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Experimental Determination Of Gasoline Vapor Loss Due To Sloshing In A Fuel Tank

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Abstract—**About 62% of the gasoline available in India is used by the two wheelers. And also as the two wheelers are not fitted with emission control devices, this significantly adds to pollution. Evaporative emissions have become a serious concern in the present scenario. Vehicles other than two wheelers are fitted with evaporative emission control devices. So causes of evaporative emissions should be taken seriously in a country like India where two wheelers rule the roads. Here we find how sloshing contributes to emission of gasoline vapours from fuel tank. Sloshing of fuel especially gasoline causes spillage as well as emission of vapours. Emission of vapours due to sloshing can be through the vents of tank or through the fuel caps due to its age. In this experiment we will find the HC emission from fuel tank with sloshing effect for different levels of fuel. Experiment is done by rocking the tank back and forth and then using gas analyser to find HC emissions. Different levels of fuel were taken from 1 litre to 6 litres which is full capacity**

Keywords—***sloshing, UNECE, HC, SHED***

I. INTRODUCTION

Sloshing can be defined as movement of free surface of a liquid in a container. In the case of two wheelers it can be due to acceleration and deceleration of the vehicle this causes sloshing. Sloshing of fuel in tank can cause movement of the fuel which causes it to spill through the fuel cap and also forces the vapors out through the vents. Although tail pipe emissions are of serious concern, more emphasis should be given to HC emission produced because of the wide spread use of two wheelers in Indian automotive market [1]. Though the amount is less this poses a serious problem to the environment and leads to air pollution and also causes wastage of fuel.

Previous work in this field has tried to figure out methods to reduce sloshing and the noise produced by sloshing [2] by carrying out simulation and impact pressure studies. And this experiment results in determining a minor portion of running loss emission, which is a type of evaporative emission [3]. The emission of vapor depends on level of fuel, age of fuel tank, terrain in which vehicle is operated. The experiment takes into account some of these factors. Sloshing does is it expels the vapors out of the tank due to movement of fuel within. But as vapors get removed more vapors occupy the available space and thus accelerates evaporative emission. The frequency of oscillation was fixed to 15 cycles per minute according to durability test standards for fuel tank- UNECE, [4] and the readings were taken for the HC emissions.

II. EXPERIMENTAL SETUP

During this experiment two similar fuel tanks used in two wheelers are taken. One is in brand new condition and other is used for about 20000kms. They undergo sloshing with the help of a mechanism run by a motor. Sloshing action is continued for a period of 180mins, and readings were taken with the help of HORIBA gas analyzer.

The fuel tank used in the experiment is obtained from Honda Dio which is a 102cc scooter. It uses a tank of capacity 6 liters made of metal. It has a metal cap and vents through which fuel vapors can come out during sloshing. The tank was fixed on a wooden platform fitted with wheels and this was then connected to an eccentric shaft mechanism driven by a motor. The speed of the motor was adjusted to make the oscillations correct.

The fuel tank was placed in a mini SHED which was setup on a moving platform with wheels. This arrangement was then connected to an eccentric shaft arrangement propelled by a motor, this was used to produce the back and forth motion of

the setup. As shown in Fig 1. The back and forth arrangement was fixed for a frequency of 15 cycles per second by adjusting the speed of the motor. Both the tanks were tested with different levels of fuel starting from 1 literto 6 liters (max capacity) and readings were taken for HC emission at each fuel level and it was compared.

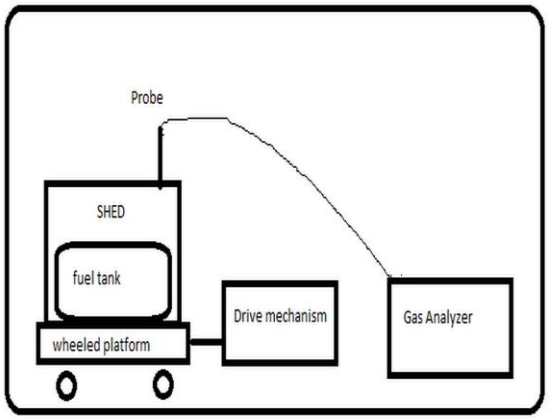

Fig.1. Experimental setup

The temperature at the time of experiment was maintained at 29 degree Celsius. Horiba gas analyser was used to measure the amount of HC during intervals of 20minutes for about 180minutes of experiment duration. This was repeated for different levels of fuel in the tank.

III. RESULTS AND DISCUSSION

The HC emissions from both the tanks were measured using the analyser and graphs were plotted. In fig 2 the graphs for HC emission vs. time is plotted when the tank contains 1 liter of fuel. At this point effect of sloshing is more because more free space available in tank also more vapor formation occurs so the emission of HC is more

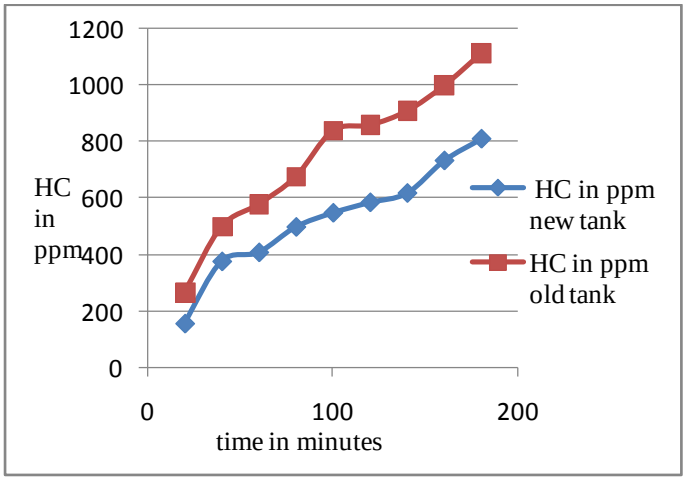

Fig.2. HC emission when tank filled with 1 litre of Gasoline

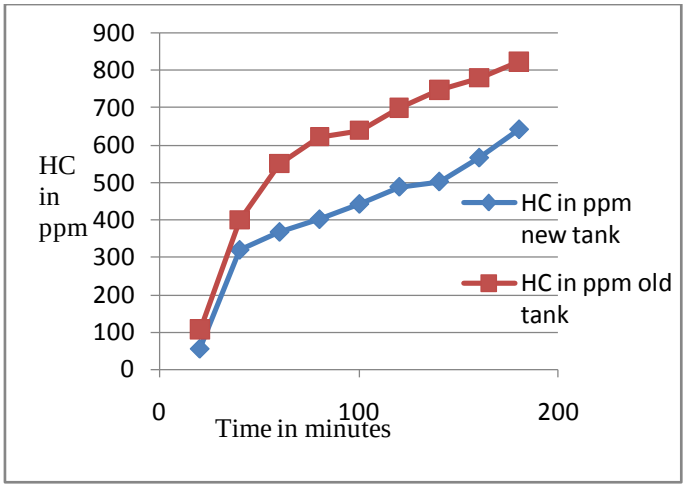

Fig.3. HC emission when tank filled with 2 liter ofGasoline

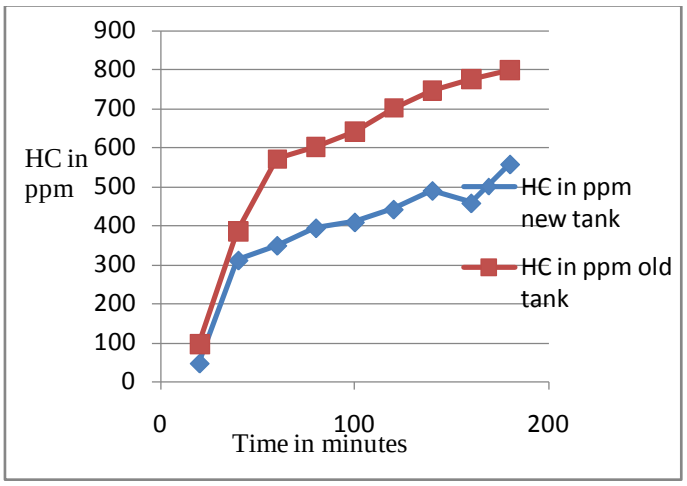

Fig.4. HC emission when tank filled with 3 liter of Gasoline.

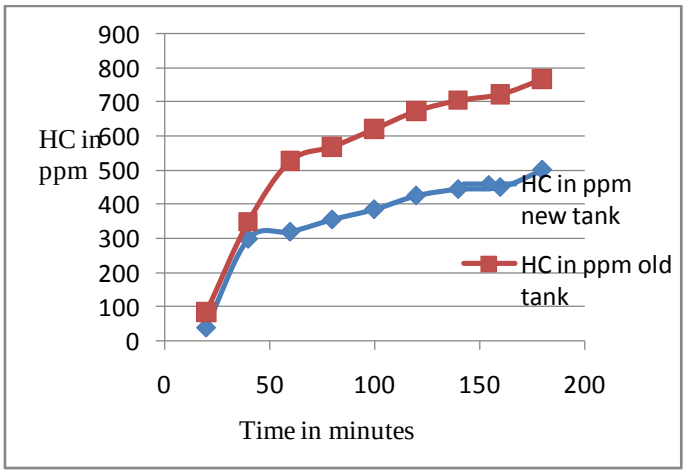

Fig.5 HC emissions when tank is filled with 4 litre fuel

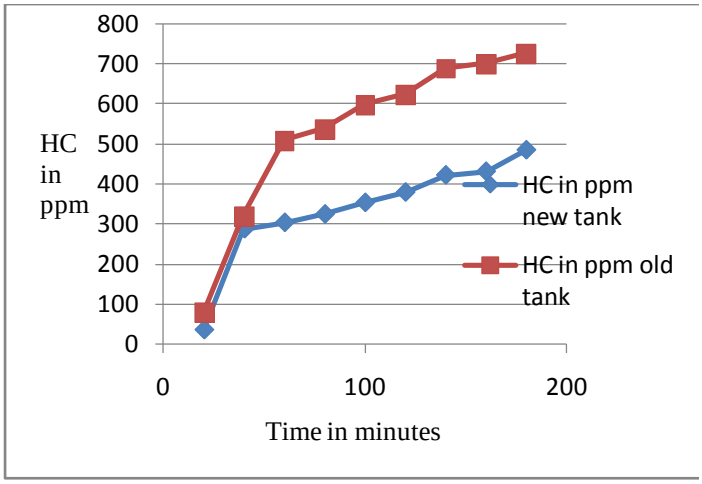

Fig.6. HC emission when tank is filled with 5 litre fuel

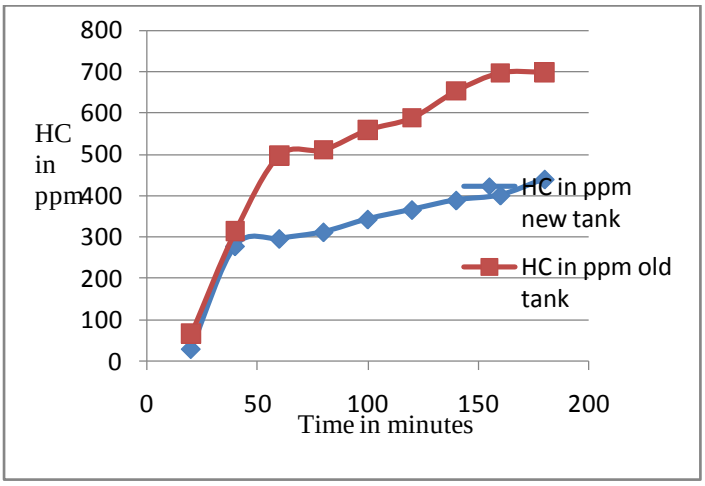

Fig.7 HC emission when tank is filled with 6 liters (full capacity)

There is very less difference in emission of vapors when fuel level increases from 2 liter to 3 liter of fuel. This can be seen from Fig. 2 and Fig. 3.This experiment also show the effect of sloshing causing more vapor loss in both the tanks this adds onto the HC emissions.The HC emission from the tank which was used is found to be more compared to that of the new tank. But both shows vapor loss due to sloshing. So this is a serious concern taking into consideration about the huge number of two wheelers in India.

IV. CONCLUSION

When we compare both the tanks, vapor loss due to sloshing is more in the used tank compared to the brand new tank. This shows that the age parameter plays a major role in vapor loss. This could be due to wear and tear of the fuel cap and damages to the vapor venting system. Also there is decrease in loss of vapor as level of fuel increases this is because the effect of sloshing reduces as the fuel level increases. But when the fuel level is 100% there is more vapors coming out due to spillage or overflow. This type of fuel vapor loss can be reduced by installing vapor recovery system. Future work is to show the simulation of this phenomenon, so that a clearer picture is available to us. Also these call for the introduction of vapor recovery systems in two wheelers in India.

V. REFERENCE

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