Palestine Polytechnic University

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Mechanical Engineering Department
Automotive engineering

Graduation Project

Traffic Emissions and Air Pollution

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Acknowledgement

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Abstract

Hebron city can still not be considered as homogeneous city, the largest pollution levels occur in street canyons where dilution of car exhaust gases is significantly limited by the presence of buildings flanking the street, and large trade movement which causes increasing number of traffic motion, and this achieve in A-Salam Street, additional to be the street one of very important junction which connect between inside and outside the city.

Through study the gases percentage out from the vehicles in discrete time of day, by using spatial modem devices to measure gases percentage in the air and others for measure noise in the study domain, and detected the direction of the emission by detect the direction of the winds motion. we can detect the range effect of emission on the environment and health, dependant on these we will find the request solution for this environment problem (health and air), and solution the vehicles problem, through divided the vehicles in two type (diesel and gasoline),(private and public),(for light and heavy) to know the degree of effect for each type, then we will suggest the solutions for this problem and so on.

Automobile transport is now an important part in our life, and as it happened with many other technological advancements, but the negative aspects of vehicles are becoming more and more pronounced, One of them is air pollution from car exhaust gases.

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1.1 Overview.

The main idea of this project is measuring the air pollutant gases in Hebron city in Al-Salam street using equipment for measuring the result (emissions value) by using sensors, and finally using programs for dealing these reading (exhaust and air pollution) to know how these can effect to human and environment, and finally how to reduce its effect, then found solving problems for air pollution.

1.2 General Idea about Project and Its Importance.

There are many different pollutants and each one has different environmental effects. The mass of emissions of two different pollutants should not be compared directly because their effects on health and the environment may be very different.

Carbon dioxide (CO_2) contributes to global warming, but has insignificant direct effect on health. A number of pollutants are toxic to humans and the environment. These include particles, heavy metals, NO_2 from NO_X and some Non Methane Volatile Organic Compounds.

Pollutants such as SO_2, NO_X and ammonia cause acidification (including acid rain), which can damage ecosystems and buildings. Combinations of some of these pollutants in the air can react together, to produce other pollutants, known as secondary pollutants. For example, ozone is made by a chemical reaction between other pollutants in the air. At ground level, it can have affect peoples health and can damage crops, forests and some materials. Find out about emissions in your area.

Emission inventories are estimates of the amount and the type of pollutants that are emitted to the air each year from all sources. There are many sources of air pollution, including traffic, household heating, agriculture and industrial processes.

For these there is studying in the project for emissions which out from the cars and gases launch from it to the atmosphere in Hebron city (Al-Salam Street), these done three numbers of devices which use to measure the gases produced from the traffic motion in the street.

For these readings it can be determined by the movement of all vehicles type and actual value for these gases in that city , then there is analyzing and comparing the results (actual) for fixed reading to check the pollution level and making future conclusion (to reduce the emission) in the Sebta area.

1.3 Project Scope.

There are pollutant gases in atmosphere, and these can produce from many sources, from industrial region, burning, and exhaust gases and other sources, and it can effect on human health and animals and plant crops.

It is wanted to measure the pollutant gases (NO_x, CO, HC, CO_2, ..., and noise) and show how it can effects, the cause of choice sAl-Salam street (high vehicle density), and the study vehicle movement (heavy and light or taxi diesel or gasoline...) to show how the vehicles quality can effect air pollution, according this data to find solving to reduce air pollution.

1.4 Literature review.

Vehicle emissions are a major source of air pollution in urban areas. The impact on urban air quality could be reduced if the trends of vehicle emissions are well understood.

The steady reliance on the automobile for transportation over the past several decades has resulted in a dramatic decline in our nation's air quality. Over 50% of the world air pollution is generated by motor vehicles, and transportation accounts for over 75% of the world CO emissions, nearly 50% of world oxides of nitrogen (NO_x) emissions, and 40% of the volatile organic compounds (VOC) emissions. Ground-level ozone, the most problematic constituent of smog, forms when volatile organics combined with NO_x in the presence of sunlight; urban areas having sunny, warm climates are particularly prone to ozone problems.[1]

A strong correlation between breathing smoggy air and an increased incidence of respiratory and cardiopulmonary disease is emerging. In general, slower lung growth in children appears to be associated with exposure to constituents of smog . These findings continue to prompt new legislation associated with motor vehicle emission controls.[2]

Aggressive air pollution control programs in the U.S. stimulated changes in engine design and emission control devices in the 1970s, and later use of reformulated gasoline and low-emission automobiles in some states also mitigated vehicle emissions. Since the phasing out of leaded gasoline in the 1970s, several oxygenated compounds, including ethanol and methyl butyl ether, have been used to enhance octane ratings and to reduce carbon monoxide emissions.[2]

There is a study in 1999 by group research department for models for traffic emissions and air pollution; five separate models are integrated in one software suite to cover traffic demand, route choice, traffic flow, traffic-induced emissions and air quality. The traffic demand model follows a behavior-oriented, disaggregated approach. The dynamic route choice is calculated by an iterated simulation of the entire day. Each individual vehicle travels through the road network using a microscopic traffic flow model. Fuel consumption and exhaust gas emissions of all vehicles in the network are determined based on dynamic characteristics.[3]

Their research model summarized into:

- Demand route in the track, traffic flow, traffic-induced emissions to know air quality.
- The dynamic route choice is calculated by an iterated simulation of the entire day.
- Traffic flow model can describe each individual vehicle travels through the road network.
- Air quality to know the percentage of pollutant gases (NO_X, CO, CO_2, HC, VOC, O_3, N_2) and the noise and how can find the way to reduce the pollutants.

All these models can describe exhaust emissions and air pollutant in certain site.

1.5 Estimated cost.

This project is funded by the Ministry of Education and Higher Education and implemented by the Renewable Energy and Environment Research Unit (REERU). The cost of the instruments, parts and other items amounts at US 20,400S.

1.6 Time planning.

In performing our project, the following schedule table will be done:

Table 1-1: 1st semester Time plane.

Action \ Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Project determination	■	■														
Data collection			■	■	■	■	■									
Data analysis						■	■	■								
Study for components								■	■	■						
Writing the report									■	■	■	■	■	■	■	
Presentation																■

Table 1-2: 2nd semester Time plane.

Action \ Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Review for introduction	■	■														
Measuring vehicle number and fuel			■	■	■	■	■									
Measuring the emission reading by using devices						■	■	■								
Analysis for emissions equations								■	■	■						
Analysis devices reading									■	■	■	■	■	■	■	
Presentation																■

1.7 Description of Project Parts.

This project contains seven chapters and various , and these chapters can be summarized as follow:

Introduction Chapter: It gives a general idea about the project and its importance.

General information about emissions and regulations chapter: It gives general view for emissions and the polices regularity and the dispersion models.

Engine design controlling emissions chapter: this chapter discus the emission that produce from engine, and how these emissions can be controllable.

Devices description and programs chapter: this chapter describes the devices that used in project.

Emission estimation technique and Calculation: this chapter describes the equations that are using for calculating emissions yearly.

Emission analysis and reading measurement: this chapter discuss the amount of emissions by using the devices.

Conclusion and Recommendations: this chapter discuss the emission resulted and its dispersion model suggested way to reduce emissions.

Chapter Two

General information about emissions and regulations

2.1. Traffic Emissions and General Emissions.

2.2. Polices.

2.3. Models.

2.4. Vehicle Emissions Models.

2.1 Traffic Emissions and General Emissions.

Road transportation has an essential economic and social role. However, it is one of the major contributors to energy consumption, air pollution, and emission of greenhouse gases. Moreover, it is at the origin of various other externalities, such as congestion, incidents, and noise pollution.

Air quality, fuel consumption, and the production of greenhouse gases are major topics of national and local regulations and of international agreements. To comply with these regulations and improve the quality of the environment where we live, it is necessary to implement adequate policies. Hence, there is need to develop methods for the assessment of the impacts on environment and mobility of these policies, and for the optimization of the associated parameters.

Benefits on emissions and fuel consumption are generally believed to be strictly linked to reduction in congestion. Congestion corresponds to increases in the density of traffic as well as in the frequency of accelerations and stop-and-go transients, during which more emissions are generated. However, improvements in congestion may not always correspond to improved total emissions.

For example, high free flow speeds generally represent favorable traffic conditions, but can generate high emissions, and lower travel times may encourage vehicle drivers to make more and longer trips.

Moreover, the spatial distribution of emissions can be affected in a negative way by measures that improve congestion.

2.2 Polices.

The policies for traffic and emissions control can be classified as follows:

– Vehicle technology measures, aimed at reducing engine-out emissions (e.g. use of cleaner fuel or exhaust gas recirculation), and/or tailpipe emissions (e.g. more effective catalytic converters).

– Traditional transportation measures, such as the construction of new road infrastructure, and the introduction of additional public transportation services.

– Innovative measures, relying on the application of information, communication and processing technologies to transportation systems. This concept is generally referred Intelligent Transportation Systems (ITS).

2.3 Models.

A typical model-based traffic emission laboratory is composed of a system of sub-models.

The most sophisticated systems are composed of:

- Demand models: trip generation, trip distribution, modal choice, and possibly other models. These are generally econometric models that estimate the transportation demand from demographic and land use information. Trip generation, trip distribution, 19 mode choice, together with traffic assignment.

- Supply models, which simulate the performances resulting from users demand, and the technical and organizational aspects of the physical transportation supply. The system includes the network configuration, the network loading or flow propagation model (that defines the relationship among path and link flows), the link performance model (that defines the relationships between link performances (such as travel time and cost) and flow of vehicles), and the path performance model (that defines the relationships between the performances of the single links and those of a whole path between any origin-destination pair).[4]

- Traffic assignment models, which represent the interaction between demand and supply. A variety of traffic flow models exist, and differ in the way traffic flow is represented and moved across a network. Microscopic and mesoscopic models represent flows at a vehicle level, while macroscopic models represent flows as a real number quantity.

- Emission models, which calculate emissions produced by the vehicles as a function of their characteristics and of their operating conditions (i.e. speed and acceleration).

- Dispersion and photochemical models (called also air quality models), which estimate how the pollutants emitted react with other components of the air, how they are dispersed and how ultimately they impact air quality in terms of concentrations of pollutant. While macroscopic dispersion models are relatively simple, microscopic dispersion models require detailed information about the external environment such as urban morphology (e.g. road width, buildings height, etc.), and micro-climate conditions, can illustrate the agreement for models.

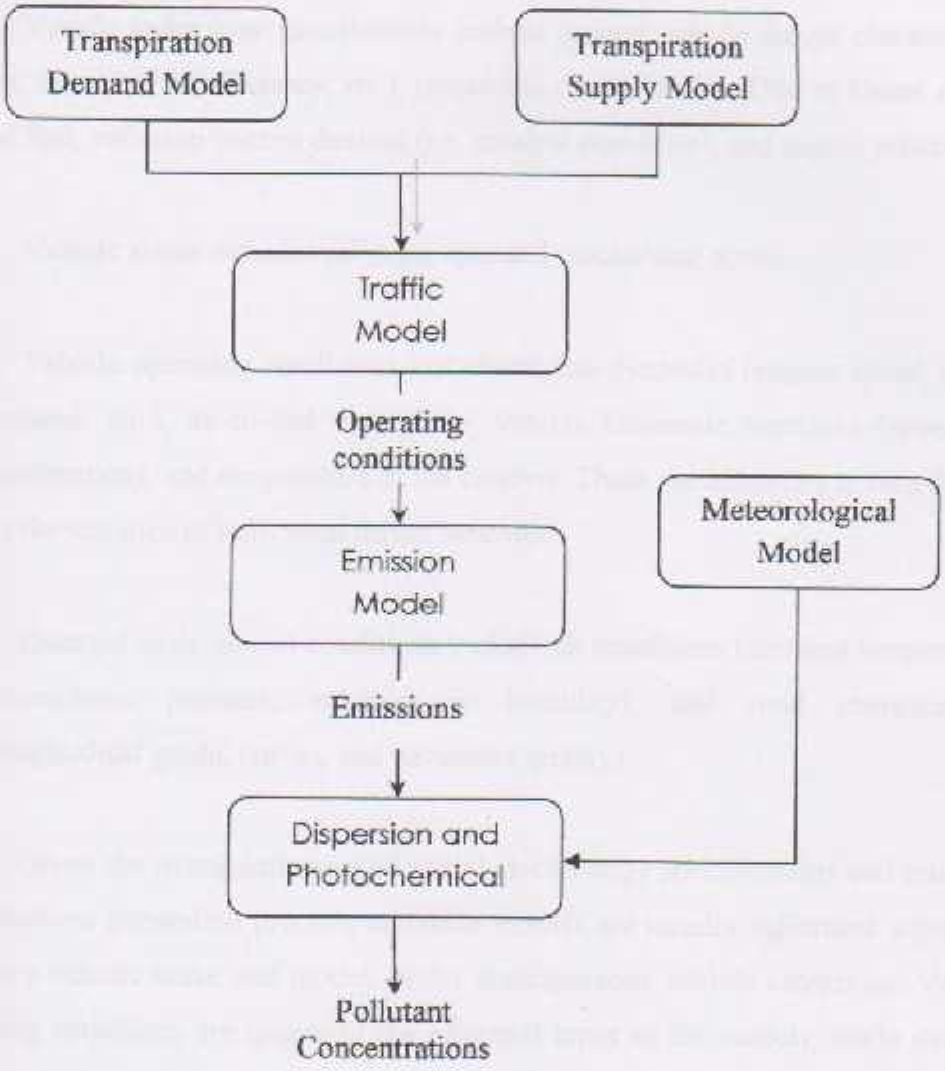

Figure 2.1: Agreement modeling.

2.4 Vehicle Emissions Model.

Variables and parameters that influence emissions can be grouped in the following categories: vehicle technology specifications, vehicle status, vehicle operating conditions, and external environment conditions.

Vehicle technology specifications include general vehicle design characteristics (weight, aerodynamic efficiency, etc.), propulsion characteristics (Otto or Diesel cycle), type of fuel, emission control devices (i.e. catalyst converter), and engine power.

– Vehicle status includes mileage, age, and mechanical status.

– Vehicle operating conditions include engine dynamics (engine speed, power demand, etc.), air-to-fuel mass ratio, vehicle kinematic variables (speed and acceleration), and temperature of the catalyst. These variables can in turn depend on the vagaries of individual driver behavior.

– External environment conditions include air conditions (ambient temperature, atmospheric pressure, relative air humidity), and road characteristics (longitudinal grade, curves, and pavement quality).

Given the strong influence of vehicle technology specifications and status on the emissions generation process, emission models are usually calibrated separately for every vehicle make and model, or for homogeneous vehicle categories. Vehicle operating conditions are generally the principal input to the models, while external environment conditions can be introduced as secondary inputs.

There are a variety of approaches for vehicle emissions modeling, each with its strengths, its weaknesses and its limitations. There are technology-based engineering models that are very detailed and are usually in practice developed for a specific vehicle or engine.[4]

Chapter Three

Engine Design Controlling Emissions

3.1 Introduction.

Emissions from an individual car are generally low, relative to the smokestack image many people associate with air pollution. But in numerous cities across the country, the personal automobile is the single greatest polluter, as emissions from millions of vehicles on the road add up. Driving a private car is probably atypical citizen's most polluting daily activity.

Internal combustion engine designs are subject to constant changes. In spite of the advanced technologies of fuel injection systems, which secure better burning process, it is necessary to use emission control systems outside of engines.

In this chapter there is stop an overview how the vehicle in the modern itself using control system for control emissions as using catalytic converter, EGR, PCV and canister purge.[5]

The exhaust gases can be classified into groups and these gases have an effect for human and animals health, and it can be site at hydrocarbon compound group, although these gases have its effect must be studied to know the affect and how it can be harmful.

3.2 The Combustion Process.

Gasoline and diesel fuels are mixtures of hydrocarbons, compounds which contain hydrogen and carbon atoms. In a "perfect" engine, oxygen in the air would convert all the hydrogen in the fuel to water and all the carbon in the fuel to carbon dioxide. Nitrogen in the air would remain unaffected. In reality, the combustion process cannot be "perfect," and automotive engines emit several types of pollutants.[5]

3.2.1 Engine Combustion equation.

In general, any equation for fuel combustion (diesel or gasoline) it can produce hydrocarbons and oxide of nitrogen and carbon dioxide and carbon monoxide and water as equation:

Fuel + Air → Hydrocarbons + Nitrogen Oxides + Carbon Dioxide + Carbon Monoxide + water + O_2 [5]

3.3 Emissions.

Main emissions produces from cars are (HC, NO_x, VOC_S, SO_2) and has an effect for human as illustrates in these sections.

3.3.1 Carbon dioxide (CO_2).

Carbon monoxide (*CO*) is a byproduct of incomplete combustion. The principal chemical reactions that happen during a combustion are :

$$2C + O_2 \rightarrow 2CO$$

$$2CO + O_2 \rightarrow 2CO_2$$

The first reaction is much faster (~10 times) than the second. Therefore, CO can be either an intermediate product, or a final product, when there is insufficient O_2 to adequately mix with the fuel. Under enrichment conditions, due to the lack of oxygen, much of the carbon present in the excess fuel is partially oxidized to CO instead of CO_2. Note that CO is also generated under stoichiometric conditions due to possible partial oxidation of HC.[6]

CO is colorless, odorless, but poisonous. It reacts with the hemoglobin present in the blood to form carboxyhemoglobin, causing a reduction in the oxygen transported from the lungs to the body cells. High concentrations of CO can increase the risk of cardiovascular problems and impede the psychomotor functions. Infants, elderly, and people with cardiovascular diseases and respiratory problems are more at risk. Also, CO indirectly contributes to the buildup of ground-level ozone and methane.[6]

As general rule the higher carbon dioxide reading more efficient engine operating, engine mechanical problem occur by decreasing CO_2 for reasons as misfire this is can be occur by imbalance for air fuel ratio as seen in figure(3.1)

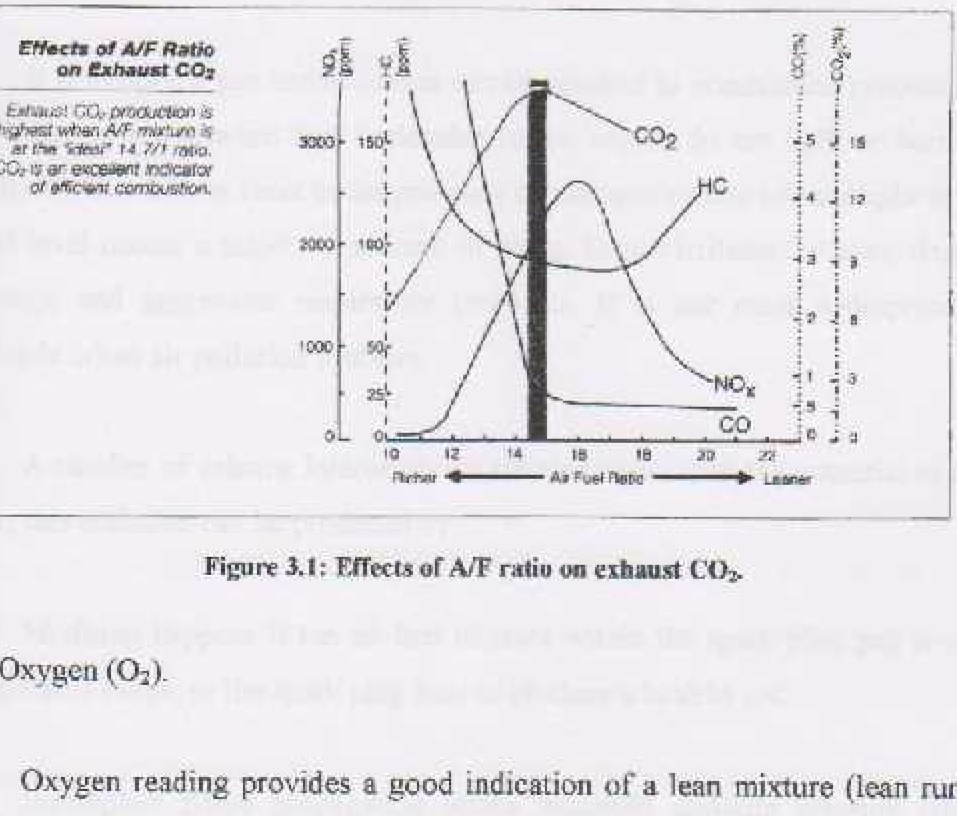

Figure 3.1: Effects of A/F ratio on exhaust CO_2.

3.3.2 Oxygen (O_2).

Oxygen reading provides a good indication of a lean mixture (lean running engine), since O_2 increases with leaner air/fuel mixture, otherwise CO indicates for richer mixture. Lean mixture and misfires causes high O_2.[6]

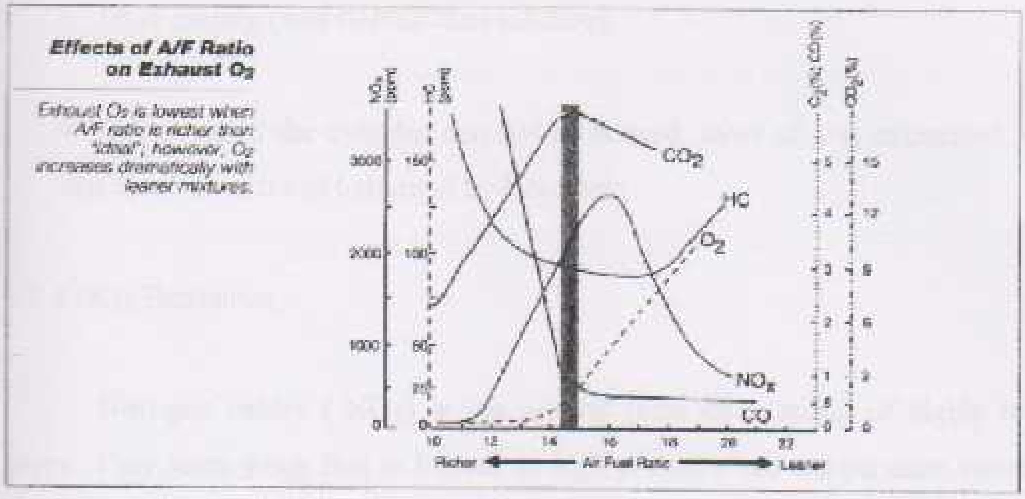

Figure 3.2: Effects of A/F ratio on exhaust O_2.

3.3.3 HC emissions.

It is unburned gas emission that can be resulted in combustion process ,or in other meaning 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. It is our most widespread and intractable urban air pollution problem.

A number of exhaust hydrocarbons are also toxic, with the potential to cause cancer; this emission can be produced by:

- Misfiring happens if the air-fuel mixture within the spark plug gap is out of ignitable range, or the spark plug fails to produce a healthy arc.

- Incomplete flame propagation intake manifold absolute pressure (IMAP) drops quickly as engine accelerates during starting, Flame can not propagates fast in diluted intake charge .

- Over fueling (fuel rich air-fuel mixture).

- Extra fuel in the cylinder can not be burned. most of it is exhausted, which can cause an extra of unburned hydrocarbon.

3.3.4 NO_X Emissions.

Nitrogen oxides (NO_X) is the generic term for a group of highly reactive gases. They form when fuel is burned at high pressure and temperature conditions, which induce the dissociation and subsequent recombination of atmospheric N_2 and O_2 that generate NO_X.

Many of the nitrogen oxides are colorless and odorless. However, nitrogen dioxide (NO_2) can be seen in the air as a reddish-brown layer over many urban areas.
The primary sources of NO_X are motor vehicles and other industrial, commercial, and residential sources that burn fuels. The combustion in motor vehicle engines causes the production of primarily NO but also NO_2 , as shown by the following chemical reactions:

$$2NO_2+O_2 \rightarrow 2CO$$

$$2CO+O_2 \rightarrow 2CO_2$$

When the fuel consumption rate is low, very little NO_X is emitted. Under endearment conditions, more NO_X tends to be formed due to the excess oxygen. During stoichiometric conditions, NOx emissions tends to increase as more fuel is burned, due to the increased combustion temperature.[7]

NO is a precursor to the formation of ground level ozone. It reacts with ammonia, moisture, and other compounds to form nitric acid that may cause serious respiratory problems. It also contributes with SO_2 to the formation of acid rain and of particulate matter. It also causes eutrophication (nutrient overload in water bodies) and contributes to the formation of smog.[7]

They also contribute to the formation of acid rain ,and it can irritate airways, especially your lungs.

3.3.5 VOCs and O_3 Emissions.

General term for a wide range of hydrocarbon compounds that produce from combustion processes and evaporation of gasoline vapors, solvents, other solvents, transportation, coating as seen in figure (3.3) contribute to Global Emissions of VOCs, in and of themselves, do not necessarily give rise to health or environmental concerns. In many areas, however, they react with oxides of nitrogen (NO_X) in the presence of heat and sunlight to form ground-level ozone the primary component of "smog." For that reason, they are regulated as "ozone precursors".[7]

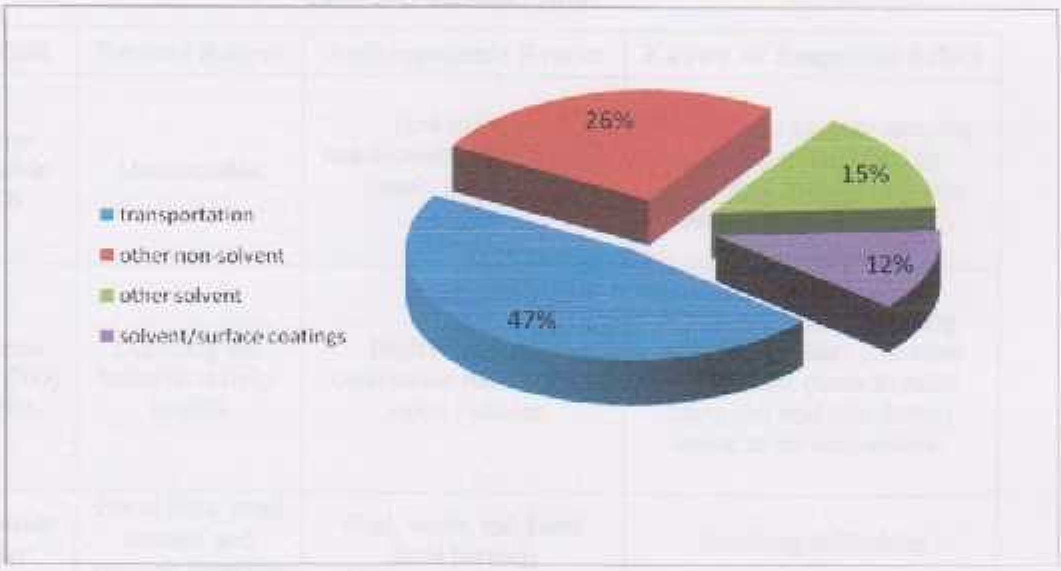

Figure 3.3: Sources for VOC.

3.3.6 SO_2 Emission.

Sulfur dioxide (SO_2) is sometimes created during the combustion process from the small amount of sulfur present in gasoline .during certain conditions the catalytic oxides sulfur dioxide to make SO_3 , which then reacts with water to make H_2 So4 or sulfuric acid . Finally, when sulfur and hydrogen react, it forms hydrogen sulfide gas . this process creates the rotten egg order you sometimes smell when following vehicles on the highway.

Particulate carbon soot is the visible black smoke you see from the tailpipe of a vehicle that's running very rich.[7]

3.3.7 Emissions Influence.

Emissions as seen can effect on human and causes ozone, its influence can illustrate in the table(3-1).[8]

Table 3-1: Emission effect.

Pollutant	Natural Source	Anthropogenic Source	Known or Suspected Effect
Carbon monoxide (CO)	Unnoticeable	Fuel-rich and stoichiometric combustion mainly from motor vehicles	Reduces the oxygen- carrying capacity of the blood by combining with hemoglobin, thus deprives tissues of O_2
Nitrogen oxides (NO) and NO_2	Lightning and bacterial activity in soils	High temperature combustion mainly from motor vehicles	Cause eye, throat, and lung irritation. Primary pollutants that produce photochemical smog and acid rain destroy ozone at the stratosphere.
Particulate matter	Forest fires, wind erosion, and volcanic eruptions	Coal, waste, and fossil fuels burning	Breathing difficulties

Sulfur dioxide (SO_2)	Volcanic eruptions and decay	Coal combustion, or smelters, petroleum refineries, and diesel engines	Cause eye, throat, and lung irritation. Primary pollutants that produce acid rain
Ozone (O_3)	Lightning and photochemical reactions in the troposphere	Product of photochemical in photochemical smog	Cause eye, throat, and lung irritation, impairs lung function
Carbon dioxide (CO_2)	Animal respiration, decay, and release from oceans	Fossil fuels and wood combustion	Partly responsible for the atmospheric greenhouse effect
Hydrocarbons other than methane (VOC_S) i.e. Volatile Organic Compounds	Biological processes	Incomplete combustion and volatile	Primary pollutants that produce photochemical smog
Methane (CH_4)	Anaerobic decay, cud-chewing animals, and oil wells	Natural gas leak and combustion	Partly responsible for the atmospheric greenhouse effect

3.4 Automobile Emission Sources.

The emission that can produced in automobile in main form from evaporative emissions that can result from diurnal, running losses, hot soak and from refueling losses.

Particular, small emissions can produced miscellaneous emissions resulted due to wear in brakes, tires, etc as it seen in figure (3.4).[9]

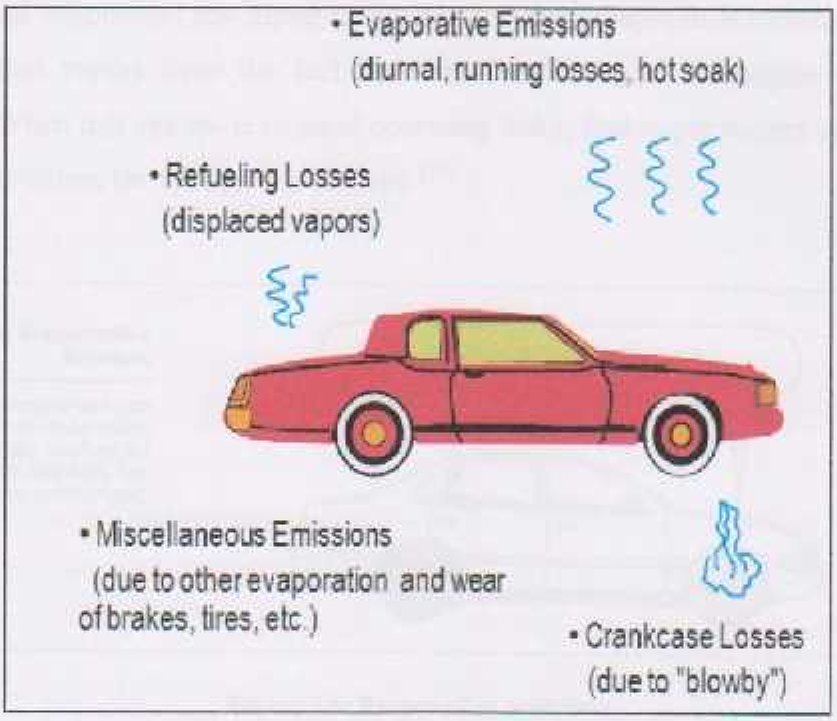

Figure 3.4: Sources of evaporative emissions.

3.4.1 Evaporative Emissions.

Up to now, there have discussed the creation and causes of tailpipe or exhaust emission output. however, it should be noted that hydrocarbon (HC) emission come from the tailpipe, as well as other evaporative sources, like the crankcase, fuel tank and evaporative emissions recovery system .

In fact, studies indicate that as much as 20% of all HC emissions from automobiles come from the fuel tank and carburetor (on carbureted vehicle, of course). because hydrocarbon emissions are volatile organic compounds (VOC_s) which contribute to smog production, it is just as important that evaporative emissions control are in as good a working order as combustion emission controls.

Fuel evaporated see figure (3.5)vehicle use an evaporative emissions system to store fuel vapors from the fuel tank and burn them in the engine when it is running. When this system is in good operating order, fuel vapor cannot escape from the vehicle unless the fuel cap is removed.[10]

Figure 3.5: Evaporative emissions.

Evaporative emissions can classified as:

- Gas tank venting: the heating of the vehicle as the temperature rises from the night-time temperature to the hottest temperatures of the day mean that gasoline in the tank evaporates, increasing the pressure inside the tank above atmospheric pressure. This pressure must be relieved, and before emissions control it was simply vented into the atmosphere.

- Running losses: the escape of gasoline vapors from the hot engine.

- Refueling losses: these can cause a lot of hydrocarbon vapor emission. The empty space inside a vehicle's tank is filled with hydrocarbon gases, and as the tank is filled, these gases are forced out into the atmosphere. In addition, there is loss from further evaporation and fuel spillage.[10]

3.5 An Exhaust Gas Analyzer.

Use of a four or five main gas exhaust analyzer can be helpful in troubleshooting both emissions and drivability concerns. presently, shop grade analyzer are capable of measuring from as few as two exhaust gases, HC, CO, CO_2 and NO_x as seen in figure (3.6).

All five of these gases, especially O_2 and CO_2 are excellent troubleshooting tools. Use of an exhaust gas analyzer will allow you to narrow down the potential cause of drivability and emission concerns, focus your troubleshooting tests in the areas most likely to be causing the concern, and save diagnostic time. In addition to helping you focus your troubleshooting, an exhaust gas analyzer also gives you the ability to measure the effectiveness of repair by comparing before and after exhaust readings.[11]

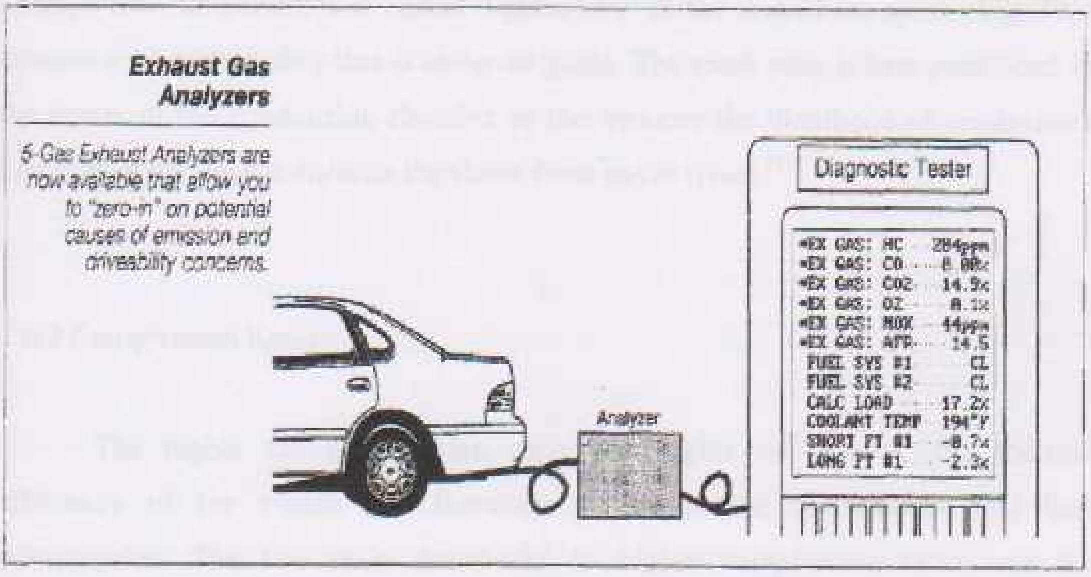

Figure 3.6: Gas analyzer.

3.6 Engine Design Control Emissions.

Engine chamber design compression ratio. valve timing. manifold designs charge stratification warm up time ignition system, thermal after-burning closed loop lambda control.

3.6.1 Engine and Chamber Design.

Main design details of an engine have a marked effect on the production of pollution emissions. It will be clear that the final design of an engine is a compromise between conflicting interests.

Combustion chamber design have an effect for fuel combustion and reducing emissions, the main source of hydrocarbon emissions is un burnt fuel that .good swirl of the cylinder charge is important, as this facilitates better and more rapid burning. Perhaps more important is to ensure a good swirl in the area of the spark plug. This ensures a mixture quality that is easier to ignite. The spark plug is best positioned in the center of the combustion chamber as this reduces the likelihood of combustion knock by reducing the distance the flame front has to travel.[11]

3.6.2 Compression Ratio.

The higher the compression ratio, the higher, in general ,the thermal efficiency of the engine and therefore the better the performance and fuel consumption. The two main drawbacks to higher compression ratios are the increased emissions and the increased tendency to knock. the problem with emissions is due to the high temperature, which in turn causes greater production of NO_x. The increase in temperature makes the fuel and air mixture more likely to self-ignite, causing a higher risk of combustion knock. with changes in combustion chamber design and the more widespread introduction of four valves per cylinder, together with greater electronic control and other methods of dealing with emissions, compression ratios have increased over the years.

3.6.3 Valve timing.

The effect of valve timing on exhaust emissions can be quite considerable. On the main factors is the amount of valve overlap. This is the time during which the inlet valve has opened but , The exhaust valve has not yet closed. The duration of this phase determines the amount of exhaust gas left in the cylinder when the exhaust valve finally closed. This has a significant effect on the reaction temperature, and hence has an effect on the emissions of NOx . the main conflict is that, at higher speeds, a longer inlet open side is that this causes greater valve overlap and, at idle, this can greatly increase emissions of hydrocarbons. this has led to the successful introduction of electronically controlled valve timing.

3.6.4 Manifold Designs.

Gas flow within the inlet and exhaust manifolds is a very complex subject. The main cause of this complexity is the transient changes in flow that are due not only to change in engine speed but also to the pumping action of the cylinders. This pumping action causes pressure fluctuations in the manifolds. If the manifolds and both induction and exhaust systems are designed to reflect the pressure wave back at just the right time, great improvements in volumetric efficiency can be attained. Many vehicles are now fitted with adjustable length induction tracts. Longer tracts are used at lower engine speeds and shorter tracts at higher speed.

3.6.5 Change Stratification.

If the charge mixture can be inducted in to the cylinder in such away that a richer mixture is in the proximity of the spark plug, then overall the cylinder charge can be much weaker. this can bring great advantages in fuel consumption, but the production of NOx can still be a problem. The later section on direct mixture injection development is a good example of the use of this technique. Many lean-burn engines use a form of stratification to reduce the chances of misfire and rough running.

3.6.6 Warm up time.

A Significant quantity of emissions produced by an average vehicle is created during the warm up phase. Suitable materials and care in the design of the cooling system can reduce this problem. Some engine management systems even run the ignition timing slightly retarded during the warm-up phase to heat engine more quickly.

3.6.7 Ignition System.

The ignition system can affect exhaust emissions in two ways; first, by the quality of the spark produced, Secondly, the timing of spark. The quality of a spark will determine its ability to ignite the mixture. The duration of the spark in particular is significant when igniting weaker mixtures. The stronger the spark the less of likelihood of misfire, which can cause massive increases in the production of hydrocarbons. the timing of the spark is clearly critical but, as ever, is a compromise with power, drivability, consumption and emissions. The production of carbon monoxide is dependent almost only on fuel mixture and is not significantly affected by charges in ignition timing. Electronic and programmed ignition systems have made significant improvements to emission levels of today's engines.

3.6.8 Thermal after-burning.

Prior to the more widespread use of catalytic converters, thermal after-burning was used to reduce the production of hydrocarbon. In fact, hydrocarbons do continue to burn in the exhaust manifold and recent research has shown in the type of manifold used, such as cast iron or pressed steel, can have a noticeable effect on the reduction of HC. at temperatures of about 600°C ,HC. And CO are burnt or oxidized into H2O and CO2. if air is injected into the exhaust manifold just after the valves, then the after burning process can encouraged.

3.7 Strategy Control Exhaust Emissions.

These strategies are the main for controlling emissions, and can reduce evaporative emissions.

3.7.1 EGR Control Valve.

The EGR Europe division of EGR Worldwide began operations in 1990. Since then, the division has expanded rapidly, with a facility in Milton Keynes, United Kingdom that boasts strong product development and design as well as distribution of products across
Europe.

The purpose of the exhaust gas recirculation valve (EGR) valve is to meter a small amount of exhaust gas into the intake systems as seen in figure (3.7), this dilutes the air/fuel mixture so as to lower the combustion chamber temperature, as seen in figure.

Excessive combustion chamber temperature creates oxides of nitrogen, which is a major pollutant. While the EGR valve is the most effective method of controlling oxides of nitrogen, in it's very design it adversely affects engine performance. The engine was not designed to run on exhaust gas. For this reason the amount of exhaust entering the intake system has to be carefully monitored and controlled. This is accomplished through a series of electrical and vacuum switches and the vehicle computer. Since EGR action reduces performance by diluting the air /fuel mixture, the system does not allow EGR action when the engine is cold or when the engine needs full power.

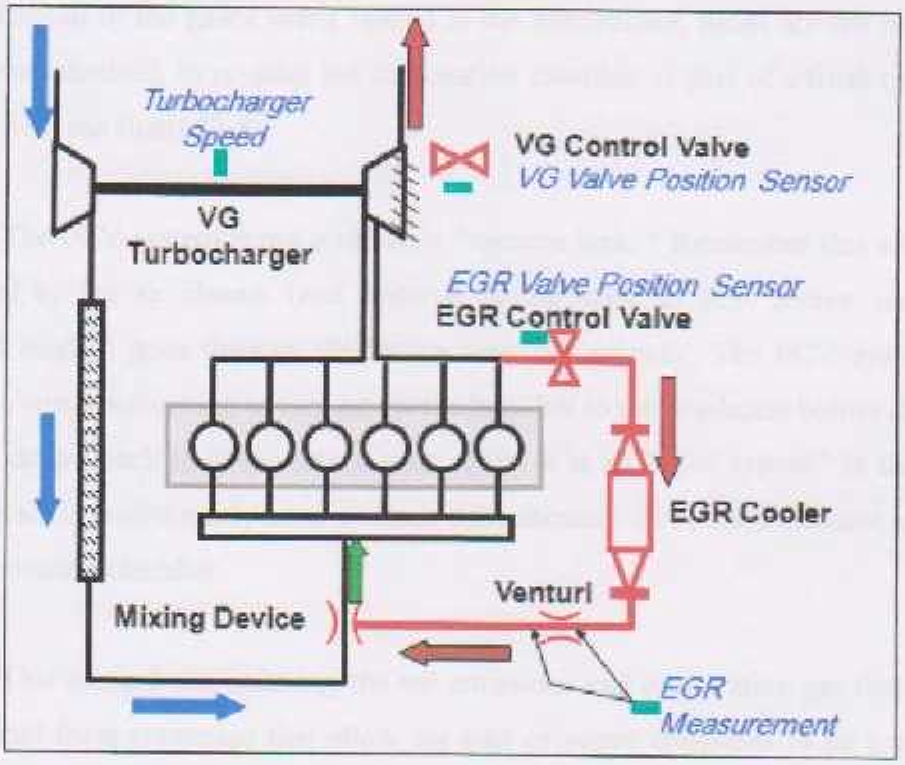

Figure 3.7: EGR cycle.

3.7.2 Evaporative Emissions Control.

Evaporative emissions control can be controlled by two ways:

- PCV (Positive Crankcase Valve):

PCV systems have been standard equipment on all new cars since the early sixties. Prior to 1963 PCV was only used in California. There are a variety of PCV systems used on various makes and models of cars produced since 1963, but all functions are essentially the same.

The PCV valve is only one part of the PCV system, which is essentially a variable and calibrated air leak, whereby the engine returns its crankcase combustion gases. Instead of the gases being vented to the atmosphere, gases are fed back into the intake manifold, to re-enter the combustion chamber as part of a fresh charge of air and fuel, see figure (3.8).

The PCV system is not a classical "vacuum leak. " Remember that all the air collected by the air cleaner (and metered by the mass air flow sensor, on a fuel injected engine) goes through the intake manifold anyway. The PCV system just diverts a small percentage of this air via the breather to the crankcase before allowing it to be drawn back in to the intake tract again. It is an "open system" in that fresh exterior air is continuously used to flush contaminants from the crankcase and into the combustion chamber.

This method can reducing the car emissions and evaporative gas that can be evaporated from crankcase that allow for part of vapor emissions to be entered to vacuum line to be combusted as general combustion .

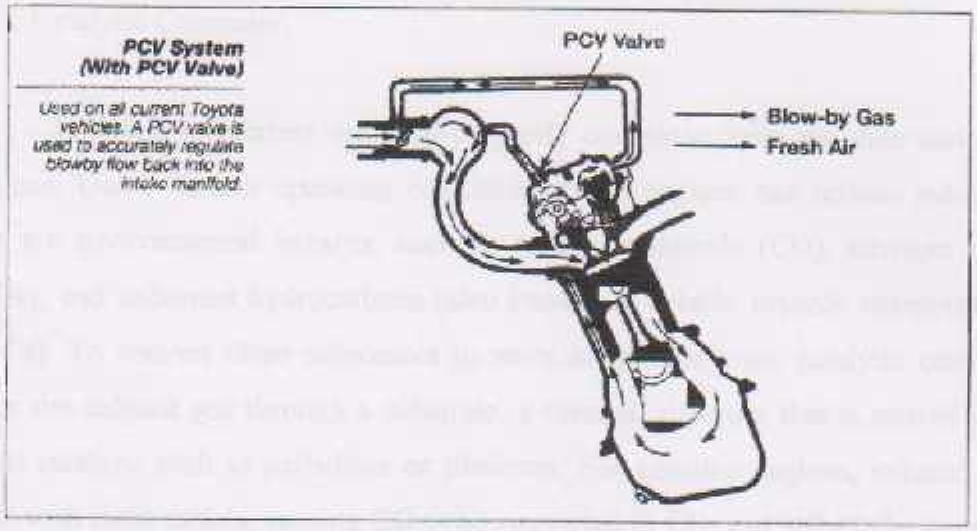

Figure 3.8: PCV valve.

- Canister Valve

Evaporative Emissions Canisters help limit the amount of gasoline vapors released into the environment by reducing evaporative emissions that occur from fuel storage and delivery in a vehicle's fuel system.

As gasoline vapors and condensed liquid from the fuel tank enter the canister through the tank tube, hydrocarbon molecules in the vapors and liquid are attracted to and stored on the surfaces of the carbon bed inside the canister. This process is called adsorption. A manifold vacuum draws fresh air through the carbon bed, pulling the gaseous molecules into the intake manifold for combustion. This process is called purging. Recognizes that a canister is an integral part of an effective evaporative control system.

3.7.3 Catalytic Converter.

Catalytic converters are used to purify emissions from gasoline and diesel engines. Under certain operating conditions, these engines can release substances that are environmental hazards, such as carbon monoxide (CO), nitrogen oxides (NOx), and unburned hydrocarbons (also known as volatile organic compounds, or VOCs). To convert these substances to more acceptable ones, catalytic converters force the exhaust gas through a substrate, a ceramic structure that is coated with a metal catalyst, such as palladium or platinum. For gasoline engines, exhaust gases react with these metals, causing CO to be converted to CO_2 and NOx to be converted to nitrogen and oxygen. VOCs are also burned in the converter, leading to the formation of CO2 and water. For diesel engines, catalytic converters are primarily used to treat the NOx compounds see figure (3.9).

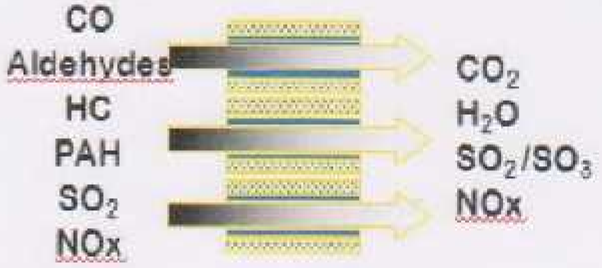

Figure 3.9: Catalytic converter.

Chapter Four

Devices Description and Programs

4.1. Introduction.

4.2. Entry RAE Device.

4.2.1. Physical Description.

4.3. VRAE device.

4.3.1. Program and Computer Interface.

4.4. Noise Dosimeter Device.

4.1 Introduction.

This chapter is describing the devices and programs includes description for devices which will be use in the project to measure gases concentration produce from the traffic motion (vehicles motion).

Operating devices and gases which measure by each device, and programs use in measure operation to compare between the measure gases and standard value approach to it by experimental, and calibration this devices to make it ready for use.

4.2 Entry RAE Device.

Street level concentration of H_2S, CO, VCO, O_2, and the LEL% measured by using Entry RAE Alarms ,which has pump cycle to measure the concentration of this gases. The pump cycle will run continuously when the concentration of the gas or vapor is nearing an alarm condition, see figure (4.1).

4.2.1 Physical Description.

As See figure (4.1) the device consists these parts:

1. Display.
2. Operation / Program keys.
3. Charge status.
4. Visual alarm.
5. Gas plate.
6. Buzzer.
7. Gas inlet with external filter.
8. Charging contacts.
9. Charging cradle.
10. Power jack.
11. RS-232 port.

Figure 4.1: Physical component.

4.3 VRAE Device.

The VRAE is a programmable multi gas monitor designed to provide continuous exposure monitoring of toxic gases, oxygen and combustible gases for worker in hazardous environments.

The VRAE detected inorganic toxic gases and oxygen concentration with the electrochemical sensors. It is also monitors combustible gases with a catalytic bead sensor and broad range of gases with thermal conductive detector.

It has five type of sensors, electromechanical sensors for toxic gases, oxygen sensor, catalytic bead for combustible gases and thermal conductivity detector (TCD) for broad range of gases.

4.3.1 Program and Computer Interface.

Each VRAE with data logging option is shipped with software package, called Pro RAE suite, and serial computer interface cable.

Its allows the user to configure the VRAE monitor through a user friendly interface and send the configuration information from the PC to the VRAE monitor. Collected data can also be extracted from the VRAE monitor to the PC in order to perform data analyses, report generation or record keeping.

4.4 Noise Dosimeter Device.

Noise dosimeter is all about measuring sound and protecting hearing. To do that well, a dosimeter must provide comprehensive information under varying condition, in multiple location and with user setting. It should be easy to use.

Sound energy is commonly expressed in decibels (dB) which relates one energy level to second energy level on a logarithmic scale.

Chapter Five

Emission estimation technique and calculations

5.1 Introduction

Whether or not emissions need to be estimated and reported as part of the project is dependent on various thresholds for a substance being exceeded. For the substances emitted from combustion engines the threshold is Categories and for some substances contained in fuel Categories, this chapter has the equations for the vehicles (gasoline, diesel, light and heavy vehicles), and see the amount of energy (emissions) produce yearly by the number of vehicles and using categories (ready table) to estimate emission per year.

5.2 Emission Estimation Techniques

In general, there are three types of emission estimation technique (EET), detailed in the project Guide, which may be used to estimate facility emissions:[3]

- Sampling or direct measurement.
- Fuel analysis or other engineering calculations.
- Emission factors.

5.2.1 Direct Measurement

It can may wish to use direct measurement in order to report, particularly if already do so in order to meet other regulatory requirements. The emissions do not require to undertake additional sampling and direct measurement to fulfill reporting requirements. For sampling data to be adequate and able to be used for emission reporting purposes it would need to be collected over a significant period of time and be representative of operations for the whole year.

Direct measurement can be used to estimate emissions from combustion engines using exhaust samples from the engines used at the facility or similar engines under conditions equivalent to those at the facility. Appropriate sampling methods must be used and the calculations to estimate emissions must be correct. In particular the fuel to air ratio and the amount of air that is entrained with the exhaust prior to measurement of its composition must be accounted for.[1]

It is not possible simply to analyze the exhaust emissions, obtain the concentration of emissions .substances in exhaust and determine emissions of those substances. It is necessary to relate the concentration of substances in exhaust to fuel use and the overall exhaust emissions or to the total gas flow from the exhaust. The concentration of a substance alone cannot be used to determine emissions of that substance.[12]

5.2.2 Engineering Calculations.

An engineering calculation is an estimation method based on physical/chemical properties. (e.g. vapor pressure) of the substance and mathematical relationships (e.g. ideal gas law).[12]

5.2.3 Estimating Emissions Using Emission Factors.

Emission factors may be used to estimate pollutant emissions to the environment. Emission factors relate the quantity of pollutant emitted from an engine to its power or fuel consumption and, in the case of road-transport vehicles, the distance travelled. When an emission factor related to engine power is used, the annual engine operating hours are required. Different emission factors have different units. Emission factors based on engine power are expressed as kg of pollutant per KWh, factors based on fuel usage are kg of pollutant per m3 of fuel and factors based on distance travelled are kg of pollutant per km travelled in the reporting year.[4]

This section provides EETs and details the data inputs required for estimating emissions from combustion engine powered vehicles. Under the research, occupiers of facilities are required to report emissions from vehicles used on-site irrespective of whether they are registered. An example of on- is used both on-site and off-site, only the on-site emissions are estimated and reported by the facility.

The EETs for vehicles provide methods for estimating emissions of CO, NO_X, PM_{10}, SO_2, VOC_S and other reportable pollutants. The parameters required to estimate the pollutant emissions depend on the type of vehicle and how it is used. For the purpose of estimating emissions, vehicles have been classified as either "road-transport vehicles" or "industrial vehicles". Road-transport vehicles include cars, light and heavy goods vehicles, buses and motorcycles used on either sealed roads or on well-formed unsealed roads. Emissions are estimated for these based on the distance travelled.

5.2.3.1 Road-transport vehicles

For road-transport vehicle pollutant emission estimations the vehicle type and distance travelled by the vehicle are required inputs to estimate pollutant emissions.

Table (5-12) contains the emission factors for cars, a category of road-transport vehicles, with petrol, diesel and LPG engines. The emission factors are all in terms of kg/km. As previously stated, only the on-site component of vehicle usage need be considered.[12]

Equation[3] estimates emissions for Road-Transport vehicles based on fuel consumption using the emission factors from Tables(5-10), (5-11), (5-12), and the load factors in Table (5-16).

$$E_{kpy,i} = F * LF * EF_i \qquad \text{Equation 1}$$

Where: $E_{kpy,i}$ = emission of pollutant i for a specific type of engine, kg/year.

F = vehicle fuel use, kg or liters per year (Table 5-).

LF = load factor utilized in facility operations for equipment type (see Table).

EFi = emission factor for pollutant i, for given engine and fuel type, kg/liter or kg (kg for LPG and liters for liquid fuels in Table 5- and Table 5-).

i = pollutant type.

For petrol powered industrial vehicles VOC_S emissions occur from exhaust (derived from equation1) and also from evaporation and the crankcase. The evaporative and crankcase VOC_S emissions are dependent only on the hours of operation as in Equation2.[1]

$$E_{kpy,i} = OpH_{rs} * EF_i \qquad \text{Equation 2.}$$

Where: $E_{kpy,i}$ = emission of pollutant i for a specific type of engine, kg/year.

OpH_{rs} = vehicle operating hours, h/year.

EF_i = emission factor for pollutant i, for given engine and fuel type, kg/h.

i = pollutant type.

- Privet Diesel vehicles:

Emissions are calculated below using Equation1.

$$E_{kpy,i} = F * LF * EF_i \qquad \text{Equation 1.}$$

Pollutant	Fuel use		Load factor		Emission factor	Emission * N* 7
i	Liters/ year		Table 5.7		Kg/Km ,table 3	Kg/year
CO	1314	*	0.25	*	$3.52 * 10^{-4}$	= 0.562
NO_X	1314	*	0.25	*	$3.43 * 10^{-4}$	= 0.547
PM_{10}	1314	*	0.25	*	$6.19 * 10^{-5}$	= 0.099
SO_2	1314	*	0.25	*	$3.63 * 10^{-5}$	= 0.058
VOC	1314	*	0.25	*	$5.87 * 10^{-5}$	= 0.094

NOTE: * Where N (34) is the number of Diesel Privet vehicles at morning period (Table5.4).
* VOC Emission is measured from the exhaust only, and so on for the others measurement.
* 7: is to convert the unit per liter (1 liter traveled 7 Km, for the privet vehicles).

- Private Gasoline vehicles:

Emissions are calculated below using Equation1.

$$E_{kpy,i} = F * LF * EF_i \qquad \text{Equation 1.}$$

Pollutant	Fuel use		Load factor		Emission factor	Emission * N* 7
i	Liters/ year		Table 5.7		Kg/Km ,table 3	Kg/year
CO	3298	*	0.25	*	$3.52 * 10^{-4}$	= 4.561
NO_X	3298	*	0.25	*	$3.43 * 10^{-4}$	= 4.444
PM_{10}	3298	*	0.25	*	$6.19 * 10^{-5}$	= 0.802
SO_2	3298	*	0.25	*	$3.63 * 10^{-5}$	= 0.470
VOC	3298	*	0.25	*	$5.87 * 10^{-5}$	= 0.761

NOTE: * Where N (110) is the number of Gasoline Privet vehicles at morning period (Table5.4).
* VOC Emission is measured from the exhaust only, and so on for the others measurement.
* 7: is to convert the unit per liter (1 liter traveled 7 Km, for the privet vehicles).
* Fuel use from table 8 research result.

Table 5-1: Morning period, Private vehicle.

Morning Period			
Private vehicle (Diesel) (Kg/year)		Private vehicle (Gasoline) (Kg/year)	
CO	0.562	CO	4.561
NO_X	0.547	NO_X	4.444
PM_{10}	0.099	PM_{10}	0.802
SO_2	0.058	SO_2	0.470
VOC	0.094	VOC	0.761

The result of the other calculation is estimated in the tables below:

Table 5-2: Midday period, Private vehicle.

Midday Period			
Privet vehicle (Diesel) (Kg/year)		Private vehicle (Gasoline) (Kg/year)	
CO	2.180	CO	8.043
NO_X	2.125	NO_X	7.838
PM_{10}	0.383	PM_{10}	1.414
SO_2	0.225	SO_2	0.829
VOC	0.36	VOC	0.875

Emission are calculated using Equation1 ($E_{kpy,i} = F * LF * EF_i$), but the number of vehicle is deferent in this period which will be 132 for Diesel and 194 for Gasoline.

Table 5-3: Evening period, Private vehicle.

Evening Period			
Private vehicle (Diesel) (Kg/year)		Private vehicle (Gasoline) (Kg/year)	
CO	0.760	CO	12.811
NO_X	0.740	NO_X	12.484
PM_{10}	0.134	PM_{10}	2.253
SO_2	0.078	SO_2	1.321
VOC	0.126	VOC	2.460

Emission are calculated using Equation1 ($E_{kpy,i} = F * LF * EF_i$), but the number of vehicle is deferent in this period which will be 46 for Diesel and 309 for Gasoline.

- Public Diesel vehicles:

Emissions are calculated below using Equation1.

$$E_{kpy,i} = F * LF * EF_i \qquad \text{Equation 1.}$$

Pollutant	Fuel use		Load factor		Emission factor	Emission * N* 7
i	Liters/ year		Table 5.7		Kg/Km ,table 3	Kg/year
CO	7650	*	0.25	*	$3.52 * 10^{-4}$	= 12.502
NO_X	7650	*	0.25	*	$3.43 * 10^{-4}$	= 12.183
PM_{10}	7650	*	0.25	*	$6.19 * 10^{-5}$	= 2.199
SO_2	7650	*	0.25	*	$3.63 * 10^{-5}$	= 1.289
VOC	7650	*	0.25	*	$5.87 * 10^{-5}$	= 2.085

NOTE: * Where N (130) is the number of Diesel Public vehicles at morning period (Table5.4).
* VOC Emission is measured from the exhaust only, and so on for the others measurement.
* 7: is to convert the unit per liter (1 liter traveled 7 Km, for the privet vehicles).
* Fuel use from table 8 research result.

- Public Gasoline vehicles:

Emissions are calculated below using Equation1.

$$E_{kpy,i} = F * LF * EF_i \qquad \text{equation 1.}$$

Pollutant	Fuel use		Load factor		Emission factor	Emission * N *7
i	Liters/ year		Table 5.7		Kg/Km ,table 3	Kg/year
CO	1615	*	0.25	*	$3.52 * 10^{-4}$	= 0.223
NO_X	1615	*	0.25	*	$3.43 * 10^{-4}$	= 0.218
PM_{10}	1615	*	0.25	*	$6.19 * 10^{-5}$	= 0.039
SO_2	1615	*	0.25	*	$3.63 * 10^{-5}$	= 0.023
VOC	1615	*	0.25	*	$5.87 * 10^{-5}$	= 0.037

NOTE: * Where N (11) is the number of Gasoline Public vehicles at morning period (Table5.4).
* VOC Emission is measured from the exhaust only , And so on for the others measurement.
* 7: is to convert the unit per liter (1 liter traveled 7 Km, for the privet vehicles).
* Fuel use from table 8 research result.

Table 5-4: Morning period, public vehicle.

Morning Period			
public vehicle (Diesel) (Kg/year)		public vehicle (Gasoline) (Kg/year)	
CO	12.502	CO	0.223
NO_X	12.183	NO_X	0.218
PM_{10}	2.199	PM_{10}	0.039
SO_2	1.289	SO_2	0.023
VOC	2.085	VOC	0.037

The result of the other calculation is estimated in the tables below:

Table 5-5: Midday period, public vehicle

Midday Period			
public vehicle (Diesel) Kg/year		public vehicle (Gasoline) Kg/year	
CO	20.196	CO	1.178
NO_X	19.680	NO_X	1.147
PM_{10}	3.552	PM_{10}	0.207
SO_2	2.083	SO_2	0.121
VOC	3.367	VOC	2.261

Emission are calculated using Equation1 (Ekpy,i = F * LF * EFi), but the number of vehicle is deferent in this period which will be 210 for Diesel and 58 for Gasoline.

Table 5-6: Evening period, public vehicle.

Evening Period			
public vehicle (Diesel) (Kg/year)		public vehicle (Gasoline) (Kg/year)	
CO	13.849	CO	0.122
NO_X	13.495	NO_X	0.119
PM_{10}	2.435	PM_{10}	0.021
SO_2	1.428	SO_2	0.013
VOC	2.309	VOC	0.234

Emission are calculated using Equation1 (Ekpy,i = F * LF * EFi), but the number of vehicle is deferent in this period which will be 144 for Diesel and 6 for Gasoline.

- Light Diesel vehicles:

Emissions are calculated below using Equation1.

$$E_{kpy,i} = F * LF * EF_i \qquad \text{Equation 1.}$$

Pollutant	Fuel use		Load factor		Emission factor	Emission * N* 3
i	Liters/ year		Table 5.2		Kg/Km ,table 3	Kg/year
CO	5610	*	0.25	*	$7.78 * 10^{-4}$	= 12.003
NO_X	5610	*	0.25	*	$6.36 * 10^{-4}$	= 9.812
PM_{10}	5610	*	0.25	*	$1.93 * 10^{-4}$	= 2.978
SO_2	5610	*	0.25	*	$6.7 * 10^{-5}$	= 1.034
VOC	5610	*	0.25	*	$2.08 * 10^{-4}$	= 3.2

NOTE: * Where N (33) is the number of Light Diesel vehicles at morning period (Table5.4).
* VOC Emission is measured from the exhaust only , And so on for the others measurement.
* 3: is to convert the unit per liter (1 liter traveled 3 Km, for the privet vehicles).
* Fuel use from table 8 research result.

- Heavy Diesel vehicles :

Emissions are calculated below using Equation1.

$$E_{kpy,i} = F * LF * EF_i \qquad \text{Equation 1.}$$

Pollutant	Fuel use		Load factor		Emission factor	Emission * N* 1
i	Liters/ year		Table 5.3		Kg/Km ,table 3	Kg/year
CO	33048	*	0.25	*	$2.51 * 10^{-3}$	= 394.015
NO_X	33048	*	0.25	*	$6.38 * 10^{-5}$	= 10.015
PM_{10}	33048	*	0.25	*	$4.94 * 10^{-4}$	= 77.547
SO_2	33048	*	0.25	*	$1.72 * 10^{-4}$	= 27.000
VOC	33048	*	0.25	*	$2.05 * 10^{-3}$	= 321.8

NOTE: * Where N (19) is the number of Light Diesel vehicles at morning period (Table5.4).
* VOC Emission is measured from the exhaust only, and so on for the others measurement.
* 1: is to convert the unit per liter (1 liter traveled 1 Km, for the privet vehicles).
* Fuel use from table 8 research result.

Table 5-7: Morning period, Light & Heavy vehicle.

Morning Period			
Light vehicle (Diesel) (Kg/year)		Heavy vehicle (Diesel) (Kg/year)	
CO	12.003	CO	394.015
NO_X	9.812	NO_X	10.015
PM_{10}	2.978	PM_{10}	77.547
SO_2	1.034	SO_2	27.000
VOC	3.209	VOC	321.8

The result of the other calculation is estimated in the tables below:

Table 5-8: Morning period, Light & Heavy vehicle.

Midday Period			
Light vehicle (Diesel) (Kg/year)		Heavy vehicle (Diesel) (Kg/year)	
CO	24.369	CO	2198.188
NO_X	19.921	NO_X	55.874
PM_{10}	6.045	PM_{10}	432.631
SO_2	2.099	SO_2	150.633
VOC	6.515	VOC	19.545

Emission are calculated using Equation1 (Ekpy,i = F * LF * EFi), but the number of vehicle is deferent in this period which will be 67 for Light and 106 for Heavy.

Table 5-9: Morning period, Light & Heavy vehicle.

Evening Period			
Light vehicle (Diesel) (Kg/year)		Heavy vehicle (Diesel) (Kg/year)	
CO	22.550	CO	1451.633
NO_X	18.434	NO_X	36.898
PM_{10}	5.594	PM_{10}	285.700
SO_2	1.942	SO_2	99.474
VOC	6.028	VOC	18.086

Emission are calculated using Equation1 (Ekpy,i = F * LF * EFi), but the number of vehicle is deferent in this period which will be 62 for Light and 70 for Heavy.

Table 5-10: Emission factors for Road-Transport vehicles – Cars.

Pollutant	Petrol (kg/km)	Diesel (kg/km)	LPG5(kg/km)
Benzene	3.78E-05	1.12E-06	neg.6
1,3 Butadiene	1.07E-05	3.02E-06	neg.6
CO	5.55E-03	3.52E-04	6.16E-03
NOx	9.02E-04	3.43E-04	6.00E-04
PM10	1.80E-05	6.19E-05	neg.6
SO2	4.05E-05	3.63E-05	neg.6
VOCs	6.76E-04	5.87E-05	7.22E-04

NOTES:

1. Source: Reference 6 for petrol and diesel emission factors.

2-Scientific notation is used; e.g. 7.38E-02 represents 7.38 x 10-2 or 0.0738.

Table 5-11: Emission Factors for Road-Transport Vehicles – Light Goods Vehicles (LGV).

Pollutant	Petrol3 (kg/km)	Diesel(kg/K m)	sPLG7 (kg/km)
Benzene	5.17E-05	4.19E-06	neg.6
1,3 Butadiene	1.78E-05	5.31E-06	neg.6
CO	1.18E-02	7.78E-04	1.32E-02
NOx	1.50E-03	6.36E-04	9.95E-04
PM10	3.10E-05	1.93E-04	neg.6
SO2	5.58E-05	6.70E-05	neg.6
VOCs	1.16E-03	2.08E-04	1.24E-03

NOTES:

* Source: Reference 1.
* LGV is Light Goods Vehicle–includes large 4 wheel drive vehicles such as the Toyota Land cruiser and Nissan Patrol.

* Scientific notation is used; e.g. 7.38E-02 represents 7.38 x 10-2 or 0.0738.

Table 5-12: Emission Factors for Road-Transport Vehicles – Diesel Heavy Goods Vehicles (HGV), Diesel Buses and Petrol Motorcycles.

Pollutant	Rigid HGV_5 (kg/km)	Articulated HGV_5 (kg/km)	Buses (kg/km)	Motorcycles (kg/km)
Benzene	4.11E-05	2.95E-05	3.62E-05	3.79E-05
1,3 Butadiene	1.26E-05	1.94E-05	1.31E-05	1.48E-05
CO	2.51E-03	2.32E-03	5.06E-03	1.90E-02
NO_X	6.38E-03	1.19E-02	1.00E-02	1.20E-04
PM_{10}	4.94E-04	5.6E-04	5.69E-04	8.70E-05
SO_2	1.72E-04	356E-04	2.65E-04	2.40E-05
VOC_S	2.05E-03	1.47E-03	1.81E-03	5.01E-03

Notes:

* Source: Reference 1 for petrol and diesel emission factors.
* HGV is Heavy Goods Vehicle.

Table 5-13: The number of vehicle at each period.

	Privet		Public		Light		Heavy	
Period time	Diesel	Gasoline	Diesel	Gasoline	Diesel	Gasoline	Diesel	Gasoline
Morning period	34	110	130	11	33	0.0	19	0.0
Midday period	132	194	210	58	67	0.0	106	0.0
Night period	46	309	144	6	62	0.0	70	0.0

Table 5-14: The research result of the privet and public vehicles operating hours and amount of fuel.

Public				Privet			
Diesel		Gasoline		Diesel		Gasoline	
OpH_{rs}	Fuel	OpH_{rs}	Fuel	OPH_{rs}	Fuel	OpH_{rs}	Fuel
425	7650	860	1615	850	1314	1380.4	3298

Number of days in the year taken without holydays.

Table 5-15: The research result of the light and heavy vehicles operating hours, and amount of fuel.

Light				Heavy			
Diesel		Gasoline		Diesel		Gasoline	
OpHrs	Fuel	OPHrs	Fuel	OpHrs	Fuel	OpHrs	Fuel
2244	5610	0.0	0.0	3400	3304	0.0	0.0

Number of days in the yearr taken without holydays.

Table 5-16: Load Factors for Various "Miscellaneous" Industrial Vehicles.

Industrial vehicle type	Load factor
Car1	0.25
Bus1	0.25
Utility1	0.25
LGV1	0.25
HGV1	0.25
Forklift	0.20
Airport equipment tug	0.80
Airport baggage tugs	0.55
Track-type tractor	0.55
Wheeled tractor	0.55
Wheeled dozer	0.55
Scraper	0.50
Motor grader	0.50
Wheeled loader	0.50
Track-type loader	0.50
Off-highway truck	0.50
Roller	0.50

Notes:

* Source: Reference 2 for petrol and diesel emission factor.

Chapter Six

Emission analysis and reading measurement

6.1 Introduction.

The emission produced from vehicles as mainly source and others, the area that are used to measure the reading and result can congests for vehicles with its all kind (diesel and gasoline) for private, public, and diesel for light and heavy truck.

These can be expressed in a wide range of collecting information for the vehicles depending on models, vehicles type, and quantity for vehicles, tracks that the driver can follow it.

Depending on these accessories, there is identification for the emission sources and identify the emissions that pollute the environment, and how these pollutant with its concentration can distribute in the street.

6.2 Area Research.

Hebron is the large population city in the west bank in Palestine. Because of that, it has a noticed traffic density. This is why Hebron was selected to be the area of this research.

The area of emission taken in Al-Salam street at its center (Sebta Center), that the cause for choosing the street since it has the most congest with vehicles in all its kind for diesel and gasoline, the street are divided into four paths with intersection (Sebta center).

Four paths are dividing into :

- Goes to north (Al-Gorah path).
- Goes to south (Al-Hawooz path).
- Goes to east (Bab Al-Zawieh path).
- Goes to west (Al-Galadeh path).

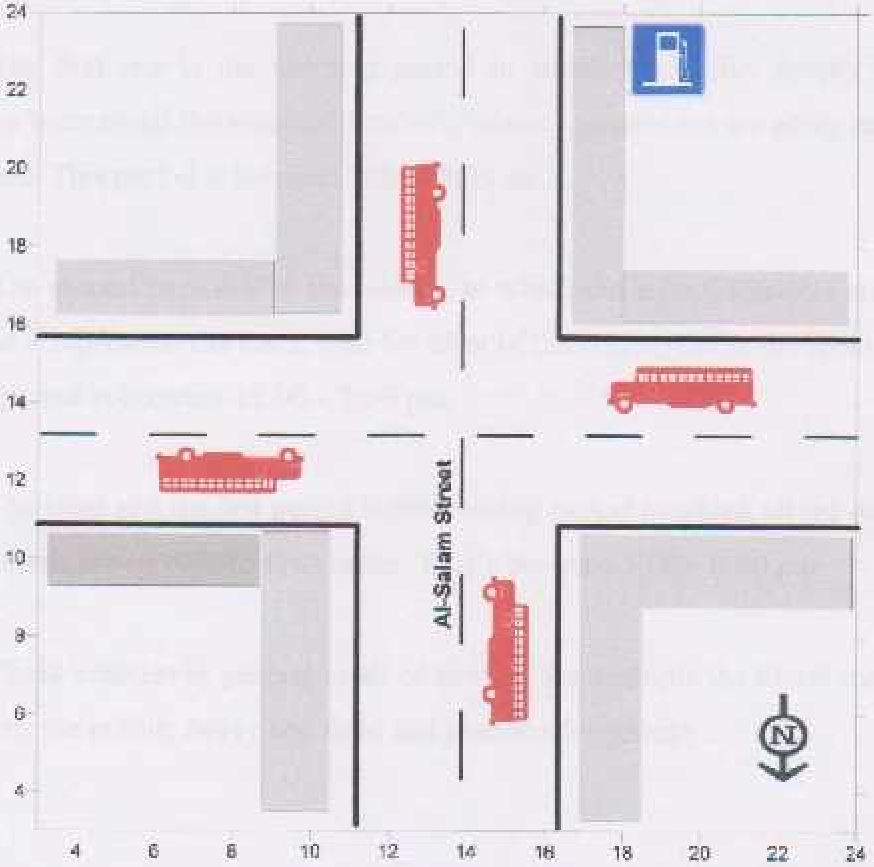

Figure 6.1: Sebta Junction.

6.3 Working Strategies.

Work is starting with dividing length for the street into four junction depend mainly on time. The strategies can divided into two approach, one can uses quantity and quality, without using Entry Rae devices, the other using the devices to determine emissions.

6.3.1 Calculation for the Quantity & Quality.

These calculation strategies determine the number and the kind of vehicles for periods of times didn't exceed two hours each intervals as it is in figure (5.2) and the table (5.1) shows the quantity and quality.

The first one is the morning period in which the traffic density is at the maximum because all the students, teachers, labors ...employees are going each to his destination. This period is between 7:00 – 8:00 am.

The second period is at the midday at which the school students are goes to home and it represents the lunch time for most of the employees of the special sector, and this period is between 12:00 – 2:00 pm.

The third and the last period is the evening period in which all the employees and the labors are on road to their home. That's between 5:00 – 6:00 pm.

These vehicles in general in all of its type, for example the diesel can include the private, the public, heavy and light and gasoline for private .

6.3.1.1 Morning Period.

This period will start at (8-9) hour and the graph in figure (6.2) and table(6-1) shows the distribution for the diesel and gasoline which equal 216 ,140 vehicles respectively, this period for people goes to their work and the student to their schools and universities.

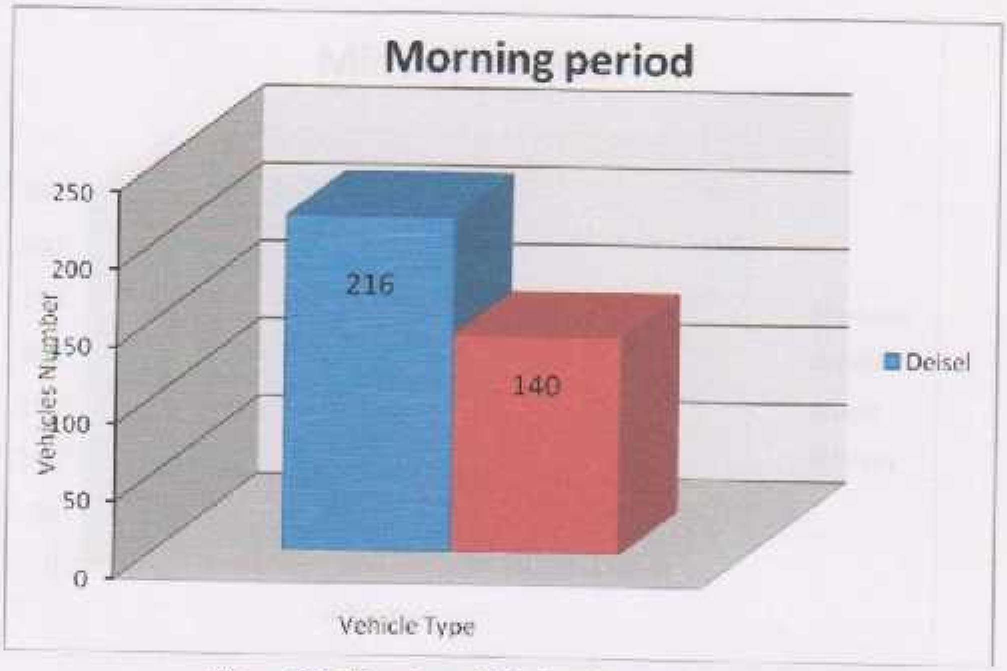

Figure 6.2: Morning vehicle classification.

Table 6-1: Morning Vehicle classification.

Morning period							
Privet Vehicle		Public Vehicle		Light Vehicle		Heavy Vehicle	
Number of Diesel	Number of Gasoline	Number of Diesel	Number of Gasoline	Number of Diesel	Number of Gasoline	Number of Diesel	Number of Gasoline
34	110	130	11	33	0	19	0

6.3.1.2 Midday Period.

This period can be an essentially for vehicle since there is too much movement in traffic. The following chart represents the distribution of the sort or the classification of the samples taken at the midday, there is 324 vehicle private in its kind of diesel and gasoline, 268 vehicle public, 67 vehicle as light and 106 as heavy, as it shows in figure (6.3) and table (6-2).

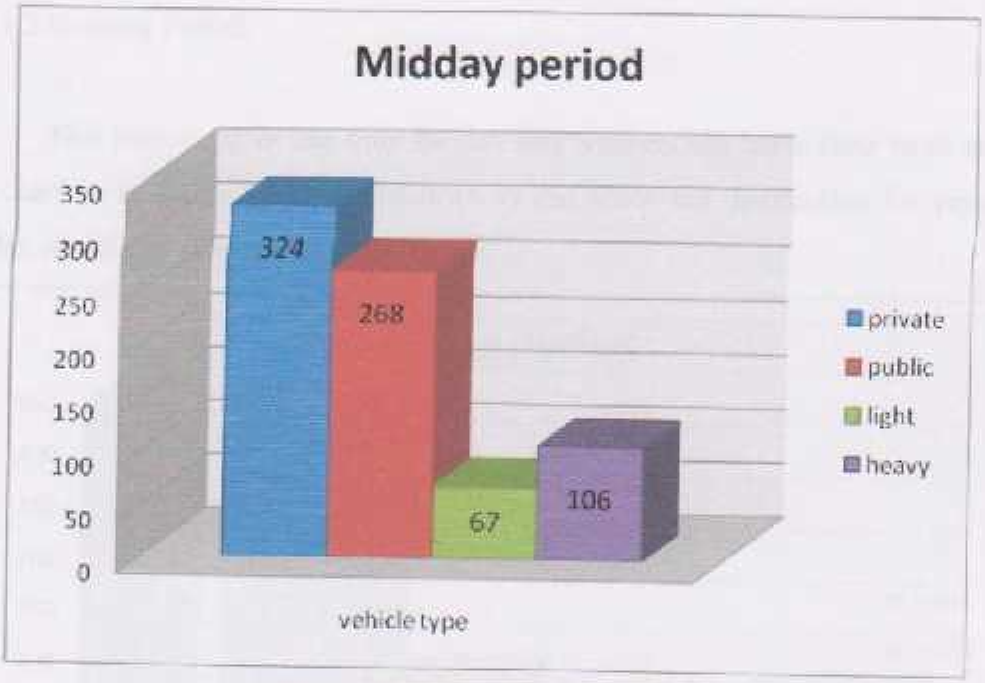

Figure 6.3: Midday vehicle classification.

The table below show the conclusion number of each vehicle type the midday period.

Table 6-2: Midday Vehicle classification.

Midday period							
Privet Vehicle		Public Vehicle		Light Vehicle		Heavy Vehicle	
Number of Diesel	Number of Gasoline	Number of Diesel	Number of Gasoline	Number of Diesel	Number of Gasoline	Number of Diesel	Number of Gasoline
130	194	210	58	67	0	106	0

6.3.1.3 Evening Period.

This period get in late time for day that workers can leave their work and in the chart as in figure (6.4) and table (6-3) can show the distribution for private , public, diesel and private.

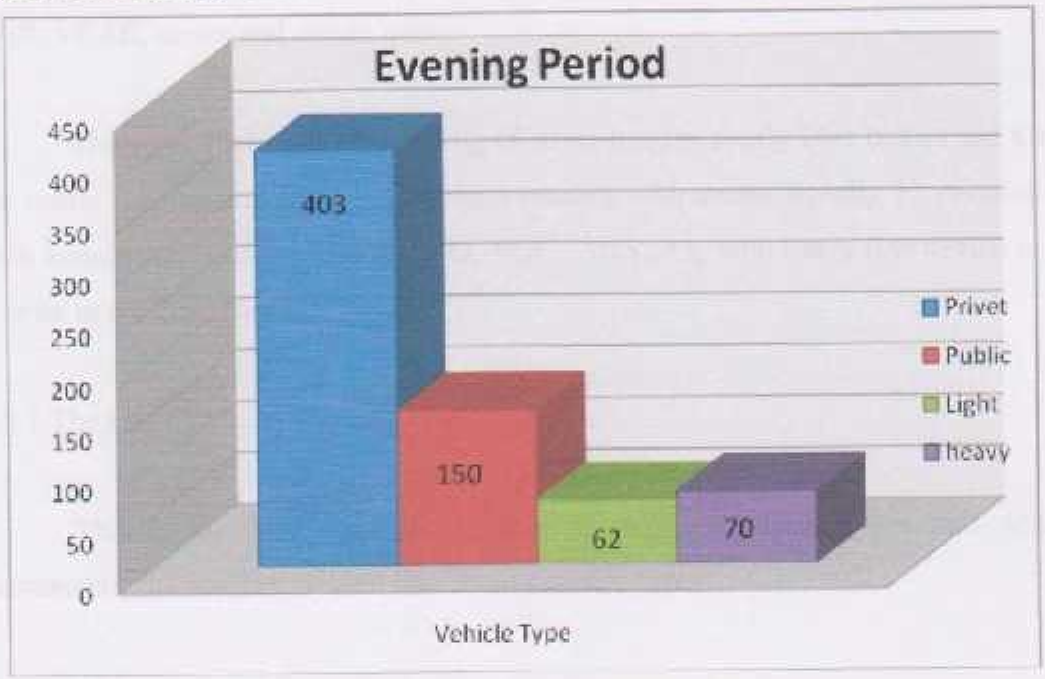

Figure 6.4 Evening Vehicle classification.

Table 6-3: Evening Vehicle classification.

Evening period							
Privet Vehicle		Public Vehicle		Light Vehicle		Heavy Vehicle	
Number of Diesel	Number of Gasoline	Number of Diesel	Number of Gasoline	Number of Diesel	Number of Gasoline	Number of Diesel	Number of Gasoline
94	309	144	6	62	0	70	0

6.4 Devices measurement.

This section can modify the results for Al Salam street, these reading and results can be taken from the entry and its software, as it discussed lately with Entry RAE, VRAE, ozone and noises device.

The work starts at the beginning of street longley nearly 20m before and after the center for junction at each 5m take a reading with a time equally 15 minutes at each minute can read for each gas CO, VOC, H2S, O_2 with Entry Rae device as it is exist in the table (6-4).

6.4.1 The first day

This is the first day that the trip is starting and there are part winds movements, the day can divided into these periodic times:

- Morning period.

At this period the reading for CO are frequently between 1 at the sides for the street and maximum at the center 42.4 ppm as in table (6-4) and also the other gases as seen in figure (6.5) , and the average reading can illustrate in table (6-5).

Table 6-4: Morning period for 1st day.

Time	CO (ppm)	VOC (ppm)	H_2S (ppm)	NO_2 (ppm)	HCN (ppm)	NH_3 (ppm)	Noise dBA	Ozone (%)	O_2 (%)
8:00	1	1	0	0.0	0.3	2	69	0.07	20.9
8:01	1.2	3.3	0	0.1	0.3	2	75.9	0.07	20.9
8:02	1.2	2	0	0.1	0..4	2	65.6	0.07	20.9
8:03	2.0	1.3	0	0.1	0.3	1	84.5	0.07	20.9
8:04	5.3	6.5	0	0.3	0.3	3	70.6	0.07	20.8
8:05	18.6	4	0	0.2	0.2	4	69.4	0.07	20.8
8:06	10.1	8	0	0.8	0.9	6	79.2	0.1	20.7
8:07	56.7	24	0	1.2	2.2	3	77.3	0.1	20.3
8:08	42.4	12	0	2.2	2.1	8	74.6	0.1	20.9
8:09	35.1	8	0	2.2	2.0	6	85.3	0.3	20.9
8:10	7.8	7	0	2.0	2.6	4	70.2	0.07	20.9
8:11	28.6	6	0	0.6	0.4	5	69.5	0.07	20.9
8:12	32.4	13	0	0.4	0.3	5	72.5	0.07	20.9
8:13	26.3	12.4	0	0.3	0.5	3	68.9	0.07	20.9
8:14	22.3	4.6	0	0.3	0.4	2	74.3	0.07	20.9
8:15	21.2	4.2	0	0.3	0.2	1	81.3	0.07	20.9

Table 6-5: Average Morning period for 1st day.

Time Range	Average Morning period for 1st day								
	CO (ppm)	VOC (ppm)	H2S (ppm)	NO2 (ppm)	HCN (ppm)	NH3 (ppm)	Noise dBA	Ozone (%)	O2 (%)
8:00 – 8:15	19.51	7.33	0.00	0.69	0.81	3.56	74.26	0.09	20.84

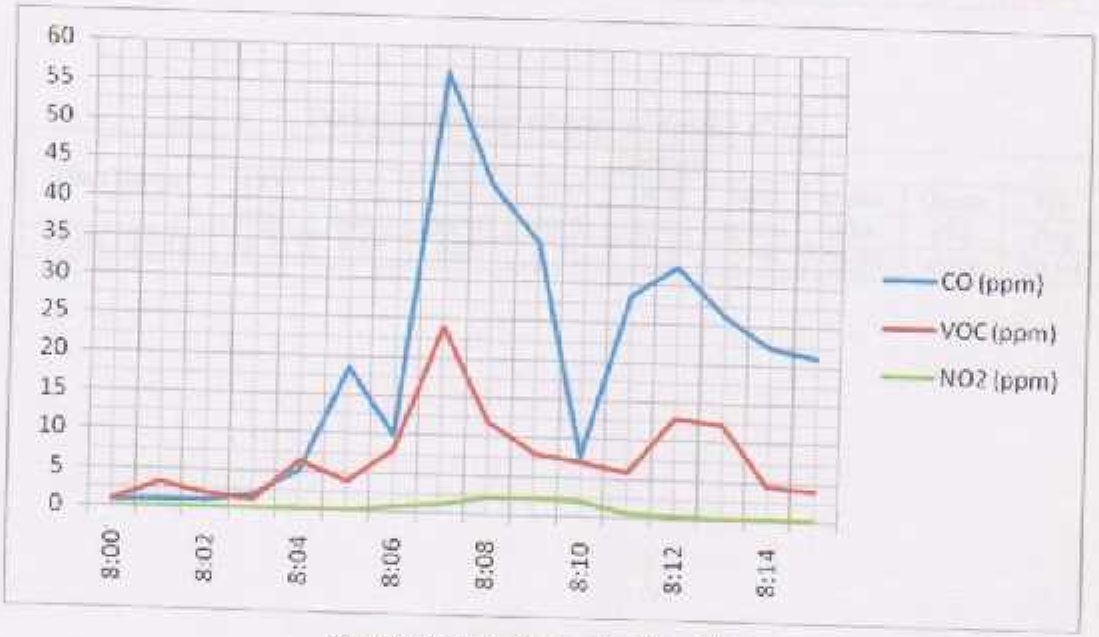

Figure 6.5: Morning period for 1st day.

- Midday period

At this period the reading for CO are frequently between 1 at the sides for the street and maximum at the center 97.6 ppm as in table (6-6) and also the other gases as seen in figure (6.6) , and the average reading can illustrate in tables(6-7).

Table 6-6: Midday period for 1[st] day.

Time	CO (ppm)	VOC (ppm)	H_2S (ppm)	NO_2 (ppm)	HCN (ppm)	NH_3 (ppm)	Noise dBA	Ozone (%)	O_2 (%)
12:00	1	0	0	0.0	0.5	2	65	0.07	20.9
12:01	1	1	0	0.1	0.6	1	75.9	0.07	20.9
12:02	0.3	0	0	0.1	0.8	2	68.6	0.07	20.9
12:03	2.1	1.2	0	0.2	0.4	1	88.5	0.07	20.9
12:04	8.4	2.3	0	0.1	0.7	2	77.6	0.07	20.9
12:05	24.1	4.2	0	0.1	0.6	3	69.5	0.07	20.9
12:06	10.1	3.9	0	0.3	0.7	2	71.2	0.1	20.9
12:07	97.6	30.2	0	1.1	2.9	4	75.3	0.1	20.9
12:08	57.3	24.4	0	2.9	3.1	6	76.2	0.1	20.9
12:09	31.5	11.3	0	2.3	2.2	4	90.2	0.3	20.9
12:10	13.1	11.4	0	2.1	2.6	2	74.9	0.07	20.9
12:11	33.6	12.3	0	0.7	0.9	1	66.2	0.07	20.9
12:12	51.7	13.6	0	0.5	0.7	1	72.5	0.07	20.9
12:13	36.3	11.5	0	0.3	0.8	2	66.5	0.07	20.9
12:14	59.1	13.4	0	0.1	0.6	3	77.6	0.07	20.9
12:15	32.1	12.1	0	0.5	0.3	2	55.3	0.07	20.9

Table 6-7: Average Midday period for 1[st] day.

Time Range	Average								
	CO (ppm)	VOC (ppm)	H2S (ppm)	NO2 (ppm)	HCN (ppm)	NH3 (ppm)	Noise dBA	Ozone (%)	O2 (%)
12:00 – 12:15	28.71	9.55	0.00	0.71	1.15	2.38	73.19	0.09	20.90

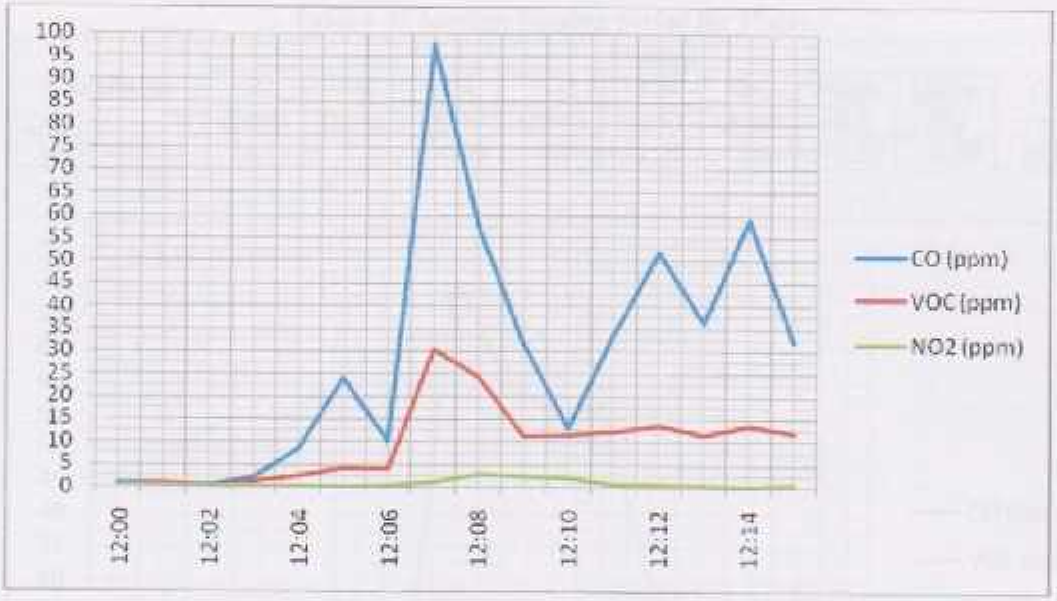

Figure 6.6: Midday period for 1st day.

- Evening Period:

At this period the reading for CO are frequently between 1 at the sides for the street and maximum at the center 75.98 ppm as in table (6-8) and also the other gases as seen in figure (6.7) , and the average reading can illustrate in table(6-9).

Table 6-8: Evening period for 1st day.

Time	CO (ppm)	VOC (ppm)	H2S (ppm)	NO2 (ppm)	HCN (ppm)	NH3 (ppm)	Noise dBA	Ozone (%)	O2 (%)
16:01	0.0	0.0	0	0.0	0.5	3	65.7	0.07	20.9
16:02	1.1	0	0	0.1	0.6	2	75.6	0.07	20.9
16:03	1.6	1.1	0	0.3	0.7	3	70.2	0.07	20.9
16:04	3.2	2.7	0	0.2	0.4	2	80.9	0.07	20.9
16:05	5.2	3.8	0	0.1	0.6	1	71.5	0.09	20.9
16:06	6.6	6.9	0	0.3	0.6	6	75.6	0.07	20.8
16:07	15	8.6	0	0.3	0.6	2	73.6	0.1	20.8
16:08	75.98	6.1	0	1.5	3.9	7	78.5	0.1	20.7
16:09	60.1	25.4	0	3.2	4.1	6	79.5	0.1	20.3
16:10	55.14	11.6	0	2.4	2.4	4	92.4	0.3	20.9
16:11	56.3	8.1	0	2.1	2.6	2	73.4	0.06	20.9
16:12	30.2	8.0	0	0.9	2.1	2	66.2	0.07	20.9
16:13	20.4	9.3	0	0.8	1.9	2.1	68.2	0.07	20.9
16:14	10.6	9.3	0	0.6	1.7	2	85.4	0.06	20.9
16:15	30.1	15.3	0	0.6	0.7	1	81.6	0.07	20.9

Table 6-9: Average Evening period for 1st day.

Time Range	Average								
	CO (ppm)	VOC (ppm)	H2S (ppm)	NO2 (ppm)	HCN (ppm)	NH3 (ppm)	Noise dBA	Ozone (%)	O2 (%)
16:01 - 16:15	24.77	7.75	0.00	0.89	1.56	3.01	75.89	0.09	20.83

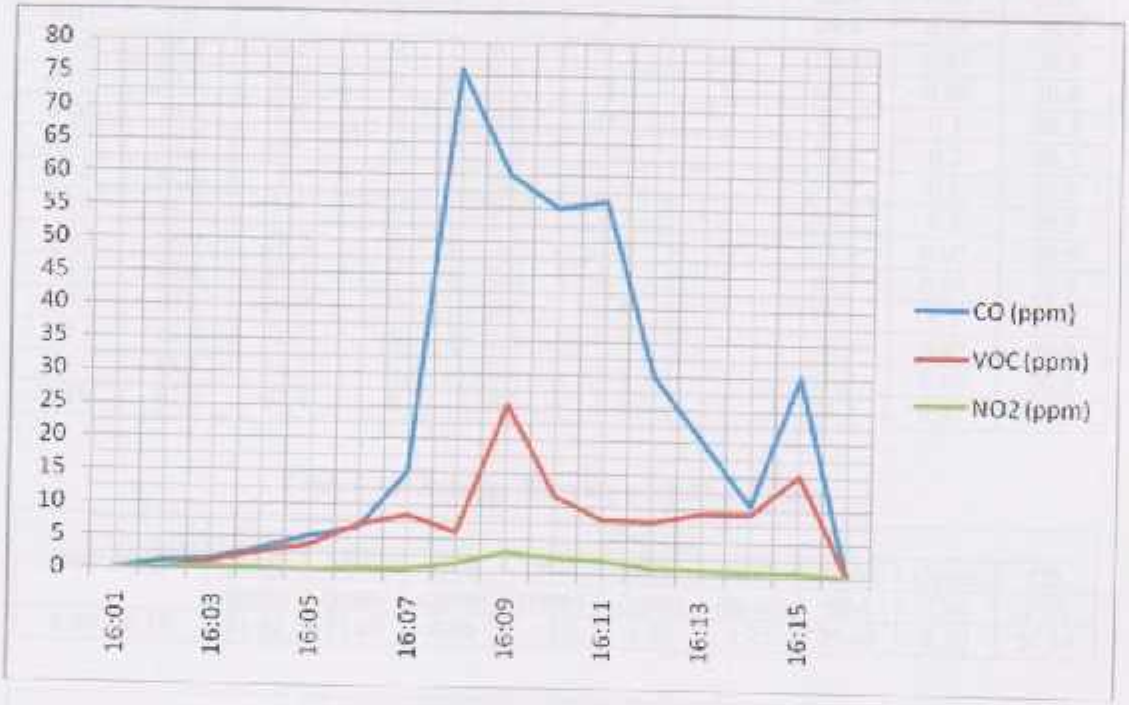

Figure 6.7: Evening period for 1st day.

6.4.2 The second day (without wind movement)

This is the second day that the trip is starting and there are not part winds movements, the day can divided into these periodic times:

- Morning period.

At this period the reading for CO are frequently between 1 at the sides for the street and maximum at the center 77.5 ppm as in table (6-10) and also the other gases as seen in figure (6-8) , and the average reading can illustrate in table (6-11).

Table 6-10: Morning period for 2nd day.

Time	CO (ppm)	VOC (ppm)	H2S (ppm)	NO2 (ppm)	HCN (ppm)	NH3 (ppm)	Noise dBA	Ozone (%)	O2 (%)
8:00	1	0	0	0.0	0.4	1	98.3	0.07	20.9
8:01	3.9	3.3	0	0.1	0.5	3	88.5	0.09	20.9
8:02	7.8	2.2	0	0.4	0.6	2	69.4	0.07	20.9
8:03	9.6	1.3	0	0.2	0.5	1	84.4	0.08	20.9
8:04	14.5	6.5	0	0.3	0.3	4	79.6	0.07	20.8
8:05	23.6	4.4	0	0.3	0.4	6	69.9	0.07	20.8
8:06	20.4	8.5	0	0.6	0.8	3	71.9	0.1	20.7
8:07	77.5	24	0	4.3	4.1	7	70.3	0.2	20.3
8:08	42.4	12	0	4.5	4.4	7	76.9	0.1	20.9
8:09	54.3	8.6	0	2.4	2.3	4	99.2	0.3	20.9
8:10	18.9	28.2	0	2.3	2.1	2	74.8	0.07	20.9
8:11	17.4	45.1	0	0.8	2.6	2	96.2	0.07	20.9
8:12	10.2	20.9	0	0.6	1.9	3	72.5	0.1	20.9
8:13	18.9	18.7	0	0.9	0.7	2	68.5	0.07	20.9
8:14	13.5	16.5	0	0.8	0.8	2	79.2	0.07	20.9
8:15	10.2	17.4	0	0.9	0.8	3	75.3	0.07	20.9

Table 6-11: Average Morning period for 2nd day.

Time Range	Average								
	CO (ppm)	VOC (ppm)	H2S (ppm)	NO2 (ppm)	HCN (ppm)	NH3 (ppm)	Noise dBA	Ozone (%)	O2 (%)
8:00 – 8:15	21.51	13.60	0.00	1.16	1.45	3.25	79.68	0.10	20.84

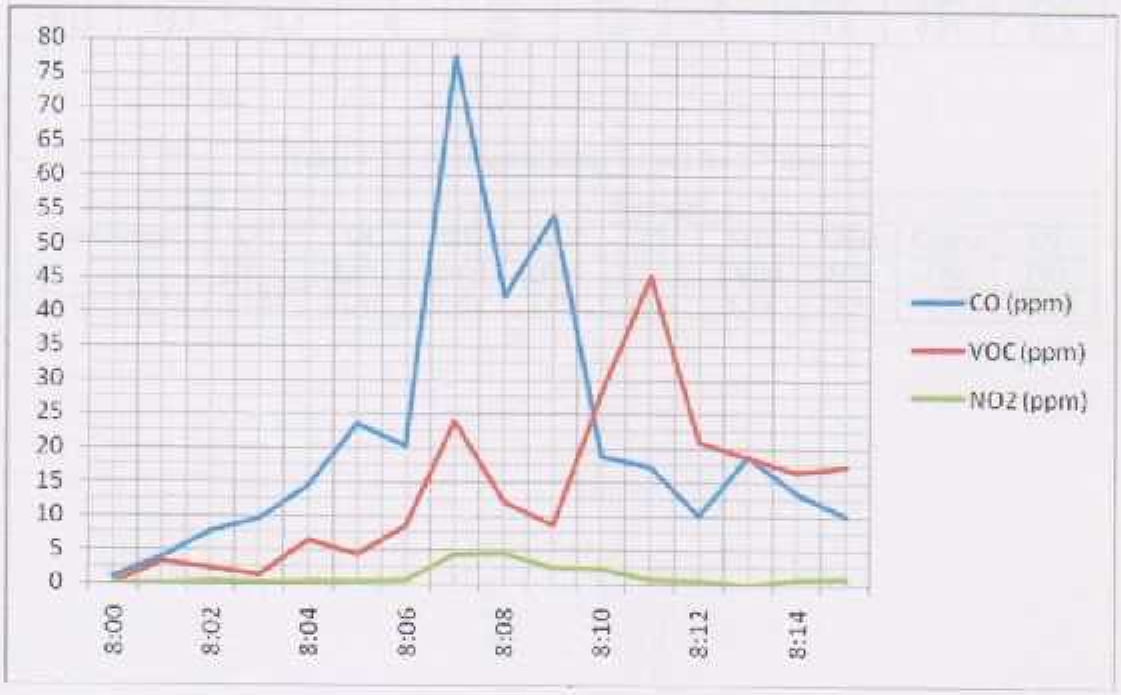

Figure 6.8: Morning period for 2nd day.

- Midday period.

At this period the reading for CO are frequently between 5.6 at the sides for the street and maximum at the center 110.6 ppm as in table (6-12) and also the other gases as seen in figure (6.9) , and the average reading can illustrate in table (6-13)

Table 6-12: Midday period for 2nd day.

Time	CO (ppm)	VOC (ppm)	H2S (ppm)	NO2 (ppm)	HCN (ppm)	NH3 (ppm)	Noise dBA	Ozone (%)	O2 (%)
12:00	5.6	1.3	0	0.1	0.4	1	70	0.07	20.9
12:01	7.6	2.1	0	0.1	0.5	3	75.5	0.07	20.9
12:02	10.2	4.3	0	0.6	0.6	2	69.7	0.07	20.9
12:03	15.47	5.9	0	0.8	0.9	1	86.5	0.08	20.9
12:04	10.69	9.4	0	0.7	0.9	6	78.6	0.1	20.9
12:05	45.2	19.4	0	0.6	0.8	6	72.6	0.07	20.9
12:06	45.3	21.3	0	1.0	0.8	3	88.5	0.09	20.9
12:07	110.6	49.4	0	5.3	5.1	8	75.3	0.13	20.9
12:08	87.9	46.7	0	6.9	5.4	8	79.2	0.24	20.9
12:09	44.8	38.6	0	3.2	5.3	6	99.8	0.3	20.9
12:10	37.6	31.5	0	2.6	4.1	4	44.8	0.2	20.9
12:11	79.1	31.7	0	2.4	4.6	4	69.9	0.08	20.9
12:12	62.7	27.8	0	3.6	3.9	3	79.5	0.07	20.9
12:13	40.2	28.1	0	2.1	2.7	3	69.5	0.07	20.9
12:14	56.3	24.5	0	2.5	2.8	2	79.8	0.09	20.9
12:15	35.2	24.3	0	2.2	1.8	3	79.8	0.07	20.9

Table 6-13: Average Midday period for 2nd day.

Time Range	Average								
	CO (ppm)	VOC (ppm)	H2S (ppm)	NO2 (ppm)	HCN (ppm)	NH3 (ppm)	Noise dBA	Ozone (%)	O2 (%)
12:00 – 12:15	41.84	22.46	0.00	2.09	2.48	3.94	75.91	0.11	20.90

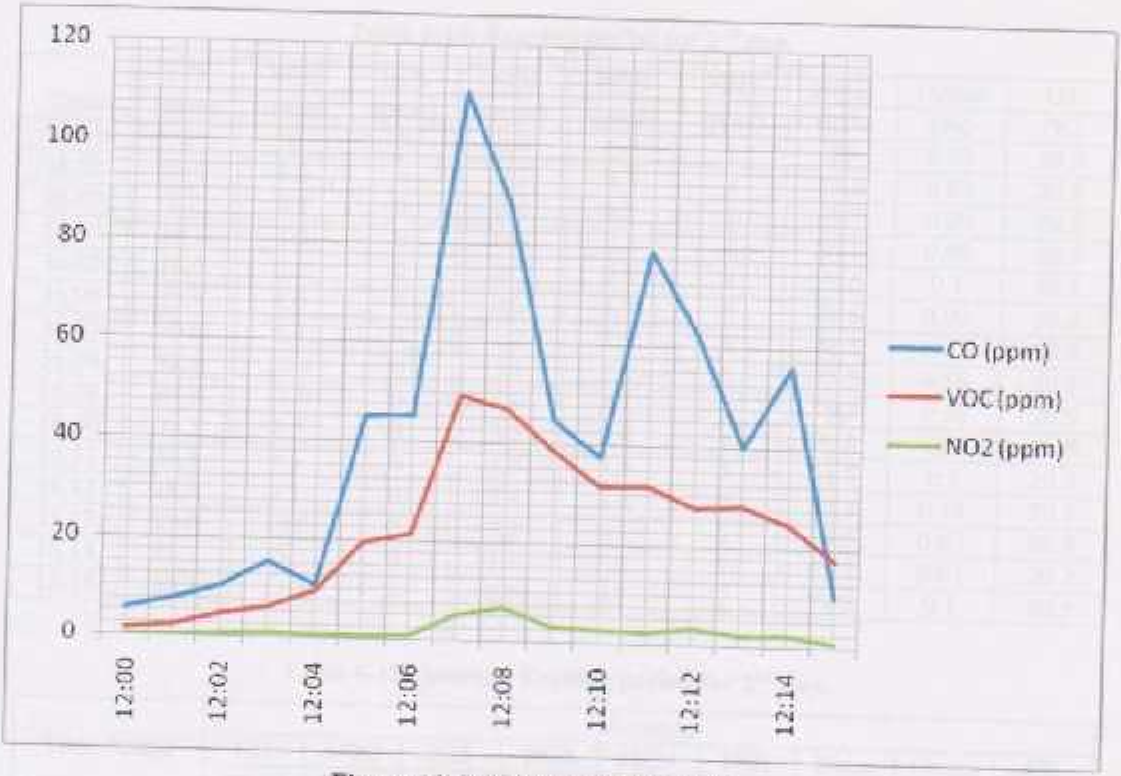

Figure 6.9: Midday period for 2nd day.

- Evening period

At this period the reading for CO_2 are frequently between 1 at the sides for the street and maximum at the center 88.6 ppm as in table (6-14) and also the other gases as seen in figure (6.10) , and the average reading can illustrate in table (6-15)

Table 6-14: Evening period for 2nd day.

Time	CO (ppm)	VOC (ppm)	H2S (ppm)	NO2 (ppm)	HCN (ppm)	NH3 (ppm)	Noise dBA	Ozone (%)	O2 (%)
16.01	1	0	0	0.0	0.2	2	70	0.07	20.9
16.02	16.6	1.6	0	0.1	0.5	2	75.5	0.07	20.9
16.03	7.2	2.4	0	0.4	0.4	1	69.7	0.09	20.9
16.04	10.2	3.0	0	0.6	0.8	2	86.5	0.08	20.9
16.05	18.6	6.6	0	0.7	0.9	4	78.6	0.1	20.8
16.06	29.3	8.6	0	0.6	1.2	4	72.6	0.09	20.8
16.07	30.6	6.7	0	1.2	1.8	3	88.5	0.09	20.7
16.08	88.6	25.4	0	5.1	3.2	6	75.3	0.16	20.3
16.09	65.8	11.9	0	4.9	4.1	6	79.2	0.24	20.9
16.10	56.3	8.5	0	3.2	3.8	4	99.8	0.3	20.9
16.11	24.4	9.3	0	2.6	3.8	3	44.8	0.2	20.9
16.12	18.6	9.3	0	2.4	4.6	3	69.9	0.12	20.9
16.13	22.6	10.5	0	3.2	4.1	2	79.5	0.07	20.9
16.14	23.1	15.3	0	3.1	2.2	3	69.5	0.07	20.9
16.15	20.4	12.4	0	0.0	0.2	2	79.8	0.1	20.9

Table 6-15: Average Evening period for 2nd day.

Time Range	Average								
	CO (ppm)	VOC (ppm)	H2S (ppm)	NO2 (ppm)	HCN (ppm)	NH3 (ppm)	Noise dBA	Ozone (%)	O2 (%)
12:00 – 12:15	28.89	8.22	0.00	1.76	1.99	2.94	71.20	0.12	19.53

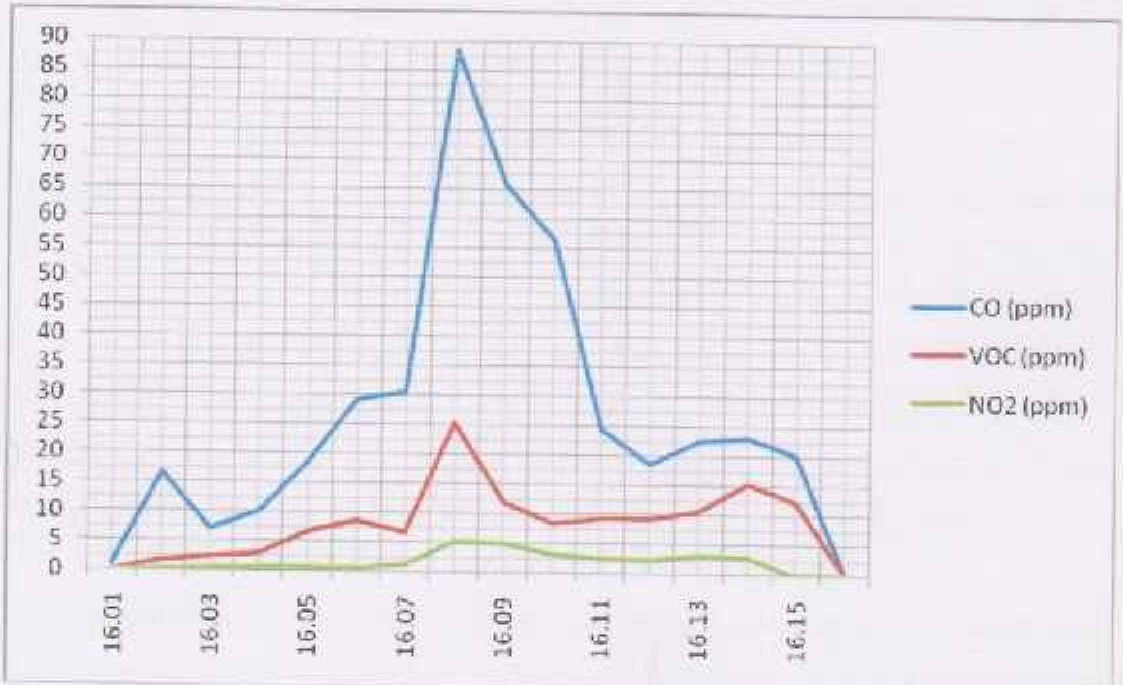

Figure 6.10: Evening period for 2nd day.

Chapter Seven

Conclusion and Recommendations

7.1 Introduction.

Emission is an important source that can hurt the human and it can be essential influence for him , there are comparing between it is for actual and theoretical to know its reliability and influence to decide how dealing with emissions and see how these pollutant can disperse into in grid of the street into dispersion model, for these concepts there is a plan if there is so much emissions to reduce them by suggested way for reducing emissions pollutant.

7.2 Gases concentration for dispersion model.

The models taken for three emissions that :

- CO model:

As shown in figure (7.1) the concentration of the gas emission is concentrated at the centre point (85-100ppm), where all vehicles meted as it interred or out from the city.

The gas concentration is largest from the north side (70-85ppm) where the vehicles are coming from north city (Bethlehem...) to the south direction, then its gradually for the west and east direction with less magnitude concentration (20-65ppm) which means the interred vehicles from north is largest source of CO emission.

The CO gas emission is the largest emission than other gases as it is received to 100ppm as the number of vehicles is increases, there for the effect gas is started from

(3-10ppm) with clear effect on the person behaviour to be more than 60ppm with hard effect causes died.

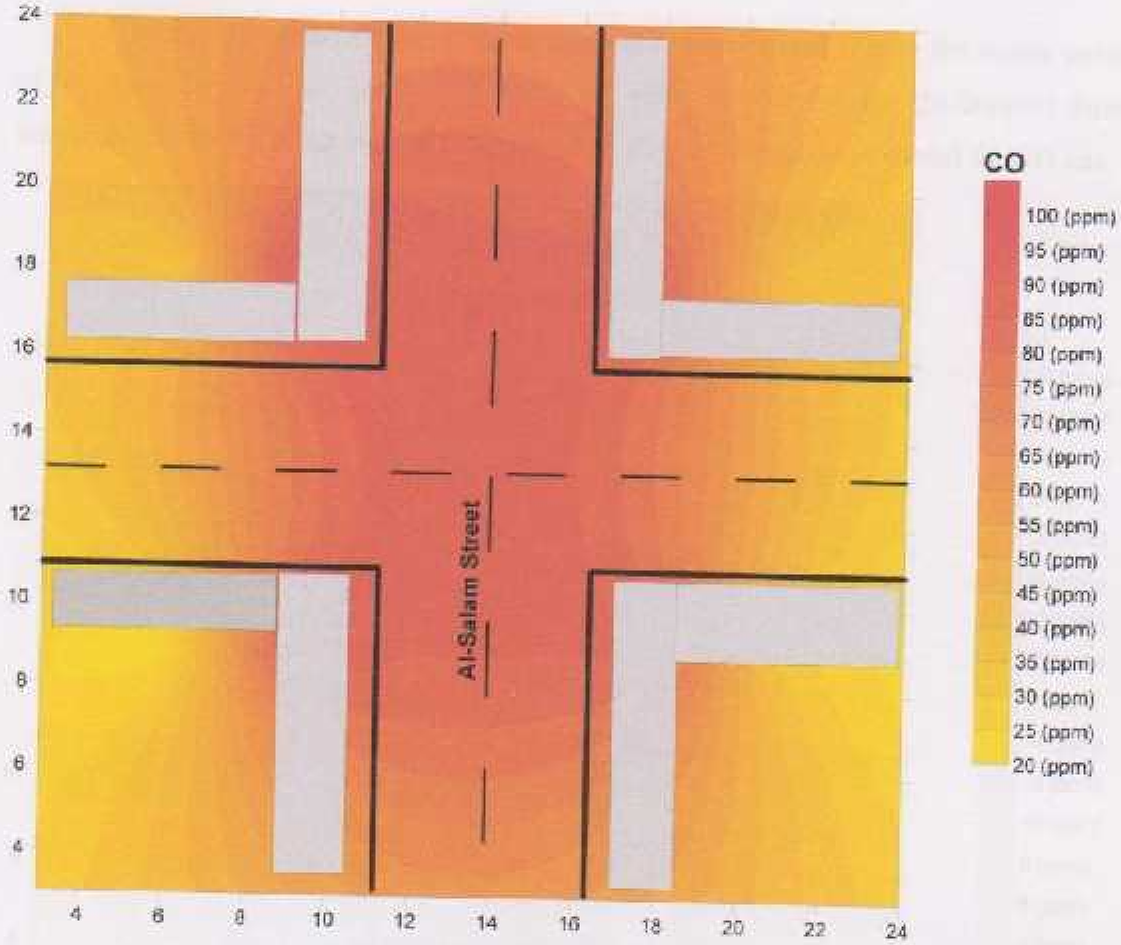

Figure 7.1: CO dispersion model.

The values taken at rated distance from the street about 1.5 meter, so the read will be larger for nearest distance where the exhaust gas concentration is larger with highest temperature, then it is dispersing in the air as it is temperature decrease.

- VOC:

The station where the gas concentration are concentrated is near the center point of the street for the VOC gas as in the CO gas with (28-32ppm) and (20-26ppm) from the north side to the south side, the Figure (7.2) show the dispersion model for CO gas.

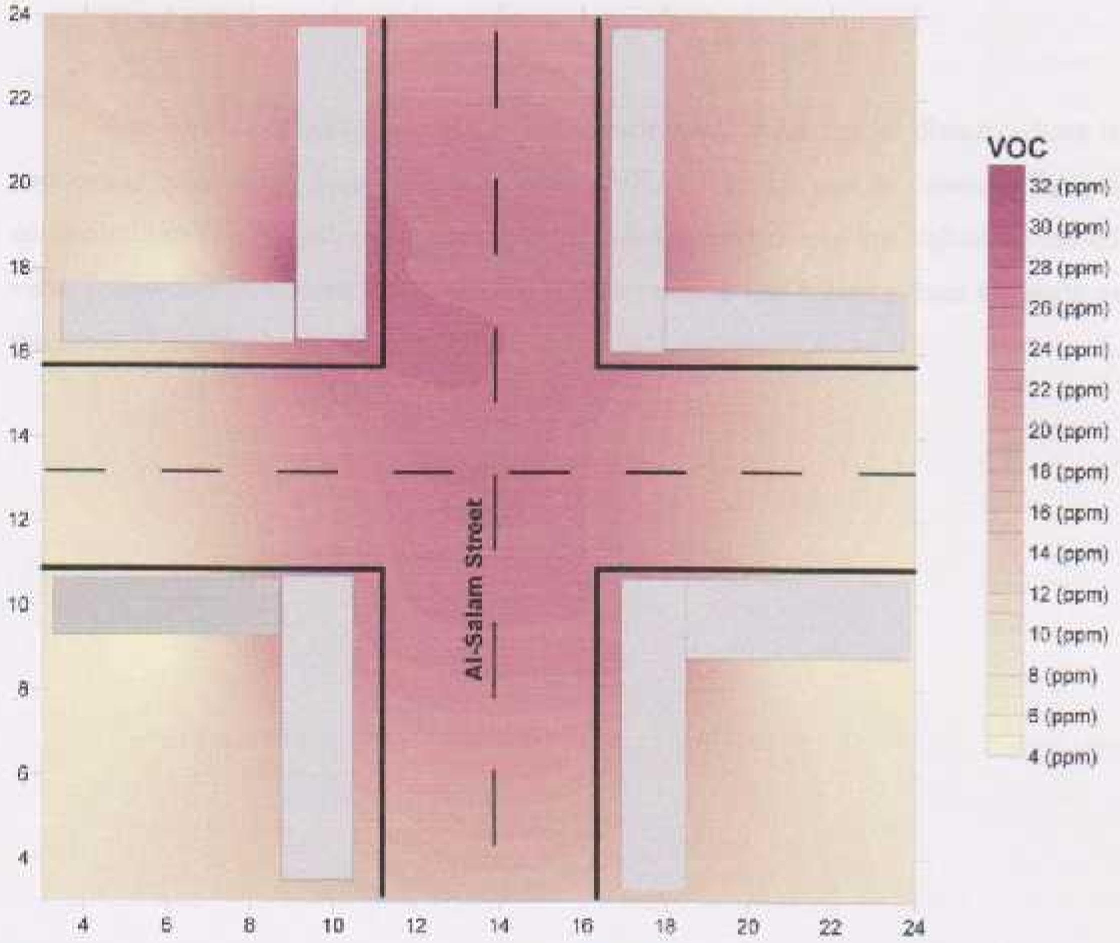

Figure 7.2: VOC dispersion model.

VOC gas emission is second pollutant after the CO as seen in the measured value, and it has the same station concentration and dispersion direction which depend directly on the wind movement and it forced, if there is high winds the value will be less than if it is low. The same way for taken measurement of CO is taken for the VOC.

The VOC is the most pollutant gas and effect on the environment and human healthy. as it is effect started from (1-3ppm) to be arrived to died level at (10ppm).

The result is value.

- NO_2:

The concentration of the NO_2 is not concentrated at the center directly, there is percentage error done when use the device (VRAE) which use to measure the gas concentration. The $NO_2$where its concentrated is being have one of the highest measured value concentration as seen in figure (7.3) for the vehicles that entering from the north to the south (5.6-6ppm) as in CO and VOC$_s$.

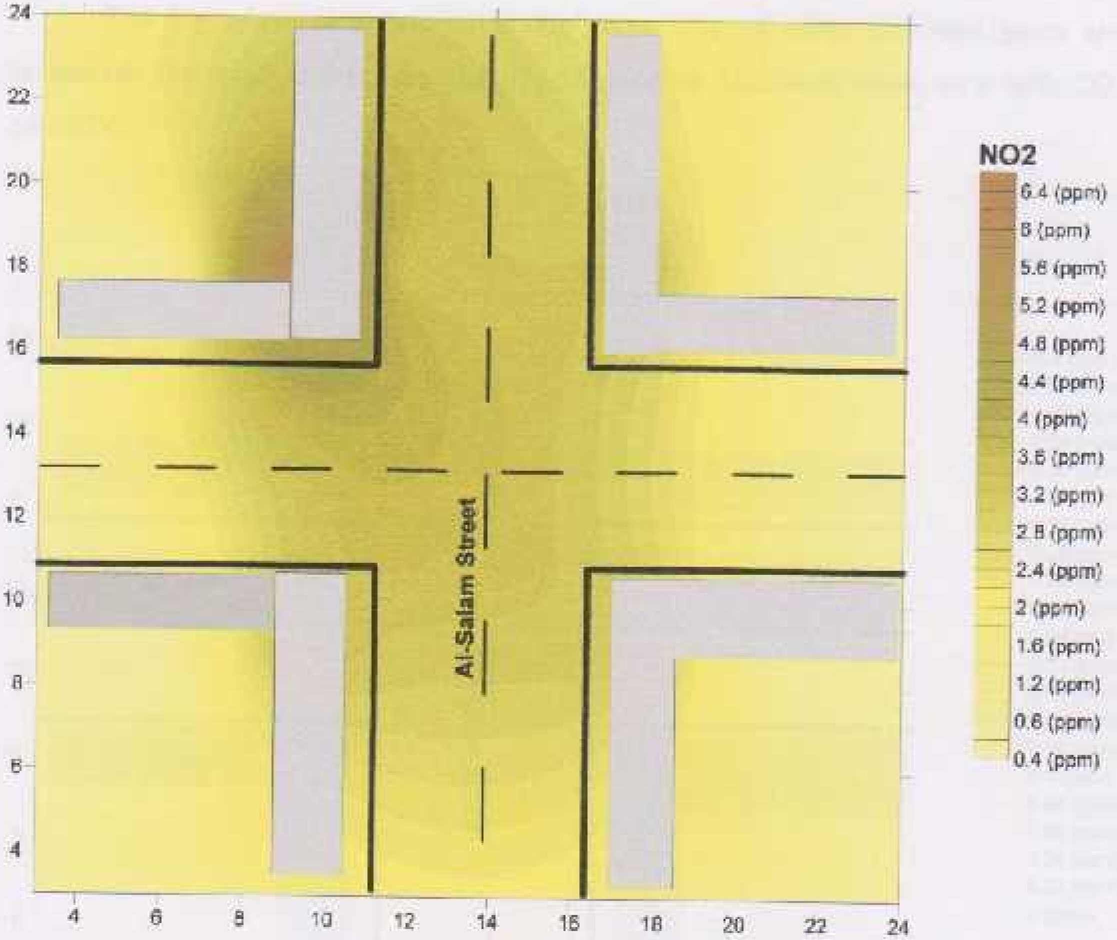

Figure 7.3: NO_2 dispersion model.

The emission from the NO is not very high as in the CO emission, but has the effect which is suitable for it.

- O3

O_3 is an secondary pollutant, but it is range is so much than the rated value detected by the EPA (0.061ppm), the concentration at the origin for the street (0.3-0.32ppm), and its maximum disturbance at the south and east with (0.34-0.4ppm) as seen in figure(7.4).

The O_3 emission measured as the same way of other pollutant gases are measured. The result is there are high O_3 emission in AL Salam street, as it with CO, and VOC.

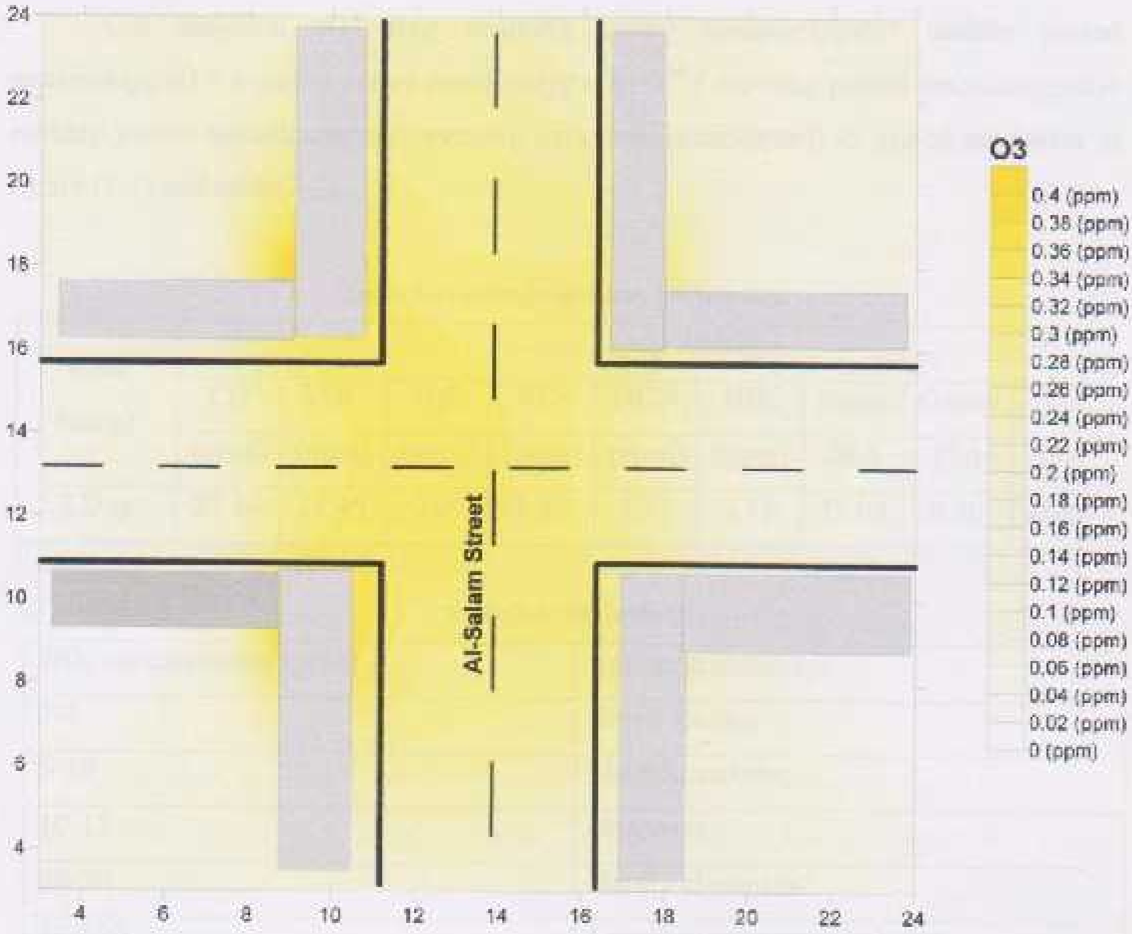

Figure 7.4: O_3 dispersion model.

7.3 Result Gases conclusion for human.

The data that reported can express how these emissions can effect on human depending on its concentrations for emission pollutant for CO, NO_2 and H_2S. The tables (7-1) and (7-2) can show how the average data influence the human health.

The table (7-1)can show the average reading for each emissions in the day by the rule of :

Gas emission =(1[st] day(morning period emission(ppm)+ midday period emission(ppm) + evening period emission(ppm))+ 2[nd] (morning period emission(ppm)+ midday period emission(ppm)+ evening period emission(ppm)) /6 period as shown in figure (7-1) and table(7-2).

Table 7-1: average emission for two day.

Time Range	Total Average								
	CO	VOC	H_2S	NO_2	HCN	NH_3	Noise	Ozone	O_2
	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	dBA	(%)	(%)
2 Day	27.54	11.49	0.00	1.22	1.57	3.18	75.02	0.10	20.64

Table 7-2: NO_2 effect.

NO_2 concentration (ppm)	Emission influence
1-3	Smell feeling
5-10	Nose scratching
10-15	closeness
20-30	Hardly closeness
30-100	Liquid maintenance in lungs
More than 100	death

Table 7-3: CO effect.

CO concentration (ppm)	Emission influence
Less than 3	No effect
3-10	Unbalance losses and behavior effect
10-30	effect on nervous system
30-60	Hardly closeness involuntary movement and causing heart disease
60-500	Tiered , faint, causing death

The average reading for CO (morning+ midday +evening)/3 equal 24.33, for the 1st day and the average for two days as table is 27.54 can effect on nervous system and involuntary movement, for NO_2 average reading (1.22 pm) can effect on respiratory and especially for closeness ,and as we see the data from chapter six the midday period can be the most emission production ,since there is an increasing for the vehicles numbers and there a small movement for wind, by see air dispersion model can see the concentration for emissions to be maximum in the center of the street.

The other gases as H_2S must give zero reading since if it give reading can cause human death. There are not losses for O_2 concentration or there are negligible (small change) from its concentration, the concentration for O_2 must be 20.9 and resulted with average with 20.64%.

The noise with the range 75.02 in acceptable range , but there are dangerous for frequented noise between any reading since its frequency frequented and can hurt the ear. The all rest emissions gasses can be on the suitable range and can effect on a small range for human health.

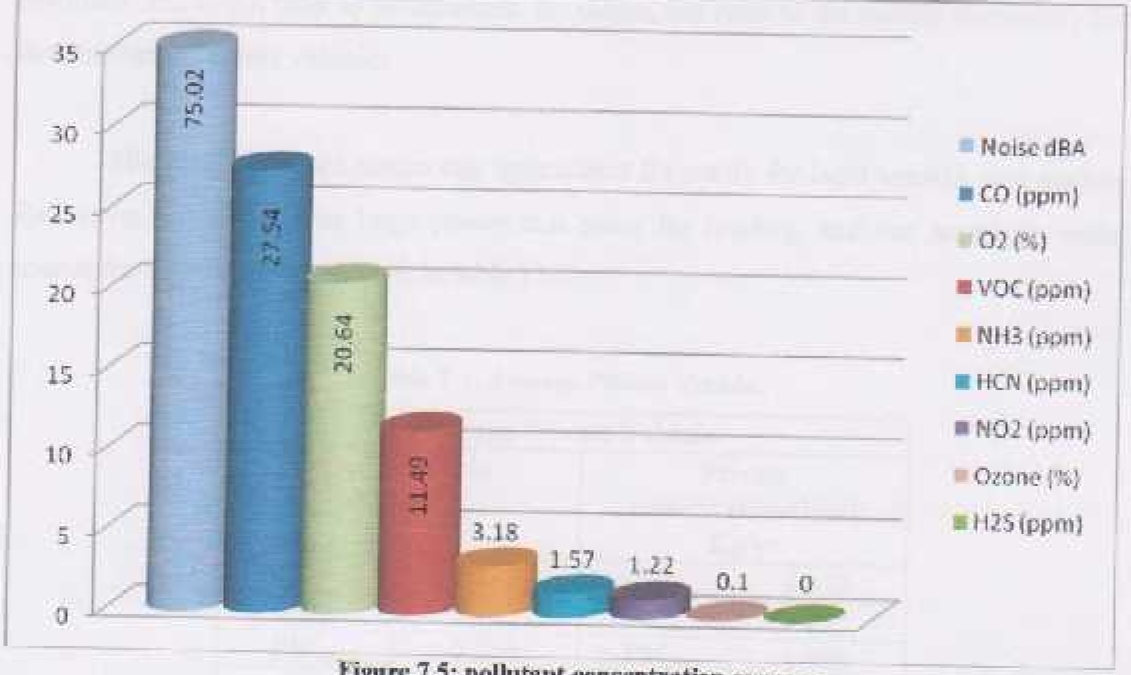

Figure 7.5: pollutant concentration average

7.4 Levels vehicle Gas emission.

The motor vehicles (Public, privet, light, and heavy)are major source of air pollution in Hebron city with largest percentage for CO and VOC and NO_x gas. The studying for vehicles quality have an effect for the amount of emissions, the studying vehicles level ,the study are combining all levels for both sides for small vehicles gasoline and diesel and on other side diesel can combined for light vehicle and heavy .

The result for emission in the street taking average reading can shown in table (7-4) these can appear especially in private gasoline and as it noticed the gasoline can be more pollutant than diesel for its molecular construction.

On contrary the public vehicles as table (7-5) there are an increasing for diesel pollutant ,this is not refer to construction for diesel, but refer to the rapidly increasing for the number for diesel vehicles.

The main pollutant notice can appearance for partly for light vehicle, and mainly for heavy, this refer to its large power that using for loading, and can appear as main source for vehicles level as seen in table (7.6).

Table 7-4: Average Private Vehicle.

Average Private Vehicle			
Private vehicle (Diesel) Kg/yr		Private vehicle (Gasoline) Kg/yr	
CO	1.167	CO	8.472
NO_X	1.137	NO_X	8.255
PM_{10}	0.205	PM_{10}	1.490
SO_2	0.120	SO_2	0.873
VOC	0.193	VOC	1.365

Table 7-5: Average public vehicle.

Average public vehicle			
public vehicle (Diesel) Kg/yr		public vehicle (Gasoline) Kg/yr	
CO	15.516	CO	0.508
NO_X	15.119	NO_X	0.495
PM_{10}	2.729	PM_{10}	0.089
SO_2	1.600	SO_2	0.052
VOC	2.587	VOC	0.844

Table 7-6: Average Light & Heavy Vehicle.

Average Light & Heavy Vehicle			
Light vehicle (Diesel) Kg/yr		Heavy vehicle (diesel) Kg/yr	
CO	19.641	CO	1347.95
NO_X	16.056	NO_X	34.262
PM_{10}	4.872	PM_{10}	265.293
SO_2	1.692	SO_2	92.369
VOC	5.25	VOC	119.810

7.5 Network problems.

The studying emissions in the Al-Salam street junction, the search team having an problem for measuring data:

- The crowded vehicle since this street is the main path for Hebron .
- There is not quick response for devices to measure data (emissions) that force the team to take result near cars .
- The changing in climate condition per day and make influence for device response.
- Hard for distribute the questionnaire because there a traffic light and there is not time to complete the questionnaire .

7.6 Recommendations.

Hebron lies among mountains in the heart of southern Palestine 35Km south of Jerusalem. According to the population of Hebron city is about 300000 in 2006 census, thus if include the surrounding towns and villages the population of the district becomes 400,000 citizen.

There are many different pollutants and each one has different environmental effects. The mass of emissions of two different pollutants should not be compared directly because their effects on health and the environment may be very different.

How To Reduce Emissions From Your Car:

- ***Limit driving:*** *Ride a bike or walk instead of driving your car. When you don't drive your car it produces zero ozone.*
- ***Ride the bus Don't let engines idle:*** *Idling engines put more ozone in the air without getting anywhere. Avoid drive-through to reduce ozone emissions.*
- ***Combine car trips:*** *When you must drive, combine several trips into one to minimize cold starts and reduce ozone emissions from your car. Emission levels are highest when a vehicle is first started. Refuel after 5 pm.*
- ***Pumping gas in the evenings reduces the time that fumes "cook"*** *during the heat of the day, forming more gases.*
- ***Avoid overfilling the gas tank:*** *Overfills and spills add more ozone-producing fumes.*
- ***Cap your gas:*** *Make sure your gas cap fits snugly to escaping fumes that produce more emission gases.*
- ***Keep your engine tuned:*** *Properly maintained vehicles reduce conditions that contribute to more emission gases in the air.*
- ***Avoid traffic congestion****: Listen to daily traffic reports to avoid areas that are backed up, at a standstill. Drive during off-peak hours if possible to reduce unsafe ozone emissions from stop-and-go traffic.*

- ***Minimize your risk:*** *You can help to minimize risks for all peoples by taking steps to reduce Traffic related air pollution Whenever possible, use public transit, bicycle or walk instead of using your vehicle.*
- ***Take fuel efficiency into account when you buy a vehicle.*** *Natural Resources produces a Fuel Consumption Guide.*
- ***Turn off the engine of your car when you stop for more than 10 seconds, unless you are in traffic or at an intersection.***
- ***Keep your vehicles well maintained. In addition, you can take steps to help minimize your risk of health effects from traffic-related air pollution.***
- ***Pay attention to air quality forecasts in your community, and tailor your activities accordingly.***
- ***Avoid or reduce strenuous outdoor activities when air pollution levels are high, especially in the afternoon during summer months when ground-level emission gases reaches its peak. Choose indoor activities instead.***
- ***Avoid or reduce exercising near areas where traffic is heavy, especially during rush hour.***
- ***If you have a heart or lung condition, talk to your health care professional about additional ways to protect your health when air pollution levels are high. The application of alternative (gaseous) fuels can significantly help to reduce pollution from road vehicles.***
- ***According increasing emissions and numbers of automobile it can be change the track direction (for example choice another branch street).***

List of Figure

Abbreviations

IMAP: intake manifold absolute pressure

VOCs: volatile organic compounds

PM: Particulate matter

EGR: exhaust gas residual.

PCV: Positive Crankcase Valve

EET: Emission Estimation Techniques.

OPHrs: operating hours

EPA: environmental protection agency

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