STUDY OF AIR POLLUTION DUE TO VEHICLE EMISSION IN TOURISM CENTRE

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ABSTRACT

Pollution due to auto exhaust has assumed menacing proportion in the developing countries like India, where its contribution is nearly 45% - 75 % of the total air pollution in urban areas, Ooty the Head Quarters of Nilgiris Districts has a large Number of commercial and non-commercial vehicles, due to increasing industrialization and Tourism related activities. In this thesis a study was conducted on vehicle pollution in Ooty town to asses pollution contribution from transport sector. The available information about mobile source emission factors has been compiled from different sector in Udhagamandalam. In this study, mobile source emission factor for carbon monoxide, hydrocarbons and smoke density for Indian vehicles have been estimated by testing different types of vehicles for their exhaust contents. It is reported from the study undertaken in this work, the emission levels of carbon Monoxide, Hydro Carbons and smoke Density of vehicle made from the year 1961 are within the permissible limits as recommended by the Environmental (Protection) Rules, 1986.

KEYWORDS: Study, Air Pollution, Automobile Emission, Ooty

1.   AIR POLLUTION - INTRODUCTION

The problem air pollution has existed ever since our ancestors sat coughing around a smoky fire in a recessed cave. In fact, there probably never was an unpolluted atmosphere, since decaying vegetation and animal matter, amoke, vapours, dust soot, carbon fumes, gases, mist, odors, radioactive materials and other natural phenomena surely have emitted gaseous and particulate matter ever since world began. Starting from 14th century, when coal was introduced as a fuel, atmospheric pollution becomes social problem. Air itself is a mixture of gases containing Nitrogen (=78.09%), Oxygen (=20.95%), Argon (=0.93%) & Carbon Dioxide (=0.03%), water vapor, Traces of neon, Krypton, Helium, Hydrogen, Xenon and ozones.

In short everything that we do to become an advanced and prosperous community, puts an ever increasing amount of unwanted and harmful foreign material into the life giving atmosphere, some of them are as follows:

1) Burning of fuels.
2) Production and use of pesticides and fertilizers to increase crops.
3) The propulsion of trains, ships, automobiles, planes, rockets, the extensive refineries for oils and minerals.
4) Conversion of raw materials into finished goods.
5) Clearing of roads.
6) Conversion of roads and buildings.
7) Chemical and other industry exhaust.

Thus from the beginning of the world the condition and concentration of many of the components of the atmosphere has been influenced by the relative rare of these additions and removals. It seems fitting and proper to examine the problem of air pollution control from the view point of public health. An average man, breathes 22,000 times and he taken in 35 lbs of air each day. The air is main link to life. It far exceeds one's consumption of food and water. Hence there is a general interest in air pollution control.

1.1 DEFINITION

Air pollution is defined as the presence of one or more contaminants in the atmosphere such as dust, fumes gas, mist, odors, smoke or vapor in quantities, of characteristics, and of duration. Such as to be injurious to human, plant or animal life or to property or which unreasonably interfaces with the Comfortable enjoyment of life and property.

1.2 NECESSITY OF THE AIR POLLUTION STUDY

Two decades ago, most of the air pollution was due to industrial emissions and burning of fuel. But the situation has changed considerable since then. The ever increasing proliferation of automobiles would indicates that, if uncontrolled, gaseous exhaust products could increase without limit. In India, during the last four decades of progress, greater emphases has been laid on industrialization rather than motorization, yet there are strong indications that automotive vehicles are turning to be an important contributor to air pollution. Auto exhaust pollution has assumed a menacing proportion in the developing countries and its control should not be delayed any more especially in India, where its contribution is about 45% - 70% of the total air pollution in urban areas. In major Indian cities, the ambient CO levels along the roads of commercial zones have reached alarming levels indicating that though the number of vehicles in major cities is comparatively smaller, the intensity of pollutants can be compared to that of any other metropolis in the world. This can be attributed to the age of vehicles with por maintenance, poor road conditions and lack of traffic planning. Moreover,

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the automobiles leave the emission at the at the ground level resulting in greater impact on the air quality.

1.3 SOURCES OF AIR POLLUTION

Table.1 gives the picture of different polluters and their emissions.

TABLE.1 DIFFERENT POLLUTERS AND THEIR EMISSIONS

Type	Category	Examples	Important Pollutants
1. Combustion	Fuel burning Transportation.	Domestic burning, thermal power plants, cars trucks and railways	Sulphur and Nitrogen oxide, carbon monoxide, nitrogen oxide lead smoke organic vapors, odors, etc.,
	Refuse Burning	Open burning dumps	Fly ash and particulate
2. Manufacturing Process	Chemical Plants	Petroleum refineries, Fertilizers, cement, paper mills, ceramic, and clay products.	Hydrogen sulphide, sulphur oxide, fluorides, odours, organic vapours and dusts.
	Metallurgical Plants	Aluminium Refineries, Steel Plants	Metal flumes (PH and Zn), fluoxides and particulate
	Water recovery	Scrap metal yards, rendering plants	Smoke, Soot, odours, Organic vapours, metal flumes.
3. Agricultural Activities	Crop Spraying	Pest and weed control	Organic phosphates, chlorinated Hydrocarbons
	Field Burning	Burning of refuse firewood	Smoke, fly ash, soot, sulphur oxides, particulates and organic vapours.
4. Solvent Usage	Spray painting Solvent Extractions, solvent cleaning	Furniture and appliances finishing dycing painting, Dry cleaning, degreasing etc.,	Hydrocarbon and tother organic vapours.
5. Nuclear Energy Programmes	Fuel fabrication	Gaseous diffusion, crushing, grinding	Flurodes, uranium and beryllium dust and other particulates
	Nuclear device testing	Bomb explosions	Radioactive fall out, sr=90 C-14 etc.,

Table.2 gives the picture of the composition of clean, dry air, Many of the compounds which acts as pollutants are minor constituents of clean air, that is No_2, O_3, SO_2, CO and NH_3, Though their concentrations are very low in unpolluted air, under polluted conditions they are greatly increased and Table.3 gives the estimated percentage emission of major pollutants from different sources.

1.4 MASS AND LIFETIME OF ATMOSPHERIC CONSTITUENTS

The mass and lifetime of selected atmospheric constituents such as N_2, O_2, CO_2, CO, NO_3, CH_4 particulate matter and SO_2 are tabulated in Table. 4

TABLE.2 COMPOSITIONS OF CLEAN, DRY AIR

COMPONENT	CONTENT	
	% BY VOLUME	PPM
Nitrogen	78.09	7,80,910.00
Oxygen	20.94	2,09,400.00
Argon	0.93	9,300.00
Carbon – dioxide	0.0318	318.00
Neon	0.0018	18.00
Helium	0.00052	5.20
Krypton	0.0001	1.00
Xenon	0.000008	0.08
Nitrous oxide	0.000025	0.25
Hydrogen	0.00005	0.50
Methane	0.00015	1.50
Nitrogen Oxide	0.0000001	0.001
Ozone	0.000002	0.02
Sulfur Dioxide	0.00000002	0.0002
Carbon Monoxide	0.00001	0.10
Ammonia	0.000001	0.01

TABLE.3 .ESTIMATE PERCENTAGE EMISSION (BY WEIGHT) OF MAJOR POLLUTANTS FROM DIFFERENT SOURCES

Source	Particulates	Sulpher oxides	Carbon Monoxides	Nitrogen Oxides	Hydro carbons
Transportation	4.3	2.4	63.8	39.3	51.9
Motor vehicles	2.8	0.9	59.2	34.9	48.8
Gasline	1.8	0.6	59.0	32.0	47.5
Diesel	1.0	0.3	0.2	2.9	1.3
Aircraft	N	N	2.4	N	0.9
Railroads	0.7	0.3	0.1	1.9	0.9
Vessels	0.4	0.9	0.3	1.0	0.3
Non-highway use of Motor fuels	0.4	0.3	1.8	1.5	1.0
Coal	29.0	60.5	0.8	19.4	0.6
Fuel combustion in stationary sources	31.4	73.5	1.9	48.5	2.2
Fuel Oil	1.0	1.2	0.1	4.8	0.3
Natural Gas	0.7	11.8	N	23.3	N
Wood	0.7	N	1.0	1.0	1.3
Industries Processes	26.5	22.0	9.6	0.1	14.4
Solid Waste Disposal	3.9	0.3	7.8	2.9	5.0
Miscellaneous	33.9	1.8	16.9	8.3	26.5
Forest Fires	23.7	N	7.2	5.8	6.9
Structural Fires	0.4	N	0.2	N	0.3
Coal refuse Burning	1.4	1.8	1.2	1.0	0.6
Agricultural Burning	8.4	N	8.3	1.5	5.3
Organic Solvent evaporations	N	N	N	N	13.4
Total	100	100	100	100	100

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TABLE. 4 THE MASS AND LIFETIME OF SELECTED ATMOSPHERIC CONSTITUENTS

Constituent	Lifetime	Mass (Tons X 10^{15})
N_2	Years	4.25
O_2	Years	1.3
CO_2	Years	28
CO	Years	0.6
NO_x	Days	0.009
CH_4	Years	5
Particulate matter	Days to Years	15.5
SO_2	Days	0.25

1.5 CLASSIFICATION OF AIR POLLUTANTS
1.5.1 Aerosols
A dispersion of solid or liquid particles of microscopic size in gaseous media, such as smoke, fog or mist

1.5.2 Smog
As the word suggested, it represents the combination of smoke and fog.
Two kinds of Smog
(1) Particularly in places where coal is the principal fuel, smog covers the areas at nights or cold days when the temperature is below about 10ºC and calm meteorological condition exist. The main constituents of such a smog are sulphus compounds, smoke and fly ash, With prolonged and serious exposures it may results in high mortality rates.
(2) The other type of smog is the photo-chemical amog which usually arises in big metropolitan cities which are highly motorized and where afverse meteorological conditions do not permit free flow of air. It is now recognized that this smog is caused by the interaction of some olefin hydrocarbons and oxidants under the influence of folar radiation, giving rise the peroxynitrate.

The main constituent of this type of smog are nitrogen oxides, peroxy nitrates, hydrocarbons, carbon monoxide and ozone. It reduced visibility, cause eye irritation and vegetation damage.

1.5.3 Smoke
Finely divided aerosol particles from incomplete combustion, consists mainly of carbon and other combustible material. It creates odour and dirt problem. Depending on the native of fuel and the efficiency of combustion, various volatile gases and other acids may accompany control of smoke usually finds a balance between the selection of fuel for burning qualities and improved combustion devices. Highly unsaturated hydrocarbons of the olefin and diolefin families as well as aromatics are removed from fuels by treating with sulfuric acid, clay, hydrogen, sulfur dioxide to improve burning qualities.

1.5.4 Industrials Dust

Overall, the effect of industrialization has been to increase the solid dust contact of the atmosphere. Sources range from major emissions such as dust in vent gases from combustion and processing operation down to minor ones such as rubber dust and tobacco aerosols, commonly called smoke. In general, a particle 10 micron or less in diameter will be suspended in air and tend to act in accordance with gas laws. The largest sources of industrial dust are combustion process.

1.5.4 Dust
A term loosely applied to solid particles predominantly large their colloidal, and capable of temporary suspension in air or other gases. Dusts do not tend to flocculate except under electrostatic forces. They do not diffuse, but settle sunder the influence of gravity.

1.5.5 Droplet
A small liquid particles of such size and sensity as to fall under still conditions, but which may remain suspended under turbulent conditions.

1.5.6 Fly Ash
The finely divided particles of ash entrained in flue gases arising from the combustion of fuel. The particles of ash may contain incomplete burnt fuel.

1.5.7 Fog
A term applied to visible aerosols in which the disperses phase is liquid. Formation by condensation is usually implied.

1.5.8 Fume
Properly, the solid particles generated by condensation from the gaseous state, generally after volatilization from melted substances, and often accompanied by a chemical reaction such as oxidation.

1.5.9 Particulate Matter
Existing in the form of minute particles either solid or liquid.

1.6 POLLUTANTS OF SPARK IGNITION ENGINES AND ITS EFFECTS
Two invisible automobile emissions, hydro carbon and oxide of nitrogen reset together in the presence of sunlight to form oxidant such as ozone a principal ingredients of Loss Angles "Smog"

The pollutants now known to be caused by each type of Ignition Engines emission are listed below.

1.6.1 Hydrocarbon
The aromatics, napthenes, olefins and parafins constitute the hydrocarbons that originate from numerous sources. The most predominant sources being the unburnt or partially burnt gasoline. Hydrocarbons are known to ne a

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participant in photochemical smog and suspected as a contribute to odour. Smog has been inferred that the nature and concentration of organic vapour of an atmosphere are among the prime determinants of its sensory quality of freshness. Thus it seems that natural events contribute significantly to air quality as hydrocarbons are concerned.

Methane is the largest single source. It is evalued primarily from bacterial decomposition which as a source seems relatively stable with time. Vegetation also contributes the hydrocarbons to the atmosphere. The automobile is the biggest single contribute to man caused hydrocarbon pollution, although the contribution of incinerators is large. Nitrogen dioxide and hydrocarbons are equally important in the photochemical formation of ozone concentrations and that the amount of ozone formed has been found to be proportionate to the product of nitrogen dioxide and hydrocarbon concentratins. Ozone may characterized photochemical smog but the eye irritation and reduced are objectionable for public health.

1.6.2 Carbon monoxide

Apart from CO_2, CO is the most abundant and widely distributed pollutant. Very little CO is due to natural events almost all is from man caused events. Approximately 90% of man caused CO is from automobiles. However, some carbon monoxide comes from natural events such as marsh gas, coal gas mines, seed germination, injured vegetation, forest etc., Carbon monoxide is odour-less and colour less gas. From health point of view CO is dangerous because it has a strong affinity for combining with the hemoglobin of the blood. Hence the hemoglobin available to carry the oxyzen to body tissues is reduced. It is possible, however that the level of CO that weare reached in the streets may affect some specially susceptible persons, such as those already suffering from a disease associated with a decrease of oxygen carrying capacity of the blood or those suffering from cardio respiratory disease. Concentration in ignition is as high as 75 ppm for period of at least 5 minutes with a medium of 60 ppm are found. The California department of public health indicated that exposure of 30 ppm for 8 hours may be as serious risk to the health of sensitive people. In addition many people when smoking, voluntarily expose themselves to levels of many orders higher than those under discussion.

1.6.3 Carbon Dioxide

CO_2 is not normally considered as a pollutant. It is essential for plant life. The primary source of CO_2 from natural events is organic material, although respiration amounts are large and will increase as the population increase. Combustion is the primary source of man caused CO_2 and that the natural and man caused amounts are of the same order of magnitude. One big absorbing source is of course photosynthesis by ocean could sold some 50 times the amount of the CO_2 in the atmosphere.

1.6.4 Oxides of Nitrogen

In addition of molecular nitrogen found in the air, nitrogen is present as NO, NO_2, NO_3, N_2O_2, N_2O_4, N_2O_5 etc., However of all these compounds the only pollutants that are significantly man caused are NO and NO_2. It should be realized however, that these two oxides of nitrogen represent only a small fraction of the total circulation of Nitrogen compounds. For example, the mass rates of NH_3 circulation are some 10 times of the two oxides of nitrogen. Nitric oxide is found at high combustion temperatures with the exact amount primarily, dependent upon the temperatures, oxygen concentration and time. In the atmosphere nitric oxide reacts with oxygen and is rapidly converted to nitrogen dioxide. This reaction can be greatly accelerated by the presence of sunlight and organic materials in the air.

Most atmospheric characteristic of oxides of nitrogen dioxide and designate the combinations as NO_x. In addition to causing a reduction in atmosphere visibility nitrogen dioxide also has an affinity for hemoglobin, however because it forms acid in the lungs, it is considerably more basic than carbon monoxide for the same concentration.

1.6.5 Sulphur Dioxide

Atmospheric sulfur is primarily in these forms, SO_2, H_2S and sulphates. H_2S is evalued primarily from natural sources. SO_2 comes primarily from man caused events, the sulphates come primarily from sea spray and from oxidation of SO_2. It is estimated that 70% of SO_2 comes from the combination of coal. It is clear that mass rates are high with respect to the mass in the atmosphere.

With regard to health, a concentration of 0.6 ppm will produce no detectable response in healthy human, most people can detect 5 ppm and find 10 ppm quite unpleasant. The situation is further complicated by the interaction and increased toxity in so far as health is concerned when sulfur dioxide, high air temperature, high air humidity, aerosols, etc are simultaneously present.

1.6.6 Lead

Concern with atmosphere lead arises primarily from its use as a gasoline additive, test have shown fairly conclusively that lead concentration in the atmosphere below traffic density patterns. The reason shows that approximately 70% of the lad used in car is emitted from the tall pipe with 30% setting almost immediately to the ground and the 40% becoming air burns and causing deflects. The lead appears in the exhaust as PbCI. The particle size of the discharge lead compound various from those of less than 0.01 micron to those of many millimeters.

The air burns lead is small in mass in comparison with that taken in via food and water, but that a higher percentage of the airborne lead reaches the blood.

1.7 EFFECTS OF AIRPOLLUTION

Table5. Shows that health effects of airpollution,Table.6. Shows that effects of airpollution on

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various materials & Table.7. Shows that effects of pollutants on plants

1.8   SOURCES OF POLLTANTS FROM SPARK IGNITION ENGINES

Automobile contribute about 60% of the total mass of air pollutants. This is shown in the Table 8.

TABLE 5. HEALTH EFFECTS OF AIRPOLLUTION

POLLUTANT	SHORT TERM HEALTH EFFECTS	LONG TERM HEALTH EFFECTS
Oxidant (Ozone and other)	Difficulty in breathing, chest tightness coughing	Impaired lung function, increased susceptibility to respiratory infection.
Total suspended particulate matter	Increased susceptibility to other pollutants.	Many components of TSP are toxic and contribute to silicosis
Sulphate particles	Increased asthma attacks	Reduced lung function when oxidant is also present.
Nitrogen Dioxide	Similar to ozone but at higher concentrations.	Increased susceptibility to respiratory infection.

TABLE 6.   EFFECTS OF AIRPOLLUTION ON VARIOUS MATERIALS

MATERIAL	POLLUTANT	EFFECTS
Metals	SO_2 Acid Gases	Corrosion, spoilage of surface, loss of metal, tarnishing.
Building Material	SO_2 acid gases, particulates	Discoloration, leaching
Paint	SO_2, H2S, Particulates	Discoloration
Textiles and textile Dyes	SO_2 Acid gases, NO_2, Ozones	Deterioration, reduced tensile strength and fading
Rubber	Oxidants, Ozone	Cracking, Weathering
Leather	SO_2 Acid gases	Disintegration, powered surface
Paper	SO_2 Acid gases	Embrittlement
Ceramics	Acid Gases	Change in surface appearance

1.8.1 Sources of Hydrocarbons

There are four possible sources of pollutants in the case of automobiles. These are listed below.

1. The Engine Exhaust
2. Crank Case Vent
3. The Carburetor
4. Fuel Tank

The two latter sources can contribute only evaporated fuel and it amount 5 to only 15% of the total unburnt hydrocarbon, emission from motor vehicles. Hence the more complex and

TABLE.7. SHOWS THAT EFFECTS OF POLLUTANTS ON PLANTS

Pollutant	Dose	Effect	Special Cases
Ozone	Mild	Flecks on upper surface, premature aging, suppressed growth	0.06 ppm for 3-4 Hr damages alfalfa white pine.
	Severe	Collapse of leaf, necrosis and bleaching	
SO₂	Mild	Intervenial chloride bleaching of leaves	1 ppm for fumigation times cause damage to alfalfa, cotton, barley.
	Severe	Necrosis in intervenial areas and skeleronized leaves	
Ethylene	Mild	Epinasty, leaf abscission	0.100 ppm for several hours affected tomatoes and pepper lants.
NO₂	Mild	Suppressed growth leaf bleaching	0.5 ppm for 10.12 days suppressed growth on tomatoes
Fluorides	Cumulative effect	Necrosis at leaf tip	

TABLE.8 DETAILS OF AIR POLLUTANTS

Sl.No.	POLLUTANT	10^6 Tones/ Years
1	Carbon Monoxide	66.0
2	Oxides of Nitrogen	6.00
3	Hydrocarbones	12.00
4	Sulfur Oxides	1.00
5	Lead Compounds	0.19
6	Particulates	1.00

more plentiful exhaust. Products of the combustion processes are potentially exhaust products of the combustion process and potentially far more harmful and easier to control than the evaporated full emission. Unburnt hydrocarbons and oxides of nitrogen in the presence of ultraviolet radiation, are mainly responsible for the irrigating and damaging consequences of smog. The reactivity of hydrocarbons and their derivatives in this photosynthesized reaction is a function of their chemical structure olefinic hydrocarbons, aldehyds and other oxygenated hydrocarbons and aromatic hydrocarbons are recognized as the more reactive components of organic material. The saturated lower paraffins (i.e., methane through pentane),benzene and acytelene are practically non- harmful.

1.8.1.1 Two sources from the fuel and carburetor system
    1. Evaporation losses from the carburetor itself.
    2. Evaporation losses from the breather vent in the
        fuel tank.

In order to relieve the interval pressure within the float bowl ,resulting from vaporization of gasoline as the carburetor gets heated during operation, modern carburetors are designed with the float bowl vented by either external vents to the outside or internal vents to the carburetor throat or both. The external vents are a source of hydrocarbon emission to atmosphere during engine operation.The factors responsible for evaporation losses from the carburetor are as follows:
1. The ratio of internal to external venting
2. Float bowl temperature as it affects are pressure difference between the outside and inside of the bowl.
3. Full volatility.

1.8.1.2 Hot Soak Losses
Another aspects of the carburetor vent loss is termed "hot soak lass" and occurs after the engine has stopped. The heat stored in the engine during operation is transferred to carburetor causing temperature of gasoline in the carburetor bowl to rise 60 to 70º F above ambient atmospheric temperature. The gasoline stored in the carburetor bowl is thus vaporized and is forced out of either the external or internal carburetor venting system to the atmosphere.

Hot soak losses, as the temperature of the gasoline in the carburetor bowl is rising, usually occur within the first 40 minutes after the engine is stopped. In present carburetor design these are a function of bowl capacity. Fuel volatility and ambient temperature for the average sized carburetor using a volatice summer type fuel, the losses vary 0.004 Ib at 75º F ambient temperature to 0.96 Ib at 100º F ambient temperature.

1.8.1.3 Breather Vent in Fuel Tank
Losses from breather vent in the fuel tank result primarily from the slow vaporization of the gasoline in the tank, forcing the vapour through the tank breather vent to the atmosphere. These losses vary with ambient temperature, fuel volatility and car operation. For summer type fuels, with

ambient temperature range of 75º to 100º F the losses results in discharge to the atmosphere of 0.008 to 0.0053 pounds per hour for a vehicle standing and 0.012 to 0.040 round per hour for a vehicle in motion.

A study of the control of hot soak and fuel tank emissions, indicates that approximately 90% of these emissions can be eliminated through changes in the fual system of the modern car. Such modifications basically consist of insulating the fuel tank, equipping it with a pressure vacuum type pop-off valve, and providing for the automobile draining of the carburetor bowl when the engine is stopped.

1.8.1.4 Blow-by Emissions
The largest secondary source of hydrocarbon emissions associated with automobile engine operation is found in the blow by gases vented from the engine crack case. These gases consist os a mix of unburnt fuel air charge and exhaust products blown past the piston rings during the compression and power strokes of the engine cycles.

Analysis of the blow-by gases indicates that they are composed approximately 85% carbureted fuel air mixture and 15% exhaust products. Accordingly the detailed composition of the hydrocarbons emitted from the crank case reflects the composition of the injected fuel, being burnt in the engine. Concentration of the blow-by gases varies between 6,000 and 11,000 ppm of hydrocarbons.

The high concentrations of hydrocarbons and the injected fuel in the blow by gases is evident from a consideration of the engine blow-by processes. The pressure differential across the piston of the automotive four stroke engine indicates that the most of the blow-by must occur during the compression and power strokes. At piston TDC, the direction of the piston travel changed and a reversal of piston side thrust occurs. Both these factors interfere with the scaling of the piston rings near the time of maximum cylinder pressure. Owing also to the generally spherical form of the flame front the cast portion of the fuel air charge to burn is that located in the annular section at the piston top and cylinder wall. The small clearance between the cylinder wall and piston is sufficient to cause quenching of the flame.

Blow-by emissions rate for cruise, idle and acceleration are found to be generally at a fixed percentage of the rates of exhaust emissions for the given engine. For deceleration, blow-by emission rates are high. Based on an assumed driving pattern, from 25 to 35% of the total hydrocarbon emission results from the blow-by gases.

Theoretical composition show that there is no hydrocarbons in the exhaust, if the system is in equilibrium. Thus it is believed that they are formed in quench area, that is in the cold zone immediately adjacent to the cold combustion chamber walls.

The bulk gases will be exhausted primarily during the middle portion of the exhaust period. During this time, it is experimentally observed that the hydrocarbon concentration is low. On the other hand the first and last part of the exhaust

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process which is primarily when the quench gases are being exhausted shows high concentration of hydrocarbons.

In looking at hydrocarbon data from real engines, however one most recognize is that oxidation does not take place in the exhaust process and exhaust system.

1.8.2 Carbon Monoxide:

In an attempt to reduce where and how carbon monoxide is formed the result of theoretical computations are presented in the figure. This shows CO concentration as a function of the extent of expansion of the gases for an ideal cycle for three different equivalence ratios. Experimentally measured exhaust gas concentration of CO are shown for two equivalence ratios.

Again, the dates show that the measured concentration of CO at peak cycle temperature that those existing at the end of the expansion. Thus as in the case of No, CO is also formed in the bulk gases, and in part at least as a result of frozen products. Particularly at rich mixtures, measured concentration of CO are closer to the peak cycle concentrations than to those existing of equilibrium occurred all during the expansion process.

Interestingly enough as one approaches stoichiometric or leaner mixtures, it appears that measured concentration of CO is more nearly approach the concentration that woud be expressed if equilibrium occurred during all of the expansion process.

Since there is non equilibrium in so far as the concentration of CO is concerned during the expansion process, it is necessary to look at the destruction reactions involved. The Primary destruction reaction for CO is,

$$2CO + 2OH \rightarrow 2CO_2 + H_2$$
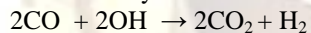
When this reaction is in equilibrium, its reaction rate is relatively rapid. It appears that the CO concentrations high because the atomic hydrogen concentration are high, that is the rate of destruction of hydrogen appears to be low. The two ractions that cause hydrogen destructions are,

$$H + H \rightarrow H_2$$
$$H + OH \rightarrow H_2O$$
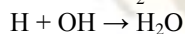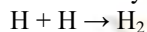
CO concentration follows directly the air fuel ratio and a rich mixture operation must be avoided at all times. There is a greater concentration of carbon monoxide in the exhaust than expected due to freezing.

As air fuel ratio decreased toward richer fuel mixture, the volumetric percentage of CO increases. This results in an increase in volumetric percentage CO with decreasing cruise speed and with decreasing severity of acceleration, reaching a maximum percent of carbon monoxide deceleration. The effect of air fuel ratio on volumetric percent carbon dioxide is opposite to that for carbon monoxide. With decreasing air fuel ratio volumetric CO decreases. With increased operating temperature and oxygen concentration (ie) high air fuel ratio and high peak cycle temperature to chemical equilibrium between CO and CO_2 is shifted towards carbon for the engine operating condition of high speed cruise and acceleration.

In contrast to volumetric percent emission, weight emission of CO expressed in pound per hour in general increase with severity of engine operation varying from a maximum of rapid acceleration through cruise to a minimum at deceleration and idle. This differences results from the more rapid increase in exhaust gas flow. With severity of engine operation, overriding the decrease in volumetric percent of carbon monoxide in the exhaust.

1.8.3 Oxides of Nitrogen

Figure shows a plot of NO concentration where as the extend of expansion of the products of combustion in the cylinder. The curves shows are for different equivalence ratios and shows the NO concentration that would be present if thermodynamic equilibrium were maintained during expansion. The measure levels correspond more nearly to the NO concentrations present at the beginning of expansion rather than the NO concentration at the end of Expansion. Concludes from, that the NO concentration measured in the exhaust should correlate reasonable well with. The peak cycle temperature shows that the peak temperature varies with location in the combustion chamber.

The NO concentrations at approximately stoichiometric air-fuel ratios follow the same trend as the peak temperature curve and for a rich mixture, they do not follow the same trend as the peak temperature curve.

If NO is primarily related to the peak combustion temperature, it may be inferred that is formed primarily in the bulk gases as opposed to being formed in a quench zone next to the cold combustion chamber walls. This deduction is shown in figure, as a function of distance for the head manifold surface that is distance downstream from the exhaust value. For three quarter of the cycle there is no flow in the exhaust line.

When exhaust does occur, the first gases to come out will be those adjacent to the exhaust valve which in turn will be followed by the large bulk of the gases by the quench zone gases scraped from the cylinder walls as the piston moves up on the exhaust stroke. If the deduction that the NO is formed primarily in the bulk gases is correct, the concentration of NO as a function of distance down the exhaust pipe should increase, reach a maximum and then decrease.

The amount of NO that would be present in the exhaust of an ideal, constant volume cycle were followed and if the NO concentration in the exhaust gas that formed at TDC, that is at the peak cycle temperature. It can be seen that for this situation NO reaches a maximum of an air fuel ratio of around 18 or 19%.

Two experimental curves for spark ignition engines are shown. Both curves were taken with the spark timing adjusted as the air fuel ratio ws changed so that the peak pressure always occurred at 10 degree. The reason for during this is, that in the engine peak temperature changed with a changes in the air fuel ratio for two reasons. In the first place, peak temperature will change with a change in the air fuel

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ratio because, of more or less excess air to be heated up, just as in a burner, However, in the engine in addition the flame speed varies with a change in air fuel ratio and as a consequences, peak pressure will occur at different cylinder volumes with a consequently change in peak temperature. One of the curve is for a premixed mixture and the other curve is for a heterogeneous mixture such as in undoubtedly present in a practical multi cylinder spark ignition engine.

The most important NO destruction reactions are,

1) $NO + N \rightarrow N_2 + O$
2) $NO + O \rightarrow N + O_2$
3) $NO + NO \rightarrow N_2O + O \rightarrow N_2 + O_2$

Of these reactions, number (1) is slowest while number (2) and (3) are the fastest. All of them are quite slow, thus explaining the fact that very little recombination takes place during expansion. The Table.9.explains the effect of vehicle mode on emissions.

**TABLE.9   EFFECT   OF   VEHICLE   MODE   ON EMISSIONS.**

Vehicle Condition	Engine	Flow	Concentration		
			HC	CO	NO_x
1. Idle	Operating	Very low	High	High	Very low
2. Cruise					
i.Low speed	Operating	Low	Low	Low	Low
ii.High Speed	Operating	High	Very low	Very low	Moderate
3. Acceleration					
i. Moderate	Operating	High	Low	Low	High
ii. Heavy	Operating	Very high	Mod erate	High	Moderate
4.Deceleration	Operating	Very low	Very high	High	Very low
5. Soak					
i. Hot	Stopped	None	--	--	--

2.   METHODS AND METHODOLOGY

Transport facilities is being improved every year in the town to meet the increase in demand due to the population growth and tourism growth. There are large no of commercial vehicles and non-commercial vehicle is Tourism Town. In order to access the auto emission of these vehicles. One Authorized Vehicle Emission Testing Centre is available in Udhagai Town. Survey was conducted in this emission centre through Regional Transport Office.

2.1   TESTING   METHODOLOGY   FOR   DIESEL VEHICLES

Netel's smoke meter Model NPM-SM-111B (Figure.1) has been designed and developed to get an accurate reading of diesel engine smoke emissions, according to the specifications laid down by MINISTRY OF SURFACE TRANSPORT (MOST). Its use promoters combustion efficiency for fuel economy in diesel vehicles and stationary diesel engines.
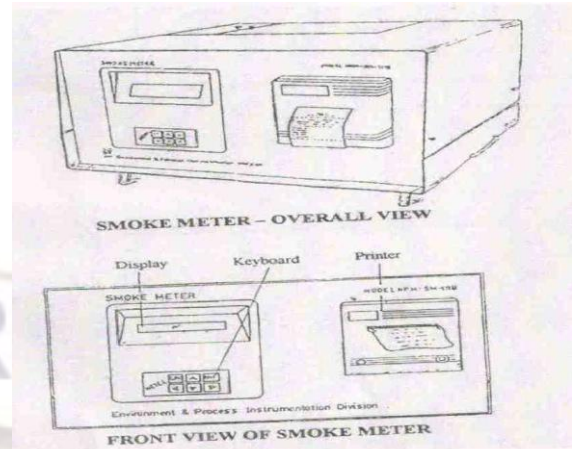
FIGURE.1 NETEL'S SMOKE METER MODEL NPM-SM-111B

The key features of smoke meter are
➢ Alphanumeric LCD display with back light for day & night operation.
➢ User friendly keyboard & display interactions.
➢ Built=in 24 column printer for hard copy of the report
➢ Autozero facility
➢ Easy Calibration check.

2.1.1 Technical Specifications
1. Model Number   : NPM-SM-IIIIB
2. Type of smoke   : Partial Flow
3. Display Indication : Light Absorption Co-efficient (K) / percentage opacity
4. Display range   : 0 to 99 / m
5. Scale Resolution   : 0.1 / m
6. Linearity   : 0.1 / m
7. Drift   : Zero: 0.1 / m
                          Span: 0.1 / m
8. Repeatibility   : 01 / m
9. Light Source Details : 5 mm diameter green LED
10.Responce Time   : 0.3 Seconds
11.Warm-up time   : 1.5 Seconds
12.Operating Temp.range : 5 to 50ºc
13.Power Requirement   : 260 V AC + 10 % 50 Hz
14.Weight   : 24 Kgs
15.Dimensions   : (W) 47.5 cm X (D) 47 cm x (H) 26 cm

2.2   TESTING   METHODOLOGY   FOR   PETROL VEHICLES

The model NPM-CHI CO / HC analyzer (Figure.2) can be for the infrared analysis of the exhaust gases of OTTO cycle engine.A check of CO / HC exhaust values is currently essential if an engine is to be correctly set up or in order to diagnose possible operative malfunctions.   Unless   exhaust

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values are correctly adjusted. It is absolutely impossible to obtain a good engine performance of good economy of operation.
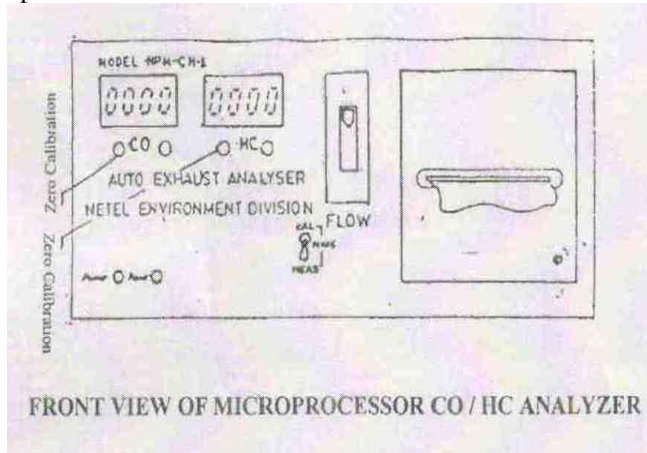
FIGURE.2 MICROPROCESSOR CO/HC ANALYZER

2.2.1 Technical Specification

Range of measurement   : CO: 0 to 8.5% vol.res.0.01%
HC: 0 to 1995 ppm, res. 5 ppm
Operating Temperature   : + 5º C to + 45º C (+2)
Pressure variation   : Max error 0.2% for variations of 50
                    millibars (37 mm Hg)
Measuring gas Intake   : 5 – 81 / min (approx.)
Flow Check   : Manual
Condensate Discharge   : Automatic
Response Time   : > 10 Sec.
Warm up time   : max 15 minutes
Power supply   : 230 C + 15%, 50Hz – 100 watts
                    Automatic Signal with Error code
Printout if > + 15%Zero Setting : Manual
Calibration   : Manual
Printer   : 24 Col.
Dimensions   : 400 x 200 350 mm
Weight   : 12 Kgs (approx.)

3. RESULTS AND DISCUSSION

A survey of vehicular pollution has been undertaken to access pollution contribution from transport sector. The available information are compiled from different sources and sued for emission estimation from transport sector in the Ooty Town. CO, HC and smoke density for Indian vehicle and the findings are plotted for the year of makes in the following graphs.

According to the study and the survey, it is concluded that old model vehicle are major polluters. Two wheelers emit major amount CO and HC.
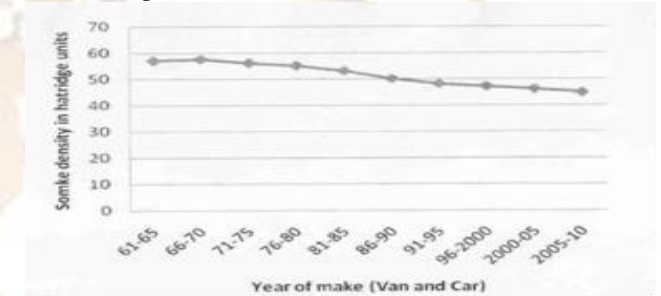
Figure.1. shows that smoke density versus year of make (lorry and bus). Permissible limit of smoke density by the 4-stroke engine (lorry and bus) is 65 hatridge units. It is fond from the plot that the emission of pollutant is maintained

well within the permissible range. i.e., below 60 hatridge units by vehicles aged with 25 years of less. Vehicles which are put in use above 25 years normally reaches the permissible limit of smoke density
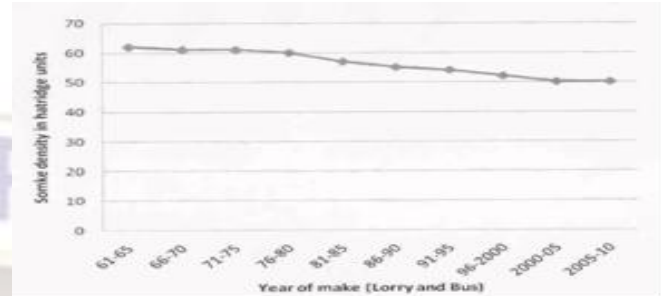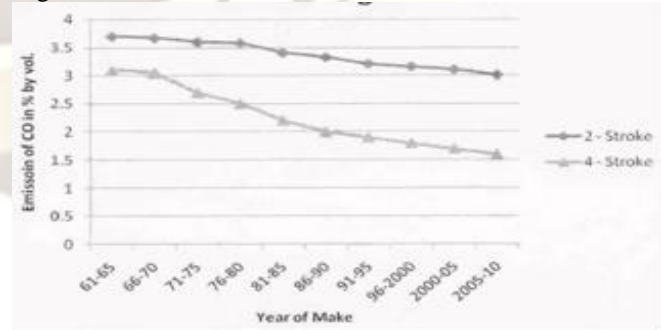

FIGURE.3.   SMOKE DENSITY VERSUS YEAR OF MAKE (LORRY AND BUS)

Figure.4.shows that smoke density versus year of make of van and tempo. Vehicle aged around 40 years is about to reach the permissible limit.


FIGURE.4 SMOKE DENSITY VERSUS YEAR OF MAKE (VAN AND TEMPO)

Figure.5. shows the emissions of CO in % of volume by 2 stroke and 4 stroke engines. It is obvious from this result that 2-stroke engines emit more CO rather than 4-stroke engines.

FIGURE.5 EMISSIONS OF CO IN % OF VOLUME BY 2 STROKE AND 4 STROKE ENGINES.

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Figure.6.shows the emission of HC in ppm which indicates that 2-stroke engines emit more HC than 4-stroke engines.
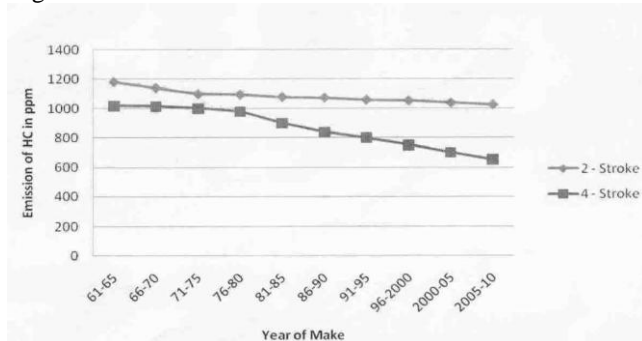
FIGURE.6 EMISSION OF HC

4.CONCLUSION

Many of the problems discussed earlier start at the local level. For quite a long time, scientists were under the impression that these problems were localized and they were trying out technologies and scientific methods to abate pollution and protect the local environment. But deep studies indicate that these problems not only affect the local environment, but the ill-effects spread to the other parts of the world as well. If this situation continues, then life on earth on become intolerable. Hence "Save our Earth" has become the slogan now. The problems and their ill-effects have to be thoroughly analyzed at the global level. But, to prevent ill-effects, suitable action has to be taken at the level. Environment is a partner to development and not an impediment. In order to maintain essential ecological process, to ensure genetic diversity, sustain species and eco-systems, prevent environment degradation, the following changes should be made in the vehicle to reduced the emission.

- **Modification in old vehicle.**

According to the study, it is often assured that gross polluters are simply old vehicles. Ashok Leyland has been able to improve its well-established range of layland and Hino-commercial diesel engines to meet Euro I emission norms essentially by modifying the "engine heads" and by fitting slightly higher pressure injection pumps. An essential features of such modifications is that they can be retrofitted to existing engines there by providing a dramatic reduction in emissions while being relatively cheap and quick. This is obviously better than a policy of banning vehicles over certain age, because that will lead not only to a neglect of vehicle's engines over the fag end of its legal life, but also a dangerous neglect of its steering breaking and suspension systems.

- Fuel Quality and Emissions. No legislation or technology can bring down emission levels unless fuel quality also improves. Most Indian refineries now have Fluidized Catalytic Crackers which produce high quality petrol with little need for octane enhancing lead compounds and have operational hydro-desulphurising units which produce diesel with maximum sulphur levels of diesel with maximum sulphur levels 0.25 percent rather than the one to three percent common even last year.

- Most Automobile manufactures have launched Vehicles with a multi-point fuel injection and engine management system that uses conical injectors and is claimed to be impervious to fuel adulteration level of even 50 percent.

- The Government of Tamil Nadu Authorized the Tamil Nadu pollution Control Board to test and issue Emission Under Control Certificate (EUCC) for four wheelers. According to the study two wheeler are gross polluters of CO and HC. Hence   Government should bring legislation such a way that the Emission Under   Control Certificate (EUCC) test for two wheelers also.

- Routine (and relatively cheap) maintenance and emission testing along with good quality fuel enables to control vehicular emissions.

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