strokes and two stroke piston engines, along with variants, such as the six stroke piston engine and the wankel rotary engine. Mostly IC engine works on fossil fuels like Petrol, Diesel. It also works on natural gases like CNG (Compressed Natural Gas), LPG (Liquefied Petroleum Gas). Mainly IC engine Classified as SI Engine (Spark Ignition Engine) and CI Engine (Compression Ignition Engine).

### A. Spark Ignition Engine:

The spark ignition engines are used in different applications, such as cars, boats and small power generators. Depending on field of application, the spark ignition engine has certain structure and components which may differ from field to field. A basic spark ignition engine used within the automotive industry has the following structure and components as shown in.

### B. Basic Operations of Four Stroke S.I Engine

Petrol engines take in a flammable mixture of air and petrol which is ignited by a timed spark when the charge is compressed. These engines are therefore sometimes called spark-ignition (S.I.) engines. These engines require four piston strokes to complete one cycle: an air-and-fuel intake stroke moving outward from the cylinder head, an inward movement towards the cylinder head compressing the charge, an outward power stroke, and an inward exhaust stroke.

#### 1) Intake Stroke:

The inlet valve is opened and the exhaust valve is closed. The piston descends, moving away from the cylinder head. The speed of the piston moving along the cylinder creates a pressure reduction or depression which reaches a maximum of about 0.3 bar below atmospheric pressure at one-third from the beginning of the stroke. The depression actually generated will depend on the speed and load experienced by the engine. This depression induces (sucks in) a fresh charge of air and atomized petrol in proportions ranging from 10 to 17 parts of air to one part of petrol by weight.

### 2) Compression Stroke:

Both the inlet and the exhaust valves are closed. The piston begins to move towards the cylinder head. The induced air-and-petrol charge is progressively compressed. This compression squeezes the air and atomized-petrol molecules closer together and not only increases the charge pressure in the cylinder but also raises the temperature. Typical maximum cylinder compression Pressures will range between 8 and 14 bar with the throttle open and the engine running under load.

### 3) Power Stroke:

Both the inlet and the exhaust valves are closed and, just before the piston approaches the top of its stroke during compression, a spark-plug ignites the dense combustible charge. By the time the piston reaches the innermost point of its stroke, the charge mixture begins to burn, generates heat, and rapidly raises the pressure in the cylinder until the gas forces exceed the resisting load. The burning gases then expand and so change the piston's direction of motion and push it to its outermost position.

### 4) Exhaust Stroke:

At the end of the power stroke the inlet valve remains closed but the exhaust valve is opened. The piston changes its direction of motion and now moves from the outermost to the innermost position. Most of the burnt gases will be expelled by the existing pressure energy of the gas, but the returning piston will push the last of the spent gases out of the cylinder through the exhaust-valve port and to the atmosphere.

## II. NEED OF PROJECT

An IC engine is not usually self-starting so auxiliary machine is required to start. Many different systems have been used in the past but modern engines are usually started by an electric motor in the small and medium size or by compressed air in the large size. In the IC engine there are the problems of Cold Starting. In this problem Cold Start attempts to start a vehicle's engine when it is cold, relative to its normal Operating Temperature, often due to normal cold weather. A Cold start situation is commonplace, as weather conditions in most climates will naturally be at a lower temperature than the typical operating temperature. Due to cold starting problem so many problems is occur. Consumer requires more effort to start the engine. In addition to start the engine in cold weather it is require supplying rich mixture of charge (Air-fuel mixture) to the cylinder. Which may increase unburnt Hydro-Carbon emission? Due to reach mixture emission of Carbon Monoxide due to less Oxygen presence inside the cylinder which is toxic. The emission of Nox is increase which creates environment problems.

## III. OBJECTIVES

The primary goal of this project was to develop cold start technologies for IC engine operation. Specifically, in this project we use the SI engines which are widely use in now days for light duty vehicles. We trying to minimize this problem in vehicles at less cost and by easy implementation.

This project contains these following major phases:

- 1) Conduct the cold start performance on the Scooty pep+ engine.
- 2) To design the system by which we can analyze the system.
- 3) To identify and acquire the emission.
- 4) Evaluate the performance, modify equipment/operating parameters and repeat if necessary.

## IV. LITERATURE REVIEW

### A. *The Problem of Cold Starts: A Closer Look at Mobile Source Emissions Levels (Matthew S. Reiter, Kara M. Kockelman)*

This paper synthesizes key findings regarding the influence of ambient and engine temperatures on light-duty vehicle (LDV) emissions. Existing literature, as well as analytical tools like the U.S. Environmental Protection Agency's Motor Vehicle Emission Simulator (MOVES), indicates that while total vehicle emissions have dropped significantly in recent years, those associated with cold starts can still constitute up to 80% for some pollutant species. Starting emissions are consistently found to make up a high proportion of total transportation-related methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), and volatile organic compounds (VOCs). After three to four minutes of vehicle operation, both the engine coolant and the catalytic converter have generally warmed, and emissions are significantly lower. This effect lasts roughly 45 minutes after the engine is shut off, though the cooling rate depends greatly on the emission species and ambient temperature. Electrically pre-heated catalysts, using the bigger batteries available on hybrid drivetrains and plug-in vehicles, may be the most cost-effective technology to bring down a big share of mobile source emissions.

This paper synthesizes a variety of current knowledge about cold start emissions for motor vehicles. Simulations performed using EPA's MOVES program suggests that, regardless of geographic location or time of year, CH<sub>4</sub>, N<sub>2</sub>O, and VOC constitute a significant cost of cold engine starts.

**B. Internal Combustion Engine Cold-Start Efficiency: A Review of the Problem, Causes and Potential Solutions (Andrew Roberts, Richard Brooks, Philip Shipway)**

One area of significant concern in this respect is that of the cold-start; the thermal efficiency of the internal combustion engine is significantly lower at cold start than when the vehicle reaches steady state temperatures owing to sub-optimal lubricant and component temperatures. The drive for thermal efficiency (of both the internal combustion engine and of the vehicle as a whole) has led to a variety of solutions being trialed to assess their merits and effects on other vehicle systems during this warm-up phase (and implemented where appropriate). The approaches have a common theme of attempting to reduce energy losses so that systems and components reach their intended operating temperature range as soon as possible after engine start. In the case of the engine, this is primarily focused on the lubricant system. Lubricant viscosity is highly sensitive to temperature and the increased viscosity at low temperatures results in higher frictional and pumping losses than would be observed at the target operating temperature. The approaches used to tackle the problem include the use of phase change materials (to reduce the cool-down rate during a period following engine running) and the use of thermal barrier coatings in an attempt to insulate the cylinder bore and prevent heat loss (thus increasing the amount of energy utilized as brake work). The review includes both system developments and material selection issues and the role the two fields have to play in tackling this critical issue. Through this review, it can be seen that the issue of internal combustion engine cold-start efficiency is one that has attracted a great deal of attention over the past 40 years. It can be seen that there are noticeable improvements to be had in both fuel consumption and emissions as a direct result of improving the cold start performance of the internal combustion engine. During cold-start, it has been seen that there are three key issues to be addressed. The first is to increase the cylinder liner temperature warm-up rates to improve combustion conditions and therefore improve emission quality. Such an issue also reduces the piston/liner friction levels and therefore improves fuel consumption. Secondly, an increase in the rate of lubricant warm-up is desirable in order to reduce friction losses as a result of the lubricant being at a sub-optimal temperature. In attempting to improve these two issues, one must not adversely affect the catalytic converter whose performance is highly temperature sensitive and is a critical part of the sustain achieving acceptable emission levels. In conclusion, in trying to improve the cold-start efficiency of an I.C. engine, one must view the problem in the context of the vehicle as a whole system. An ideal solution is one that both improves emission quality and reduces fuel consumption whilst also having durability that is acceptable in terms of the expected life of the vehicle and is also cost effective to implement for the manufacturer.

**C. Cold Start Performance Enhancement of Motorcycle Catalytic Converter by Latent Heat Storage System (By K.K. Bokde, A.V. Waghmare)**

Sources of environmental pollution are the motor vehicle consuming traditional fuels and the industries. About 30% of the total heat generated is lost in the exhaust gases by an internal combustion engine. Under normal operating conditions Catalytic converters appear to be the most effective means of reducing air pollution from internal combustion (IC) engines. The conversion efficiency is practically zero during the starting and warming-up period. So it is very important to improve the conversion efficiency under these conditions particularly in large cities, where the number of starting per vehicle per day tends to be high. In the present work we tried to enhance the performance of the catalytic converter by maintaining it hot for maximum conversion efficiency.

A Phase Change Material [PCM] based thermal energy storage system integrated with the catalytic converter is designed, fabricated and tested. After overnight stay motorcycle engine is operated during warm up condition for half an hour, some of the thermal energy of the exhaust gases is stored in the PCM during charging period. During engine shut down period (discharging period), PCM underwent partial solidification and the latent heat thus produced is used to maintain the Catalytic converter hot for maximum conversion efficiency. Due to this after half an hour when engine is started called as cold start period, it is observed that performance of the catalytic converter is improved. We conclude that cold start emissions of the S.I. engine are reduced as compared to emissions of the engine during warm up period by using PCM based catalytic converter.

- 1) On an average, 23% reduction in cold start emissions of %CO is achieved.
- 2) On an average, 21% reduction in cold start emissions of HC ppm is achieved.
- 3) The performance of TES system improves as the number of starting of motorcycle increases.
- 4) As charging period increases, the performance of TES system also improves.

## V. SUMMARY OF LITERATURE REVIEW

- 1) The engine performance and emissions depend on engine speed and temperature of surrounding.
- 2) When the temperature of surrounding is low then the lubricating oil becomes more viscous and it resists the motion of engine so fuel consumption increase.
- 3) When we start the engine at low temperature condition the emission of unburnt fuel (HC) and carbon monoxide (CO) is higher.
- 4) Due to low temperature of surrounding and engine it requires rich mixture to start it up.
- 5) As temperature of engine increase the emission of Carbon Monoxide (CO) is decrease and emission of Carbon Dioxide (CO<sub>2</sub>) is increase.
- 6) The emission of Oxygen is decrease by increasing of temperature of engine as it converts CO to CO<sub>2</sub>.

- 7) As increasing of temperature, combustion of fuel is properly occurring so that emission of Hydro-Carbon (HC) is decrease.
- 8) As increasing of temperature, emission of NOx is increase because Nitrogen is react with Oxygen at high temperature.

### **REFERENCES**

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