Reduction of hydrocarbon by preheating Air-Fuel Mixture by flue gas in S.I. Engines.

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Abstract : The main pollutants contributed by S.I. engines are CO, NO_X and unburned hydro-carbons. Dangerous hydrocarbon smokes from internal combustion(IC) Petrol engine is due to incomplete combustion of fuel. For maximum combustion of fuel in engine and to avoid dangerous harmful gases from exhaust, we propose a new concept of pre heating a fuel-oxygen mixture, before fed into the S.I. engine. This preheating of fuel makes the expansion in fuel. This preheating and expansion of fuel is done in separate expansion chamber by exhaust gas from engine. Preheating of fuel is done at constant pressure which expands the fuel volume as the ratio of increasing in temperature. Hence this makes the reduction of hydrocarbon and increase the thermal efficiency of the engine.

Index Terms: Hydrocarbons (HC), Internal Combustion Engine (I.C.), Nitrogen Oxygen (NO_X), Spark Ignition engine (S.I.), Four stroke petrol engine, Fuel pre-heater, Expansion chamber.

INTRODUCTION

Hydrocarbon emissions result when fuel molecules in the engine do not burn or burn only partially. Hydrocarbons react in the presence of nitrogen oxides and sunlight to form ground-level ozone, a major component of smog. Ozone irritates the eyes, damages the lungs, and aggravates respiratory problems. A number of exhaust hydrocarbons are also toxic, with the potential to cause cancer.

Aim of this Paper, is to reduce Hydrocarbon and other dangerous gases from exhaust in Internal Combustion Petrol Engine by maximum combustion of fuel air mixture in the engine. Expanding the fuel by preheating is not only for maximum combustion but also to achieve more thermal efficiency of the engine.

PERFECT COMBUSTION:

FUEL (hydrocarbons) and AIR (oxygen and nitrogen) which gives CARBON DIOXIDE, water and unaffected nitrogen.

$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$.

TYPICAL ENGINE COMBUSTION:

FUEL (hydrocarbons) and AIR(oxygen and nitrogen) which gives UNBURNED HYDROCARBONS, NITROGEN OXIDES, CARBON MONOXIDE, CARBON DIOXIDE and H_2O.

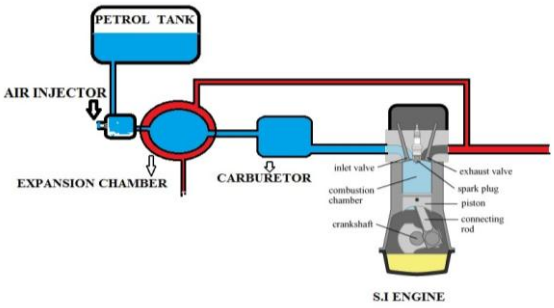
$C_3H_8 + 2O_2 \rightarrow 3C + 4H_2O + C + H_2O$

FUEL PREHEATER —- EXPANSION CHAMBER:

Fuel preheater is a general term which describe any device designed to heat the fuel mixture before another process with some sources, in this experimental setup hot flue gas from engine is used as source of preheating the fuel. While expansion chamber is the chamber where the expansion of fuel takes place with the help of pre-heater.

The pre-heating of inlet ait to the engine can be achieved by fixing a heat exchanger inside the exhaust pipe. Fuel is sucked through the heat exchanger to carburetor. The fuel mixture from air injector is flowing through heat exchanger gets heated by engine exhaust gas. This reduces the water vapour in the inlet air and the temperature of the fuel mixture is raised. The temperature raise causes maximum combustion in the engine and it is also more suitable for warming up the engine in cold condition and also increase the thermal efficiency of the engine.

EXPERIMENTAL SETUP :



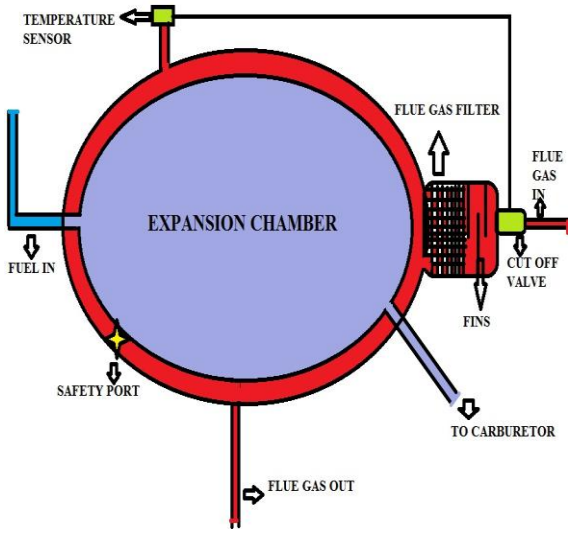
PROCESS:

PETROL TANK → AIR INJECTOR →EXPANSSION CHAMBER→ INLET VALVE OF ENGINE.

In this experiment consist of additional two parts on compared to ordinary system. One is expansion chamber and another is air injector chamber.

First petrol from the tank is passed to the air injector chamber where the air mixed with petrol in 2:1 ratio. Then the mixture is passed to the expansion chamber. Expansion chamber is surrounded by copper or aluminum tubes where the hot exhaust gas is passed through it.

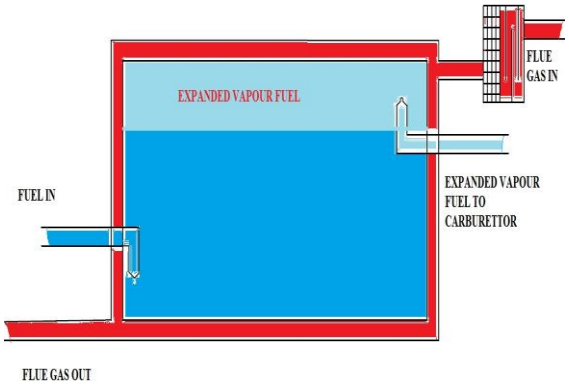
At initial state (starting time):



Fuel inlet of the expansion chamber is given at bottom while the outlet is given at the top of the chamber. Exhaust gas inlet is given at top of chamber while outlet is given at bottom of chamber. At the inlet of exhaust gas mesh type filter is provided to filter the carbon content and also to filter the dust particles present in it. Pressure lead screw is also provided in the exhaust gas flow tube. Lead screw is provided for safety purpose only. If the pressure of the exhaust gas tube increases lead screw automatically release. Temperature of the flue gas tube is maintained constantly by using sensors.

At initial stage, chamber is fully filled with fuel after a few seconds fuel at top of chamber is consumed by the engine then the hot air from engine is used to heat the chamber.

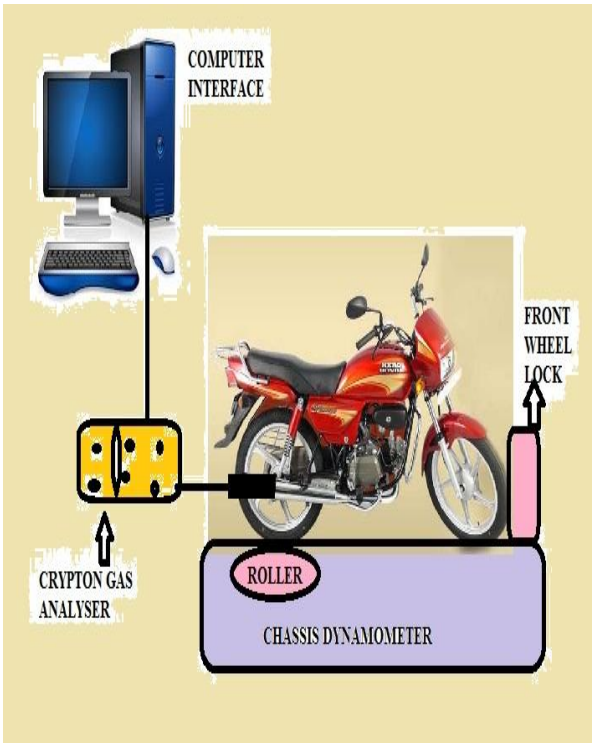
At running (after few seconds):



After few meters running of vehicles fuel at top of the chamber are consumed by the engine. Then that gap is filled by the expanded fuel because of heat supplies from exhaust gas.

SET UP :

The experimental setup consist of test bike, two wheeler chassis dynamometer, engine speed sensor, exhaust gas analyzer and computer interface for analyzing the exhaust gas. Test bike was mounted on chassis dynamometer and the experiments were carried out to measure the exhaust gas using the exhaust gas analyzer. Exhaust analyzer was interfaced to a computer to record the exhaust emission for every 2 secons.



Among various exhaust gas emission, hydrocarbon were emitted in relatively large quantities. The variation of hydrocarbon with de-sign variables (engine cubic capacity (CC) / displacement volume, secondary air supply) and operating variables (idiling speed, lubricating oil temperature) were analyzed and the data were used for simulation. The hydrocarbon were found to be influenced by engaging choke starting system or multiple starting attempts at starting. All the test runs were carried out at an ambient temperature of 30^{o}C.

PRACTICAL OBSERVATION:

Test was conducted using 50 ml of fuel and its observation are as following two different conditions.

WITHOUT PREHEATER

S. No	Fuel used (ml)	Speed (rpm)	Distance covered (km)
1.	50	0-40	1.8
2.	50	0-40	1.7
3.	50	0-40	1.8
4.	50	0-40	1.9

WITH PREHEATER

S. No	Fuel used (ml)	Speed (rpm)	Distance covered (km)
1.	50	0-40	2.4
2.	50	0-40	2.5
3.	50	0-40	2.4
4.	50	0-40	2.3

Air-Fuel mixture from carburetor is fed to expansion chamber. Expansion chamber is surrounded by copper and aluminium tube in which the hot flue gas from the engine is circulated, which is used to maintain the temperature of about $45\text{-}50^{O}$ C. This is used to preheat the Air-fuel mixture. This temperature is maintained by sensor arrangement.

Since the temperature of the mixture is doubled my preheater, volume of the mixture is also doubled because of constant pressure process.

As the mixture is expanded , complete combustion takes place inside the engine during power stroke. Because of complete combustion there is no unburned hydrocarbon while exhaust stroke, hence the hydrocarbon is completely burned this reduces the presence of hydrocarbon in flue gas.

The ratio of expansion can be controlled by controlling the ratio of increase in temperature in the expansion chamber.

$PV = mRT$ (*mR = constant)

$PV \propto T$ (*Pressure = constant)

$V \propto T$

$$\frac{V_1}{V_2} = \frac{T_1}{T_2}$$

Since T_1- Temperature of mixture in carburetor.

T_2 – Temperature of expansion chamber

V_1 – volume of mixture at inlet of expansion chamber

V_2 – volume of mixture at outlet of expansion chamber

ADVANTAGES:

- Maximum combustion
- Increase in thermal efficiency
- Fuel expansion
- Reduce of hydrocarbons
- Elimination of moisture
- Maximum utilization of fuel.

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