Presentation of the

Technical paper

On

<u>“THE EVAPORATIVE LOSSES CONTROL SYSTEM”</u>

Presented by

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ABSTRACT

The internal combustion engine was one of major breakthrough by Jean Joseph Etienne Lenoir around 1960. Since than its modification has been under progress and now every thing now days runs on internal combustion engine, from industry, marine to a small nano car. The diesel engine has provided the power units for cheap transportation system, i.e. buses, and goods transportation system, i.e. trucks, Indeed the petrol engine powered automobile and diesel engine powered buses and trucks are the symbols of modern technological society.However, in recent time the internal combustion engine powered vehicles have come under heavy attack due to most serious problem of air pollution. From these powered vehicles different pollutants like carbon monoxide, unburned hydrocarbons, oxides of nitrogen and other particular emissions causes air pollution. The evaporate loss both tank and carburetor are possible sources of atmospheric pollution from a petrol engine powered vehicle. The evaporative emission from fuel tank causes fuel tank losses. These losses are due to due to temperature increases etc. similarly the carburetor losses are due to evaporative emission from carburetor.All above explain different types of losses causes the air pollution. The air pollutants by automobile are 50% of total air pollutants which has rang the alarms for the pollution board. In recent years the pollution has caused many bigger problems. So this technical paper deals with a case study of method which is not prominent in India i. e. evaporation loss control device (ELCD). It is a step for controlling of the evaporative losses.

Keywords: Engine, Pollution, Evaporation losses.

INTRODUCTION

The rise in civilization and modernization has made the developers to make many developments in the I.C. engines used now days for many purpose. In the development of transport the internal combustion engines, both petrol and diesel engines, has played a very important role. The petrol engine has provided reliable small power units for personalized transport and in this way revolutionized the living habits of people to a great extent. The diesel engine has provided the power units for transportation system, i.e. buses, and goods transportation system, i.e. trucks. Indeed the petrol engine powered automobile and diesel engine powered buses and trucks are the symbols of modern technological and developing society.

However, in recent times the internal combustion engine powered vehicles have come under heavy attack due to various problems and most serious problem is air pollution which has alarmed the govt. and has caused many problems, for example the covering of Taj Mahal marble with the black pollutant coating. The main pollution contributes by automobiles are carbon monoxide (CO), unburned hydrocarbons (UBHC), oxides of nitrogen and other particular emissions.

However, in developing countries like India, the air pollutants by automobiles are about 50 per cent of the total air pollutants. The pollutants amount becomes millions of tones. As of 2010, India is home to 40 million passenger vehicles. More than 3.7 million automotive vehicles were produced in India in 2010 (an increase of 33.9%), making the country the second (after China) fastest growing automobile market in the world in that year. According to the Society of Indian Automobile Manufacturers, annual vehicle sales are projected to increase to 4 million by 2015.

As the market is rising in automotive industry so it is imperative that serious attempts should be made to conserve earth's environment from degradation. Pollution has been caused due the incomplete combustion of the fuel. Another type of pollution occurs due to evaporation of fuel from fuel tank and from carburetor etc. So a new technology has been introduced i. e. evaporation loss control device which controls the evaporation of fuel using carbon as a base material which is a good absorbent of fuel. The device helps to conserve the fuel and the efficiency of vehicle is increased. As now a days fuel prices are increasing day by day, so this ha increased the pressure on automotive engineers to increase the efficiency of engine.

The use ELCD is one of the pioneer steps towards looking inside the vehicle and increasing the efficiency from inside the vehicle. ELCD has made a prominent improvement in the vehicle as the results show. It is the need of tomorrow for leading the way to a sustainable development

POLLUTANTS FROM GASOLINE ENGINES

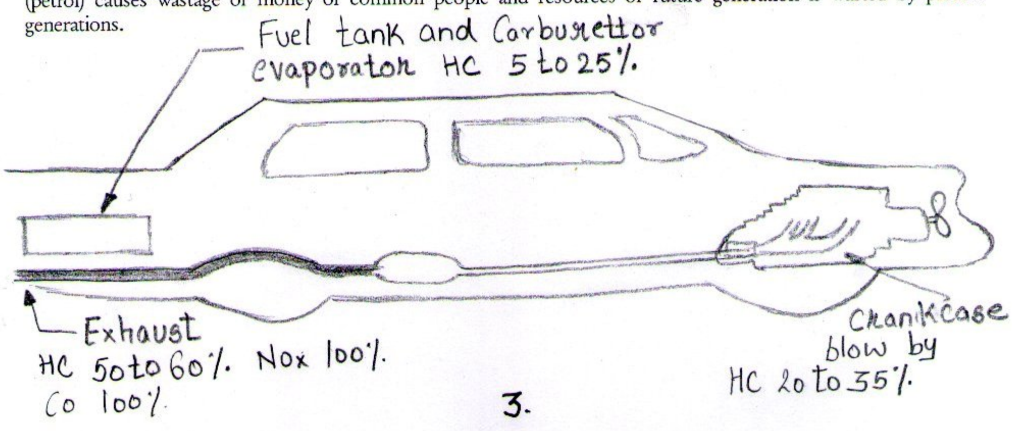
Pollution is one of major problem which is caused now days ringing the bell of pollution control board. The unburn fuel and air mixture is a major factor causing pollution. There are four possible sources of atmospheric pollution form a petrol engine powered vehicle:

1.) The fuel tank
2.) The carburetor
3.) The crankcase
4.) The exhaust pipe.

The contribution of pollutants, by source, as follows.

a)	Evaporative loss (both tank and carburetor)	15 to 25% of HC
b)	Crankcase blow	20 to 35% of HC
c)	Tail pipe exhaust	50 to 60% of HC and Almost all CO and No_x

The evaporative losses are the direct losses of raw gasoline from the engine fuel system. This raw gasoline (petrol) causes wastage of money of common people and resources of future generation is wasted by present generations.



EVAPORATIVE LOSSES

Evaporative emissions account for 15 to 25 per cent of total hydrocarbon emission form a gasoline engine. The two main sources of evaporative emissions are the fuel tank and the carburetor.

- ## EMISSIONS FROM EVAPORATIVE LOSSES FROM THE CARBURETTOR AND THE FUEL TANK

These results from the dissipation of heat when the engine is turned off and from variations in temperature between day and night. The following equations have been established.

Engine stopped: % weight of benzene in vapour = 0.45 of the weight of benzene in petrol

Respiration:% weight of benzene in vapour = 0.89 of the weight of benzene in petrol.

EMISSIONS FROM EXHAUST

$$BZ_{exh} = 0.50 + 0.44\, BZ_{gas} + 0.04\, Ar$$

Where

BZ_{exh}	Is the percent weight of benzene in the exhaust
BZ_{gas}	Is the percent weight of benzene in petrol (gasoline)
Ar	Is the percent weight of other aromatics in petrol (gasoline)

For Benzene exhaust from petrol vehicles, separate equations were used for three-way catalysts, three way plus oxidation catalysts, and other catalyst types. For vehicles with a three- way catalyst, running on baseline gasoline, the following equation was used

$$\text{3-way catalyst BZ\%} = 1.077 + 0.7732^{*}\,(\text{Volume \% benzene}) + 0.0987^{*}\,(\text{Volume \% aromatics} - \text{volume \% benzene})$$

This equation was obtained by the EPA Regulatory Development and Support Division (RDSD) from work done by Chevron Oil Company. For vehicles with a three-way plus oxidation catalyst, running on baseline petrol the equation used was

- ## FUEL TANK LOSSES

Fuel tank losses occur by displacement of vapour during fillings of petrol tank, or by vaporization of fuel in the tank, forcing the vapour through a breather vent to the atmosphere. Fuel tank losses occur because the tank temperature is increased during the vehicle operation which causes an increase in the vapour pressure and thermal expansion of tank vapour.

- ## MECHANISM OF TANK LOSS

When a partially filled fuel tank is open to atmosphere the partial pressure of the vapour phase hydrocarbons and vapour pressure of the liquid are equal and they are in equilibrium. If the temperature of the liquid is increased, say by engine operation, the vapour pressure of the liquid will increase and it will vapourize the total pressure of the tank increases and since the tank is open to atmosphere the vapour will flow out of the tank. This, outflow to the vapour will increase if in addition to liquid temperature rise, the vapour temperature is also increased.

Less the tank fill, greater is the evaporation loss. The effects of tank fill and temperature are shown in table.

Tank fill	Ambient temp ^0C	Temp. rise during test, ^0C	Loss during operation
1 / 4	19	7	5.7
1 / 2	16	4	1.2
3 / 4	18	2	0.1
Full	22	3	0.0

When a car is parked in a hot location the evaporation of the gasoline is greater. The vapour which vent from a partially filled tank during vehicle operation called soak, is a mixture of air and hydrocarbon.

- CARBURETTOR LOSSES

Carburetor losses result from external venting of the float bowl relieving the internal pressure as the carburetor heats and “hot soak” losses which occur after the engine has been stopped, as a result of evaporation of petrol stored in the bowl, loss being through vent pipe or through the air cleaner. Most of the loss from the carburetor occurs due to direct boiling of the fuel in the carburetor bowl during hot soak. If the pressure in the fuel line becomes greater than the pressure holding the needle valve closed, after supply will occur. One of the possible reasons may be fuel evaporation pressure in the carburetor bowl which presses down the bowl and increase pressure in the fuel line. If the after supply is more than the bowl volume the losses from the carburetor will change drastically.

HOT SOAK EMISSIONS

Hot soak emissions are the gasoline vapours generated immediately following shutdown of an engine due to vaporization of the fuel remaining in the carburetor float bowl as it is warmed by the residual heat of the engine.

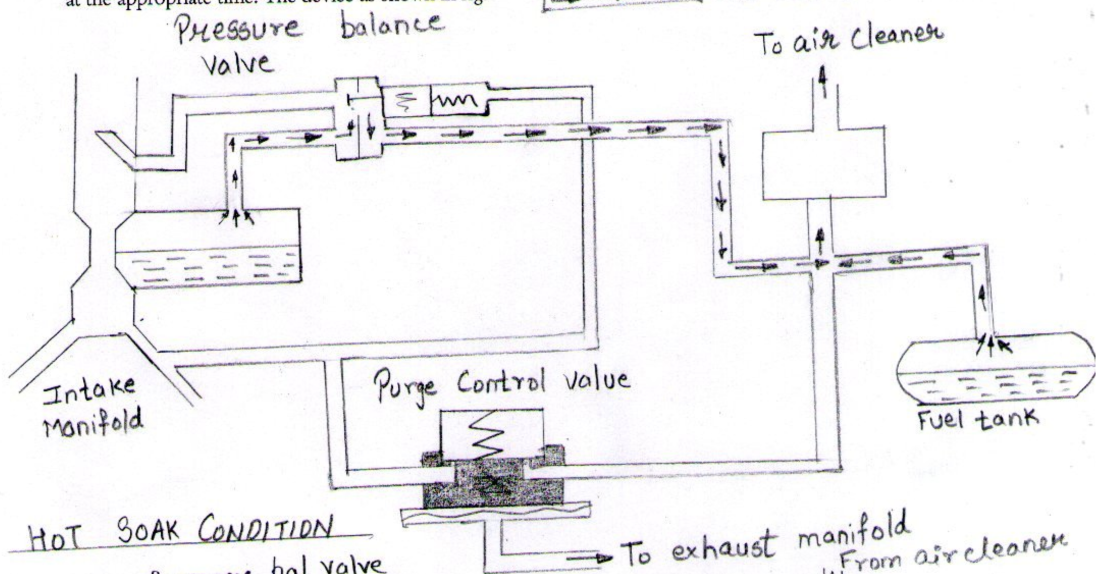
HOT SOAK SOURCE OF THE VALUE USED IN NON-ROAD

The beta release of NONROAD does not include any estimates of hot soak evaporative emissions. There are two reasons for this. First, the limited data that are available indicate that hot soak emissions are minimal relative to other types of hydrocarbon emissions on the order of 1 % of total HC emissions from gasoline fueled non-road engines. As described in the following section on other methods and data, the available hot soak data for non-road engines is limited to rather inconclusive data from just 8 engines in a narrow power range and values available from highway engines are not considered representative of non-road engines due to the different size, design, packaging, and fuel metering systems involved.

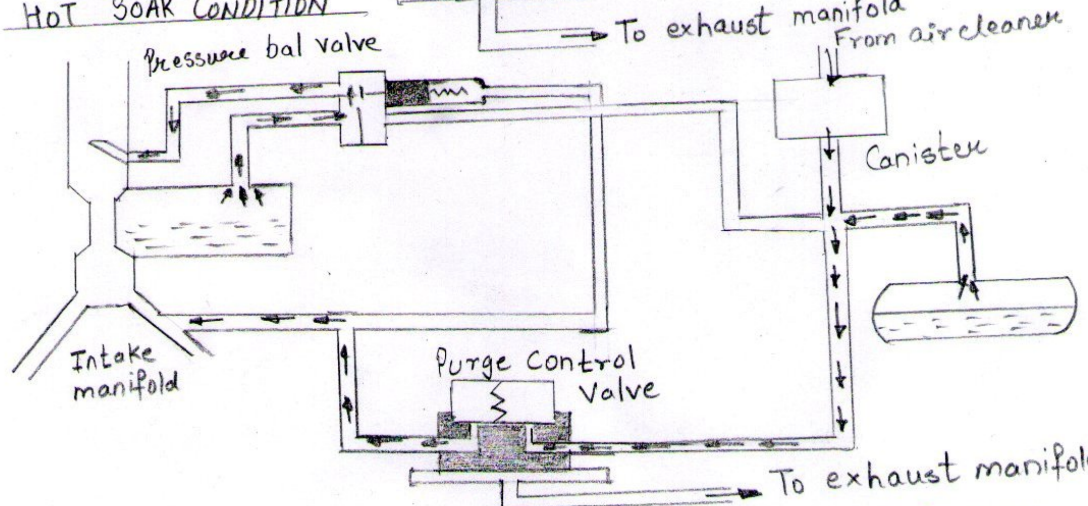
Thus, until more data become available, the Non-road Engine Emissions Modeling Team (NEEMT) plans to follow the same approach used in NEVES as well as in the EPA Phase I small engine regulatory model and in the CARB OFFROAD model namely to not include hot soak emission factors in the model. However, the model code is written to allow for the addition of a hot soak emission data file if such estimates become available.

EVAPORATION LOSS CONTROL DEVICE (ELCD)

This device aims at controlling all evaporative emissions by capturing the vapours and recirculating them at the appropriate time. The device as shown in fig. HYDROCARBON VAPOURS



HOT SOAK CONDITION



It consists of an adsorbent chamber, the pressure balance valve and the purge control valve. The adsorbent chamber, which consists of a charcoal bed or foamed polyurethane which is placed between petrol tank and the engine. It holds the hydrocarbon vapour before they can escape to atmosphere. The carburetor bowl and the fuel tank, main sources of HC emissions, are directly connected to the adsorbent chamber when engine is turned off i.e. hot soak condition when a warmed up car is stopped and its engine turned off or on hot sunny day. This results in some boiling in the carburetor bowl and significant amount of HC loss occurs. Thus the hot soak loss is adsorbed there. The adsorbent bed when saturated is relived of the vapours by a stripping action allowing the air form the air cleaner to draw them to the intake manifold through the purge valve and desorbed gasoline forms a part of the engine fuel mixture. The internal seat of the pressure valve at that time is so located that there is a direct pressure communication between the internal vent and the top of the carburetor bowl, maintaining designed carburetor metering forces. This provides a small but significant benefit towards increasing the fuel efficiency and controlling air pollution

The ELCD (evaporation loss control device) completely controls all types of evaporative losses. However, the tolerance of the carburetor for supplying F/A ratio reduces to about 3 per cent only. This requires very accurate metering control.

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