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Emission control in IC engines

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Abstract:—Global warming has become a very huge challenge for mankind and one of the reasons for environmental degradation is emission of harmful gases due to incomplete combustion of the fuel. The problem is becoming severe day by day because of increase in the vehicular density. Numerous solutions have been proposed till date to overcome this challenge. In this paper the effect of addition of browns gas to air fuel mixture has been investigated. By electrolysis[1] process, Brown's gas [2], a highly combustible gas is generated when water is sent into hydrolyser kit. Due to high combustible nature of the brown's gas, both browns gas and fuel completely burns in the IC engine[3], hence giving no scope for the incomplete combustion. With the introduction of browns gas a 99% decrease in the unburned hydrocarbons[4] and Carbon monoxide[5] has been observed when compared to exhaust because of air fuel mixture alone (without browns gas).

Keywords:—Electrolysis, Brown's gas, IC engine, Unburned hydrocarbons, Carbon monoxide

I. INTRODUCTION

In today's world, there are more number of vehicles on road than before. On an average every house in developed and developing country has at least one two or four wheeler at their home. Cost escalation and increase in demand of the crude petroleum and failure to invent an alternative source of fuel are the current day problems. Added to this, petrol products when burned in an engine emit harmful effluents as exhaust. These effluents are responsible for acid rains, glacier melts, global warming etc. Numerous researchers around the world are involved in the field of developing alternate fuels and to reduce emission by external means like use of catalytic convertors and engine modifications. However some researchers [6]have also suggested the use of additives like browns gas, blending vegetable oils with petrol etc to reduce emissions. In this present research work at attempt to study the exhaust when browns gas (additive) mixed with air and petrol as a fuel in four stroke engine was done.

II. THEORY ON BROWNS GAS

Hydrogen is a combustible gas and water on electrolysis splits into two molecules of hydrogen and one molecule of oxygen, hydrogen and oxygen though evolve separately in the electrolysis setup but combines immediately to form Oxy-hydrogen gas(HHO) or commonly called as Brown's gas in the collection tube.

On introduction of the brown's gas and air fuel mixture through the air-inlet manifold of the carburetor (figure 1) into the IC engine, the highly flammable Browns gas[4] ignites a fraction of a second earlier than the fuel. No flash points, explosive points or temperatures soaring, takes place during the combustion within the cylinder. The flame speed of hydrogen is very high compared to that of gasoline. Hence there is no delay in combustion between two points in the cylinder ensuring a smoother performance, this helps in uniform and complete combustion of the additive and fuel mixture inside the cylinder of the engine. In addition to this the life and performance of the engine improves . And because of the complete combustion of the fuel and Browns gas mixture, it ensures that there are no unburned hydrocarbons and also oxidizes the partially oxidized carbon i.e. carbon monoxide (CO) into completely oxidized carbon dioxide (CO2) which is less harmful compared to carbon monoxide. This results in significant decrease in hydro carbon level in the exhaust of the engine [3]. The brown's gas doesn't cause any pollution as the product after combustion is steam.

The brown's gas is liberated using the electrolysis process, where the current is passed through the solution of distilled water and potassium hydroxide(electrolyte), this liberated volume of brown's gas directly depends on:

i. Concentration of Electrolyte.
ii. Current sent into the solution.
iii. Area of contact between the electrode and the solution.

A. Hydrolyser kit Design:

The production of browns gas is done by a hydrolyser kit, designed for this purpose. The kit contains four cylindrical polycarbonate canisters (fig. 2) filled with 1M KOH solution till the electrodes are completely immersed. The electrodes are made up of 316L stainless steel (100mm length x 40mm breadth x 1mm thick), the electrical connections are made with the Teflon coated wires and the electrodes are held with nylon screw, nut and washers so as to resist the heat produced and to provide insulation, also the electrodes are separated using rubber washers to avoid short circuiting. These four canisters are electrically connected in series to maintain constant current in all the canisters. The evolved brown's gas from each canister is directed to flow through Pressure equalizer tubes and the gas from all the canisters is sent into the gas control valve and then to the Inlet manifold of the carburetor. The canisters are sealed using Teflon tapes to avoid leakage of brown's gas.

III. EXPERIMENTAL METHODOLOGY

The experiment was conducted on a Bajaj RE auto rickshaw of 4 stroke, 180cc displacement, air cooled, and

6BHP engine. The brown's gas from the hydrolyser kit is sent into the cylinder of the engine, and emission test was done on the exhaust gas from the emerging from the engine. Here the approximation was made on the volume flow rate of the browns gas from the hydrolyser kit, the experiment was performed using two different apparatuses due the high rate of error and the average of these results has been displayed. For this experiment two canisters were connected in series, with both their out lets connected to a common tube using a T valve. Different flow rates were obtained for different values of current through the canisters. The canisters were connected in series with a 12V Variable Supply. The two methods used to measure the flow rate were

1. Gas Flow Meter:

This method involves connecting the output from the canisters to the input of a gas flow meter. There is a possibility of error due to higher pressure inside the meter hence the reading will be lower than the actual value.

2. Downward Displacement Of Water:

This method involves inverting a measuring cylinder filled with water in a trough containing water. The outlet from the canisters is introduced into the measuring cylinder. As the gas is evolved the water level decreases and hence we can evaluate the gas evolved per unit time. The lower pressure inside the measuring cylinder creates a suction of sorts and hence the reading tends to be higher than the actual value. By taking the average of results error is eliminated to a considerable extent and a graph was plotted (fig. 3).

The hydrolyser kit consists of four canisters placed in series inside a wooden frame and the tubes are connected to each canisters and the overall setup is as shown in figure 4. And the series goes accordingly as shown below.

- Battery
- Hydrolyser Kit
- Flow control Valve
- Engine
- Emission testing

The sequence explains, the Current from the 12Volts and 7 Ampere hours, commercially available lead acid battery is drawn by the hydrolyser kit and the liberated brown's gas is sent to the flow control valve and the gas from the flow control valve is sent into the cylinder of the engine through the air intake manifold of the carburetor and the fuel, air and brown's gas mixture is burned in the cylinder. The emission testing was done for different flow rates but for one particular flow rate, the effluents from the emissions were reduced to a very large extent as shown in the results below in table I.

IV. RESULTS AND DISCUSSIONS

The results obtained gives a clear picture on how effective the hydrolyser kit is, as the effluents in the emission gasses are reduced to a very high extent. The Hydro carbon has reduced by 99.25% and Carbon Monoxide has reduced by 98.668% by volume. This means that there are only traces of amounts of effluents present after the hydrolyser kit is installed into the vehicle

Table 1. Emission levels before and after passing of Browns gas

	Emission before passing brown's gas.	**Emission after passing brown's gas**
Hydrocarbons	2800ppm	21ppm
Carbon monoxide	2.5%vol	0.0333%vol

A. Figures and Tables:

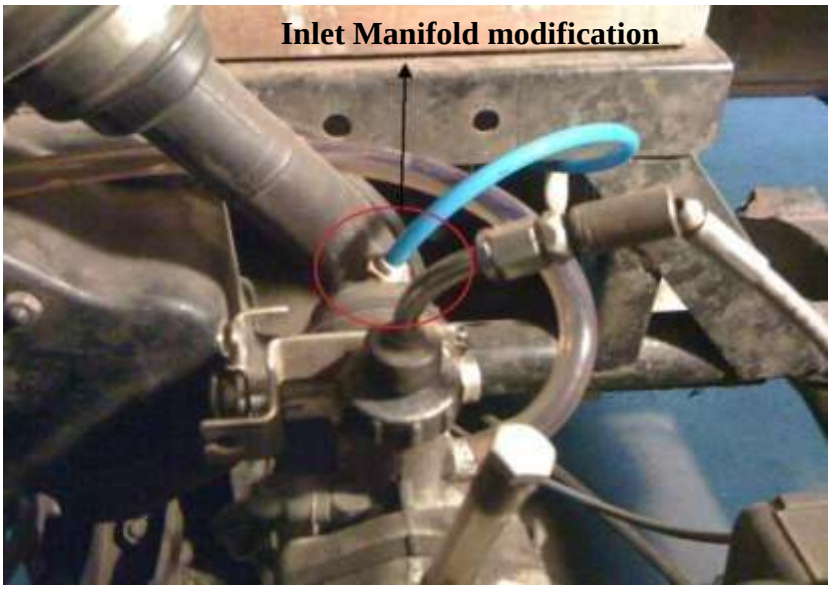

Figure 1: Modifications to inlet manifold for the introduction of browns gas.

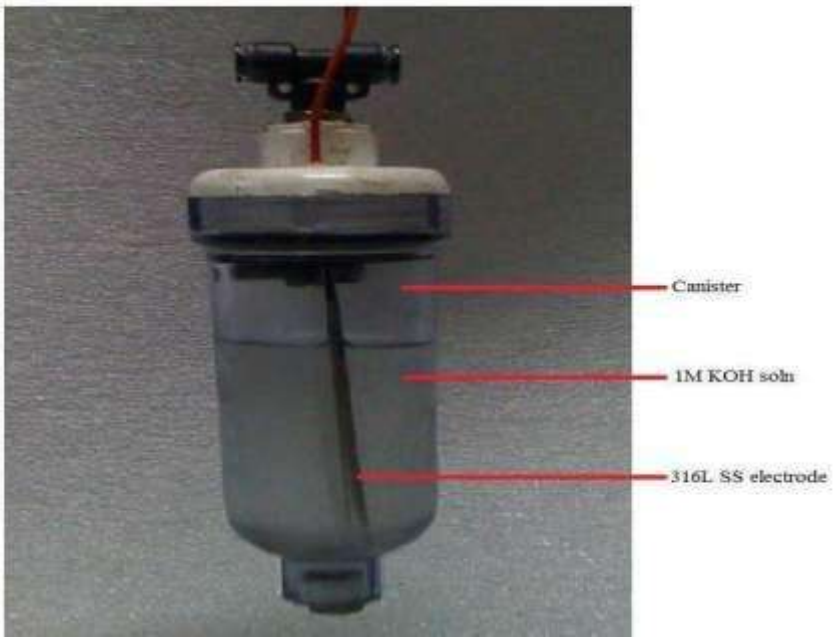

Figure 2: Single Canister.

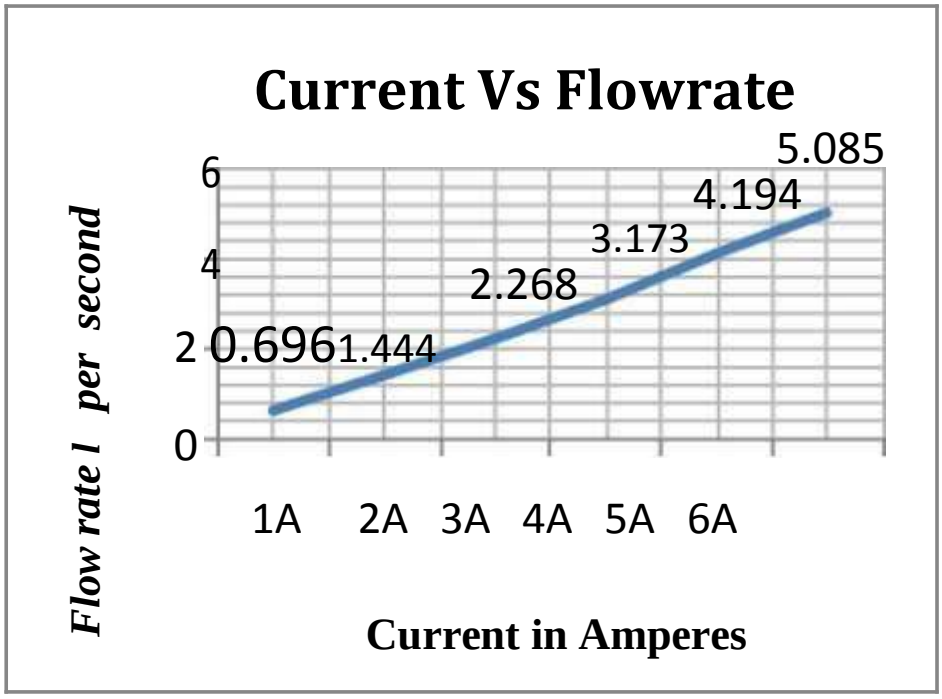

Figure 3: Shows flow rate of browns gas against Current.

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