Palestine Polytechnic University

College of Engineering & Technology

Mechanical Engineering Department

Automotive engineering

Graduation Project

Assessment of Traffic Induced Pollution and Dispersion in Al-Salam Main Road

Project Team

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According to the orientations of the supervisor on the project and the examined committee is by the agreement of a staffers all, sending in this project to the mechanical engineering department are in the college of the engineering and the technology by the requirements of the department for the step of the bachelor’s degree.

Project supervisor signature

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Committee signature

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Department head signature

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Dedication

To our parents who

Spent nights and days doing their best

To give us the best....

To all students and who

Wish to look for

The future...

To who love the knowledge and

Looking for the new

In this world...

to all of our friends…

Acknowledgement

To begin with our prophet saying that" who" ever does not thank people, he or she would not thank God. So we would like to extend our gratitude to the administration of Palestine Polytechnic University in general, and the administration of the Mechanical Engineering Department in particular. At the same time express our special thanks to the Teachers of the university.

Last but not least, special acknowledgment and appreciation and respect would be rendered to our project supervisor Dr. Imad Al-Khatib .

It's our pleasure to thank whoever participated in backing up this project to be a real and successful one.

Mohammed Al Qadi **Zeyad Al Atawneh**

Sufian Al Natsheh

Abstract:

The proposed graduation project addresses a major air pollution problem in Hebron city and mainly in a highly traffic dense road which is Al-Salam Road. The road connects the northern part of Hebron city with it southern part where major industrial sector is located, passing through the heart of the city where commercial buildings are located. The road capacity and the types of vehicles crossing round the clock in addition to the dominant atmospheric conditions are instrumental in assessing the pollution and how pollutants are dispersed and possibly deposited. In the proposed work, a survey campaign will be implemented by which the status of round the clock traffic will be determined in term of the density, types, average speed, waiting time at traffic lights, and traffic categories. Based on the data collected a mathematic model will be used to estimate the total average emission. In addition an experimental work is going to be set and implemented by which emission measurement campaign will in different location within the road will be carried out very close to "emission sources." Emission measurement will include ten major gases and the noise emission. In order to assess the dispersion based on the dominant wind pattern, the wind speed and direction and the air temperature will be measured during the campaign. The data collected will be used in a specialized and verified mathematical model to assess the pollution pattern. It is intended after the analyses of the data and the interpretation of the results to come out with several recommendations that form a mitigation plan for any adverse traffic pollution in the main Al Salam road .

Table of Contents:

List of Table

List of Figure

List of Abbreviations

Abbreviations	Meaning	Page Number
CO_2	Carbon Dioxide.	2
NO_2	Nitrogen Dioxide.	2
NO_X	Nitrogen Oxides.	2
SO_2	Sulfured Dioxide.	2
CO	Carbon Monoxide.	3
HC	Hydro Carbon.	3
VOC	Volatile Organic Compounds.	4
O_3	Ozone.	5
N_2	Nitrogen .	5
US	United state.	5
LDVs	Light-Duty Vehicles.	12
HDVs	Heavy-Duty Vehicles.	12
EPA	Environmental Protection Agency.	12
HAPs	Hazardous Air Pollutions.	14
ETS	Environmental Tobacco Smoke.	17
SI	spark ignition engine.	17
CI	Compression Ignition Engine.	17
UHC	Unburned Hydrocarbons.	18
FA	Fuel Air Ratio.	18
EGR	Exhaust Gas Recirculation.	19
PM	Particulate Matter.	20
CARB	California Air Resource Board.	21
PM_{10}	Particulate matter 10 Microns dia.	22
$PM_{2.5}$	Particulate matter2.5 Microns dia.	22
SCR	Select Catalytic Reduction.	23
SO_x	Sulfur Oxides.	24
O_3	Ozone.	29
Pb	Lead.	29
PH	measure of the acidity.	30
PCBs	Central bureau Palestinian statistic.	34
LEL	Lower Explosive Limit.	41
RAE	Research Assessment Exercise.	41
H_2S	Hydrogen Sulfide.	41
VRAE	Hand-held one-to-five gas monitor.	43
TCD	Thermal Conductivity Detector.	43
PC	Personal Computer.	43
dB	Decibel.	44
COMEAP	Committee on Medical Effects of Air Pollution Episodes.	47
H_2SO_4	Sulfuric Acid.	50
MTBE	Methyl Tert-Butyl Ether.	50
$E_{KPY,i}$	Emission of pollutant I for specific	51

	type of engine.	
L_Y	Distance travelled in reporting year.	51

Abbreviations	Meaning	Page Number
E_{Fi}	Emission factor for pollutant.	51
HGV	Heavy Goods Vehicle	52
REERU	Renewable Energy and environment research unit	61
PPM	Part Per Million	66
i	Pollutant Type.	51

Chapter One

Introduction

1.1. Overview.

1.2. General Idea about Project and Its Importance.

1.3. Project Scope.

1.4. Literature Review.

1.5. Estimated Cost.

1.6. Time Planning.

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 people's health and can damage crops, forests and some materials. Find out about emissions in Al Salam street 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 Al-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 20,400$.

1.6. Time Planning.

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

Table 1-1: 1st semester Time plane.

Week / Action	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.

Week / Action	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 and dispersion																
Presentation																

Chapter Two

Emission Sources and Effects of Air Pollution

2.1. Introduction to Air Pollution.

2.1.1. Air Pollutions.

2.1.2. Global Warming**.**

2.2. Sources of Air Pollution.

2.2.1. Mobile Sources.

2.2.2. Stationary Sources.

2.2.3. Indoor air Pollution**.**

2.3. Spark Ignition Engines Emission.

2.4. Compression Ignition Engines Emission.

2.5. Effects of Air Pollutants.

2.5.1. Welfare Effects -Acid Rain.

2.1. Introduction to Air Pollution Problems.

2.1.1. Air Pollutions.

At present, all vehicles rely on the combustion of hydrocarbon fuels to derive the energy necessary for their propulsion .Combustion is a reaction between the fuel and the air that releases heat and combustion products. The heat is converted to mechanical power by an engine and the combustion products are released into the atmosphere .A hydrocarbon is a chemical compound with molecules made up of carbon and hydrogen atoms .Ideally, the combustion of a hydrocarbon yields only carbon dioxide and water, which do not harm the environment .Indeed, green plants "digest" carbon dioxide by photosynthesis .Carbon dioxide is a necessary ingredient in vegetal life .Animals do not suffer from breathing carbon dioxide unless its concentration in air is such that oxygen is almost absent.Actually, the combustion of hydrocarbon fuel in combustion engines is never ideal .Besides carbon dioxide and water, the combustion products contain certain amount of nitrogen oxides (NOx)carbon monoxides (CO) and unburned hydrocarbons (HC), all of which are toxic to human health.

2.1.2. Global Warming.

Global warming is a result of the "greenhouse effect" induced by the presence of carbon dioxide and other gases, such as methane, in the atmosphere.These gases trap the Sun's infrared radiation reflected by the ground, thus retaining the energy in the atmosphere and increasing the temperature .An increased Earth temperature results in major ecological damages to its ecosystems and in many natural disasters that affect human populations .Among the ecological damages induced by global warming, the disappearance of some endangered species is a concern because it destabilizes the natural resources that feed some populations.

Carbon dioxide is the result of the combustion of hydrocarbons and coal.Transportation accounts for a large share 32 %from 1980 to 1999of carbon dioxide emissions .The distribution of carbon dioxide emissions is shown in **Figure 2.1**.

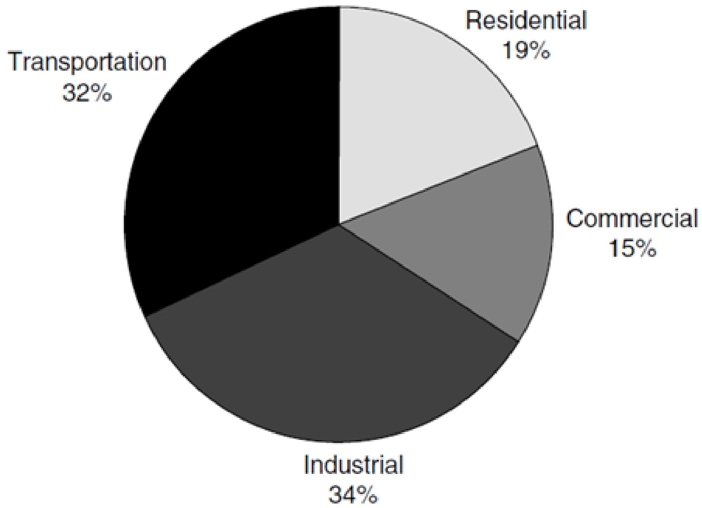


Figure 2.1:Carbon dioxide emission distribution from 1980 to 1999

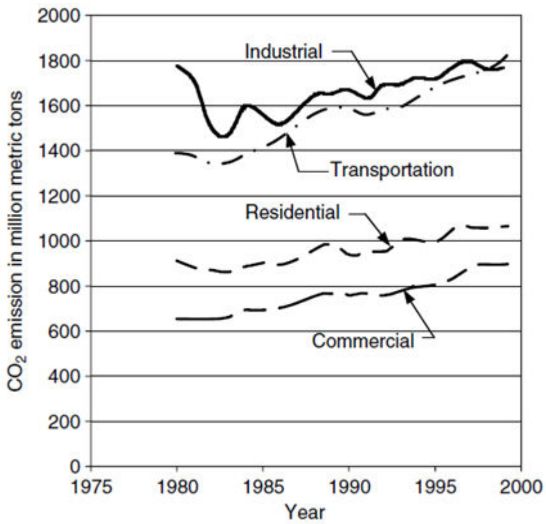


Figure 2.2 :Evolution of carbon dioxide emission

Figure 2.2 ,shows the trend in carbon dioxide emissions .The transportation sector is clearly now the major contributor of carbon dioxide emissions.

It should be noted that developing countries are rapidly increasing their transportation sector, and these countries represent a very large share of the world's population .The large amounts of carbon dioxide released in the atmosphere by human activities are believed to be largely responsible for the increase in global earth temperature observed during recent decades **Figure 2.3**.it is important to note that carbon dioxide is indeed digested by plants and sequestrated by the oceans in the form of carbonates .

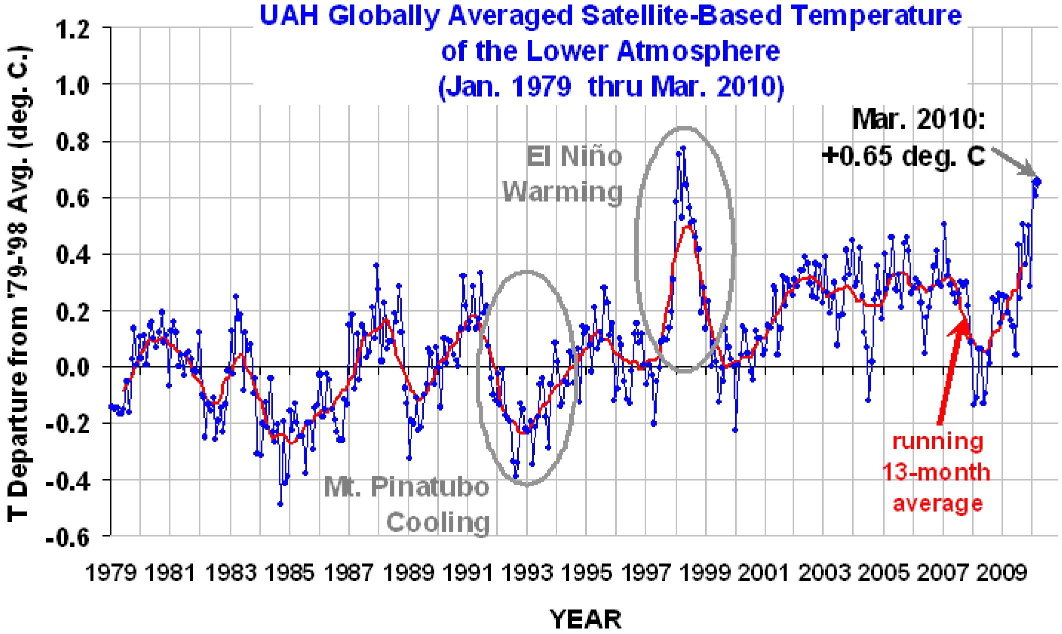


Figure 2.3 :Global earth atmospheric temperature.

However, these natural assimilation processes are limited and cannot assimilate all of the emitted carbon dioxide, resulting in an accumulation of carbon dioxide in the atmosphere.

2.2. Sources of Air Pollution.

A source of air pollution is any activity that causes pollutants to be emitted into the air .There have always been natural sources of air pollution, also known as biogenic sources .For example, volcanoes have spewed particulate matter and gases into our atmosphere for millions of years .Lightning strikes have caused forest fires, with their resulting contribution of gases and particles, for as long as storms and forests have existed .Organic matter in swamps decay and wind storms whip up dust . Trees and other vegetation contribute large amounts of pollen and spores to our atmosphere .These natural pollutants can be problematic at times, but generally are not as much of a problem as are human-generated pollutants or anthropogenic sources

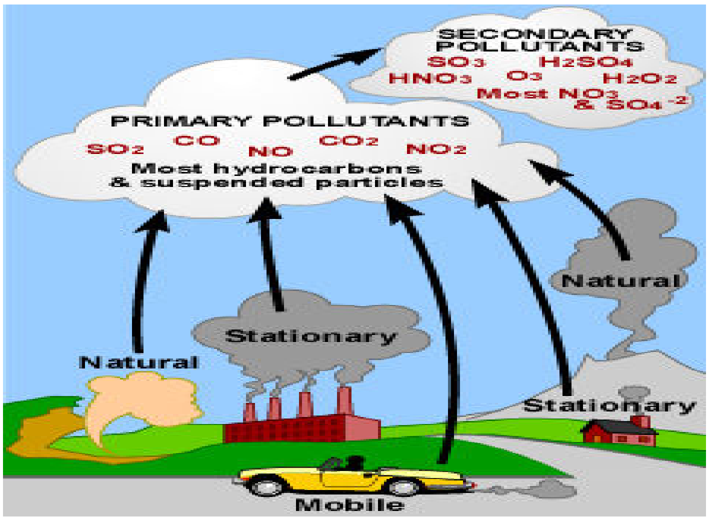


Figure2.4: Types of air pollutions

The quality of daily life depends on many modern conveniences .People enjoy the freedom to drive cars and travel in airplanes for business and pleasure . They expect their homes to have electricity and their water to be heated for bathing and cooking .They use a variety of products such as clothing, pharmaceuticals, and furniture made of synthetic materials .At times, they rely on services that use chemical solvents, such as the local dry cleaner and print shop .Yet the availability of these everyday conveniences comes at a price, because they all contribute to air pollution .Human-generated sources of air pollution or anthropogenic sources are categorized in two ways :mobile and stationary sources .Mobile sources of air pollution include most forms of transportation such as automobiles, trucks, and airplanes .Stationary sources of air pollution consist of non-moving sources such as power plants and industrial facilities .Stationary sources are classified as point source or area source .A point source refers to a source at a fixed point, such as a smokestack or storage tank, that emits air pollutants .An area source refers to a series of small sources that together can affect air quality in a region .For example, a community of homes using woodstoves for heating would be considered as an area source, even though each individual home is contributing small amounts of various pollutants

2.2.1. Mobile Sources.

"Is a term used to describe a wide variety of vehicles, engines, and equipment that generate air pollution and that move, or can be moved, from place to place .Mobile sources are classified as on-road .Traffic and non-road sources" .On-road "or highway sources include vehicles used on roads for transportation of passengers or freight .On-road sources include light-duty vehicles (LDVs) also referred to as passenger cars(, heavy-duty vehicles (HDVs), and motorcycles that are used for transportation on the road .On-road vehicles may be fueled with gasoline, diesel fuel, or alternative fuels, such as alcohol or natural gas" .Non road "sources include gasoline and diesel powered vehicles, engines, and equipment used for construction, agriculture, transportation, recreation, and many other purposes .These sources emit both criteria pollutants and other hazardous air pollutants .

Mobile sources account for more than half of all the air pollution in the United States. The primary mobile source of air pollution is the automobile .EPA studies show that today's cars emit 75 to 90 percent less pollution for each mile driven than their 1970 counterparts, thanks largely to advancements in vehicle and fuel technology .But today's motor vehicles are still responsible for up to half of all the emissions released into the air .The specific pollutant categories include 45 percent of the volatile organic compound (VOC) emissions, 50 percent of the nitrogen oxides (NO_X) emissions, approximately 60 percent of the carbon monoxide(CO) emissions and 50 percent of the hazardous air pollutants in urban areas .

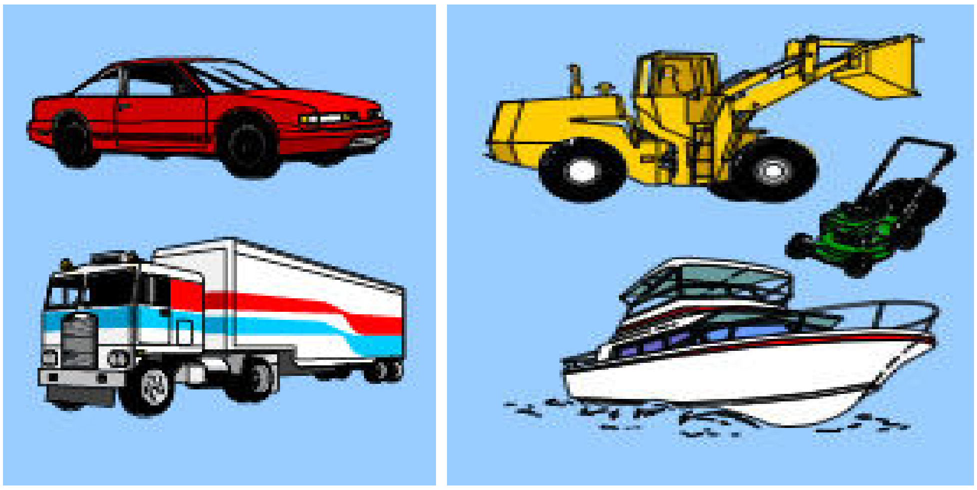


Figure 2.5 Mobile sources of air pollution

Mobile sources pollute the air through combustion and fuel evaporation . These emissions contribute greatly to air pollution nationwide and are the primary causes of air pollution in many urban areas .Combustion is the process of burning . Motor vehicles and equipment typically burn fuel in an engine to create power . Gasoline and diesel fuels are mixtures of hydrocarbons, which are compounds that contain hydrogen and carbon atoms .In "perfect "combustion, oxygen in the air would combine with all the hydrogen in the fuel to form water and with all the carbon in the fuel to form carbon dioxide .Nitrogen in the air would remain unaffected .In reality, the combustion process is not "perfect, "and engines emit several types of pollutants as combustion byproducts .Evaporation is the process by which a substance is converted from a liquid into a vapor" .Evaporative emissions " occur when a liquid fuel evaporates and fuel molecules escape into the atmosphere . A considerable amount of hydrocarbon pollution results from evaporative emissions that occur when gasoline leaks or spills, or when gasoline gets hot and evaporates from the fuel tank or engine .

Perfect Combustion:

(Fuel)hydrocarbons + (Air)oxygen and nitrogen → (Carbon dioxide)CO2 + water +(unaffected nitrogen)

Typical Engine Combustion:

Fuel +Air → Unburned Hydrocarbons +(Nitrogen Oxides) NOx + (Carbon monoxide) CO +(Carbon dioxide) CO_2 + water.

2.2.2. Stationary Sources.

Are non-moving sources, fixed-site producers of pollution such as power plants, chemical plants, oil refineries, manufacturing facilities, and other industrial facilities .There are hundreds of thousands of stationary sources of air pollution in the United States .Stationary sources emit both criteria pollutants and hazardous air pollutants (HAPs).Air pollution from stationary sources is produced by two primary activities .These activities are stationary combustion of fuel such as coal and oil at power generating facilities, and the pollutant losses from industrial processes . Industrial processes include refineries, chemical manufacturing facilities, and smelters

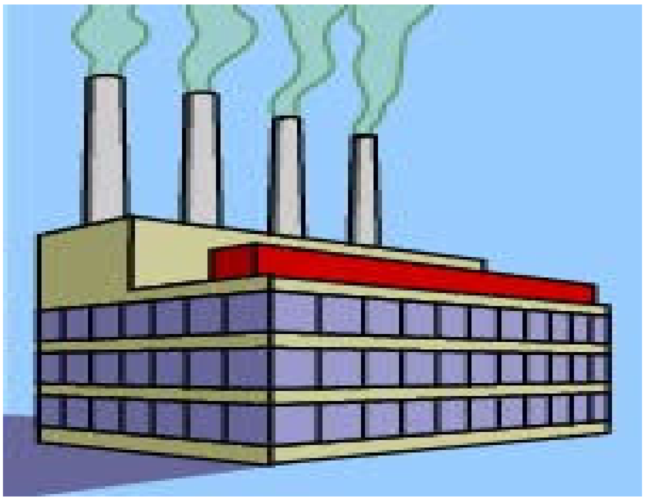


Figure2.6 :Stationary sources

Stationary sources have many possible emission points .An emission point is the specific place or piece of equipment from which a pollutant is emitted .Air pollutants can be emitted from smokestacks, storage tanks, equipment leaks, process wastewater handling/treatment area, loading and unloading facilities, and process vents .A process vent is basically an opening where substances (mostly in gaseous form) are "vented "into the atmosphere .Common process vents in a chemical plant are distillation columns and oxidation vents .Emissions from storage tanks are due to pollutants that can leak through the roofs, and can leak through tank openings when liquids expand or cool because of outdoor temperature changes .Also, air pollutants can escape during the filling and emptying of a storage tank .Air pollution produced from wastewater occurs when wastewater containing volatile chemicals comes in contact with the air .Volatile means that it can be evaporated, or pass from a liquid state to a gaseous state .Large, stationary sources of emissions that have specific locations and release pollutants in quantities above an emission threshold are known as point sources .Those facilities or activities whose individual emissions do not qualify them as point sources are called area sources .Area sources represent numerous facilities or activities that individually release small amounts of a given pollutant, but collectively can release significant amounts of a pollutant .For example; dry cleaners, vehicle refinishing and gasoline dispensing facilities, and residential heating will not typically qualify as point sources, but collectively the various emissions from these sources are classified as area sources .

Stationary sources are also classified as major and minor sources. A major source is one that emits, or has the potential to emit, pollutants over a major source threshold .A minor source is any source which emits less pollutants than the major source threshold.

Another source of air pollution is indoor air .The levels of pollutants in the air inside homes, schools, and other buildings can be higher than the level of pollutants in the outdoor air.

2.2.3. Indoor Air Pollution.

Comprises a mixture of contaminants penetrating from outdoors and those generated indoors .In the last several years, the amount of scientific evidence has indicated that the air within homes and other buildings can be more seriously polluted than the outdoor air in even the largest and most industrialized cities .Other research indicates that people spend approximately 90 percent of their time indoors . In addition, people who may be exposed to indoor air pollutants for the longest periods of time are often those most susceptible to the effects of indoor pollution . Such groups include the young, the elderly, and the chronically ill, especially those suffering from respiratory or cardiovascular disease.

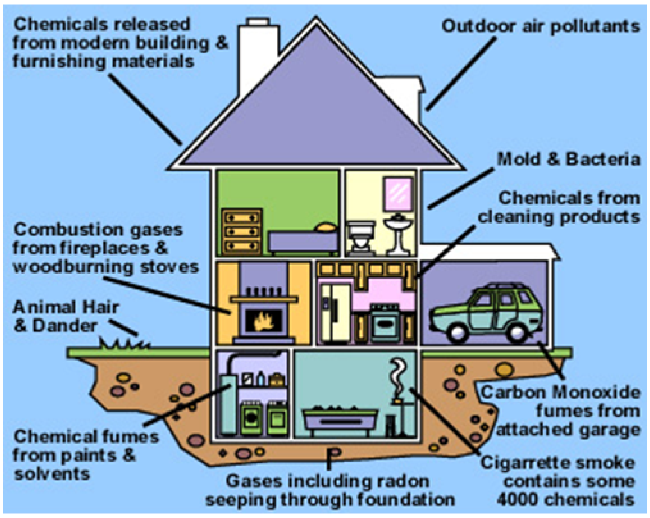


Figure 2.7 :Indoor air pollution

There are many sources of indoor air pollution in homes .These sources of indoor air pollution include combustion sources (oil, gas, kerosene, coal, wood, tobacco products), building materials, wet or damp carpet, cabinetry or furniture made of certain pressed wood products; household cleaning products, central heating and cooling systems, humidification devices, and outdoor sources such as radon, pesticides, and outdoor air pollution .

The relative importance of any single source depends on how much of a given pollutant it emits and how hazardous those emissions are .In some cases, factors such as how old the source is and whether it is properly maintained are significant .For example, an improperly adjusted gas stove can emit significantly more carbon monoxide than one that is properly adjusted .

Radon and environmental tobacco smoke (ETS) are the two indoor air pollutants of greatest concern from a health perspective .Radon is a naturally occurring gas that is odorless, colorless, and radioactive .Environmental tobacco smoke (ETS) is the smoke emitted from the burning of a cigarette, pipe, or cigar, and smoke inhaled by a smoker .It is a complex mix of more than 4,000 chemical compounds, containing many known or suspected carcinogens and toxic agents, including particles, carbon monoxide, and formaldehyde .

The main mobile source of pollution is the Traffic induced pollution which comprises the road transportation sector .In order to understand this type of pollution, it is essential to shed light on the types of internal engines used mainly for combusting the hydrocarbon fuel .The technique used for converting the chemical energy in the fuel to mechanical energy depends on either a spark ignition (SI) engine type or a compression ignition (CI) engine type .Each engine emits exhaust gases and in the following sections, these emission will be discussed.

2.3. Spark Ignition Engines Emission.

Incomplete combustion is a natural consequence of SI engine operation and results from the unique nature of each particular fuel-engine interface; i.e., the quality of fuel used, the specific geometry of an engine's combustion chamber, and the particular means of ignition and burn utilized to produce power .The major by-products of incomplete combustion , or engine pollutants, associated with SI chemistry are carbon monoxide; unburned hydrocarbons; and nitric oxides.

Carbon monoxide, an intermediate product of combustion of any hydrocarbon fuel, is a rich SI combustion product produced at both full-load and idle operation .At idle, 0.3vol %CO is lethal and can cause death in confined spaces within 30 min .The major source of CO is a result of chemical kinetics within the bulk gas; however, CO is also produced by partial oxidation of (UHC)during the exhaust stroke as well as dissociation of CO_2 produced during combustion .The rapid drop in gas temperature during expansion will freeze CO concentrations at levels different from those predicted on the basis of equal temperatures and equilibrium composition calculations .Control of CO is chiefly by improved *FA* management and lean burn, such as with a stratified engine .Additional (CO) reduction is obtained using exhaust gas afterburning management via catalyst.Unburned hydrocarbons, or (UHC), can be found in the boundary layer around the combustion walls, where convective and irradiative heat transfer have quenched the reaction at the end of flame travel . Additional sources of (UHC) can include fuel pyrolyzed during burn, lean operation misfire, rich combustion during start-up, and (FA) variation between cylinders .Non-combustion (UHC) emissions include desorbed or out gassed fuel that had undergone oil film loading early in the charge induction process and gases trapped in small quench zones and crevice volumes formed by the piston crown, top ring, and cylinder walls.Early efforts to reduce and control (UHC) in SI engines used fuel injection to replace carburetion, adjustments in spark timing, and careful attention to minimize the surface-to volume ratio in the design of a combustion chamber .Lean burn combustion, a technique for CO management, has also been used as a technique for controlling (UHC) emissions.Recall that stratified combustion is based on having the ability to burn rich during that portion of the reaction in which the greatest fraction of charge is consumed.

A lean burn design approach produced engines having poor fuel economy with unacceptable performance, which required increased maintenance .Most current (UHC)control systems now incorporate catalytic reduction of the (UHC) exhaust . Oxidizing catalytic converters, containing materials such as platinum, reduce both (CO) and (UHC)without interfering with engine operation but require the use of unleaded gasoline to prevent catalyst poisoning.In-cylinder NO_x formation within SI engines is by a different chemical kinetic mechanism than either (CO) and (HC) processes.

The NO_x is generated at high temperatures by reactions that occur between nitrogen and oxygen .The production of NO_x is increased by higher combustion temperatures and the presence of oxygen such as occurs under fuel lean conditions . Thus, NOx formation in SI engines is influenced by the AF ratio and by engine design parameters that affect peak temperature, including compression ratio, spark timing, and cooling .In-cylinder control techniques attempt to lower the peak temperature and include external and internal circulation techniques .With external circulation, exhaust gas recirculation (EGR)returns a small fraction of exhaust, i.e., products of combustion, to dilute the intake charge and thereby reduce the peak temperature and thus lower the amount of NO_x formed .With internal circulation, valve timing is controlled such that during intake there is an overlap period in which the exhaust valve is still opened along with the intake valve allowing internal exhaust gas recirculation.

Three-way catalyst systems are also used to effectively reduce spark-ignition exhaust emissions by oxidizing (CO) and (HC) as well as providing for (NO_x) reduction.

However, the discharge control method requires stoichiometric or oxygen-deficient exhaust gas composition to work .A computer controlled closed loop air-fuel ratio feedback control system upstream of the three-way catalysts is required to monitor the oxygen content, i.e., stoichiometric conditions .

Figure 2.8 illustrates the general relationship among CO, UHC, and NO_x emission concentrations and fuel-air mixture equivalence ratio for an SI engine operating on a hydrocarbon fuel such as gasoline .Non-engine UHC emissions include fuel tank, crankcase, and carburetor evaporative losses.

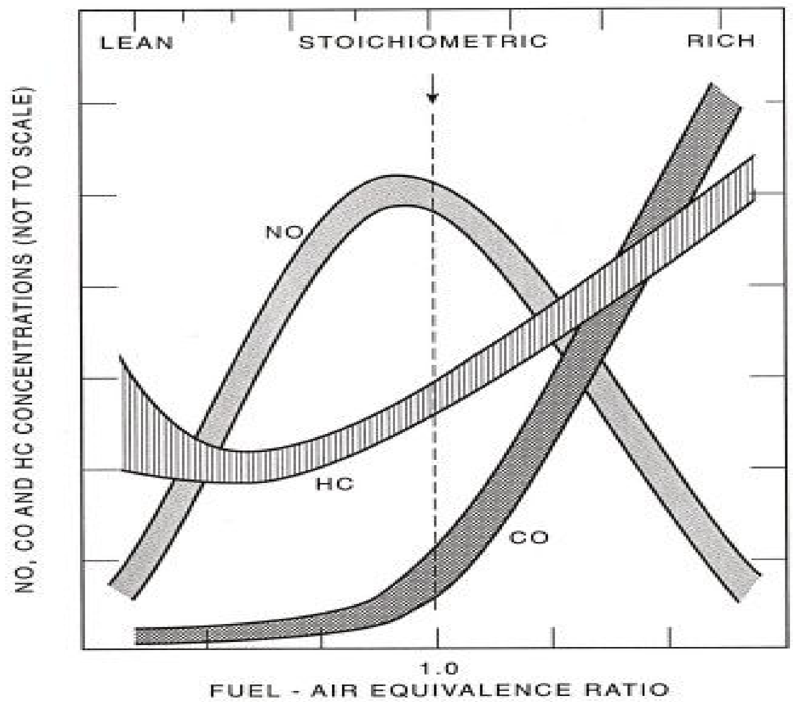


Figure 2.8 Spark-ignition emissions vs .equivalence ratio

2.4. Compression Ignition Engines Emission:

Diesel engine operation depends on a high compression ratio process to raise intake air above the self-ignition temperature of the fuel .Unfortunately, diesel engines run with excess oxygen i.e., lean and produce exhaust emissions including carbon monoxide, hydrocarbons (HC), odor, particulate matter (PM), smoke, sulfur dioxide SO_2, as well as nitrogen oxide (NO) and small amounts of nitrogen dioxide (NO_2) collectively known as NOx .Diesel engines are substantial (PM) and NO_x emitters but discharge relatively small amounts of (CO) and hydrocarbons (HC).

Gasoline engines pollute in somewhat the opposite fashion, however, being the greater emitters of (CO) with modest amounts of (PM) while exhausting substantial (HC) and (NO_x) .Although the (NO_x) problem is a serious environmental issue for both gasoline and diesel engines, both (PM) and(NO_x) from diesel engine powered vehicles are required to meet increasingly tough emissions legislation by the.S .Environmental Protection Agency and the California Air Resource Board (CARB) It is a matter of record that a large fraction of all (NO_x) emissions in the western United States come from heavy-duty diesel engines .The required (NO_x) characteristic of diesel engines is a major factor that impacts operation of future U.S .heavy diesel vehicles.Emission regulations and standards are set for various classes of diesel engines and vehicles at state and national levels.

Recall that carbon monoxide is due to insufficient oxygen for complete oxidation of carbon .Since diesel fuel combustion occurs in excess air environments, (CO) emissions are much lower for CI engines than SI engines .Unburned hydrocarbons, UHCs are due to specific CI fuel-engine interface characteristics, including (1) fuel injection, i.e., spray pattern, length of injection, and degree of atomization; (2) particular combustor geometry, i.e., shape of combustion chamber, fuel quenching from spray contacting the wall, and chamber burn pattern; and (3)combustion itself, i.e., fuel structure, locally rich mixture chemistry, and time available for burn.

Diesel (UHC) emissions contain original, decomposed, and recombined diesel fuel constituents and, therefore, differ from those (HC) compounds generated by SI combustion of automotive fuels .Odor is a by-product of the incomplete burning of diesel fuels .Compression-ignition engine chemistry produces partially oxidized, as well as decomposed and recombined, fuel fractions .The hydrocarbon composition of diesel fuels promotes incomplete combustion, odor-producing, aromatic ring hydrocarbons and oxygenated aldehyde compounds such as form aldehyde .Volatile organic compounds (VOCs) associated with diesel operation are located in unburned hydrocarbon tailpipe emissions as well as in vehicle evaporative fuel emissions.Due to the lower volatility of diesel fuel, CI engine powered vehicles have extremely low evaporative and cold-start emissions .The unburned hydrocarbon levels depend largely on load and speed of an engine, but with the high overall AF ratios of diesels, hydrocarbon emissions are generally lower than those of comparable SI engines .A portion of the hydrocarbon emissions can be reduced with the oxygen contained in the diesel engine's exhaust discharge by use of a noble-metal catalyst.Particulate matter (PM) is a term used to identify solid particles and liquid droplets found in the atmosphere .PM can range from mixtures of “coarse” particles to collections of “fine” particles .Coarse PM are designated by(EPA) as (PM_{10}), i.e . 10 microns (0.0004inch) particles, and are predominantly non combustion in origin, material including road dust, tire and brake wear debris, and pollen .Fine PM, designated as($PM_{2.5}$), are 2.5microns (0.0001 inch) particles and result chiefly from a variety of internal and external fuel combustion sources .Particles with diameters of 0.1 micrometers (100 nanometers) or less are referred to as “ultrafine,” while “nanoparticles” have diameters of 50 nanometers or less .So called “secondary” fine particles are also formed in the atmosphere from gases such as sulfur dioxide, NOx, and VOCs.

Diesel particulate matter is a complex mixture of solid and liquid materials generated within the engine cylinder during combustion consisting of dry carbon particles i.e., soot, heavy hydrocarbons adsorbed and condensed on the carbon particles (referred to as soluble organic fraction), and a combination of several components of diesel exhaust including hydrated sulfuric acid .(PM) emissions size distribution is affected by both operating conditions and fuel parameters .Most of the particulate emissions from diesel engines are smaller than 2.5 microns.

Diesel engines in the past had been suspected of causing serious health effects simply because people could see and smell “smoky” exhaust from older diesel engines.Smoke, either a solid or liquid (aerosol)particulate suspended in an exhaust stream, is easily observed and contains certain diesel particulates that are in fact carcinogenic.Ultrafine particle PM emissions from modem diesel engines, however, are not visible but contain fine particulate matter .Control strategies, including incorporating catalytic filters, active traps, and soot afterburning, are but a few of the ongoing after treatment approaches being pursued to try to control diesel particulate.

Diesel engines additionally produce unacceptably high levels of NO_x at high speeds and loads .Oxides of nitrogen are a result of excess air and high-compression ratio operation of modern CI engines .The production of (NO_x)by engine combustion is thus dependent to a large degree on the following three factors:

- Post-combustion gas temperatures
- Duration of these temperatures
- Species in post-combustion gases, with O_2 being most critical

The diesel industry has been attempting to integrate an effective way to reduce (NOx) emissions into the diesel infrastructure for many years .Presently only two routes have been identified with potential for commercial success :select catalytic reduction (SCR) and exhaust gas recirculation .(SCR) requires significant harsh aggressive chemicals to be introduced on board the vehicle as well as at the fueling stations Any reduction in peak temperature or excess air helps to reduce NOx emissions .In EGR, the exhaust gas from the engine is recycled to the engine intake thereby lowering the oxygen level and ensuing engine temperature which reduces (NO_x) emissions .EGR is used in both SI and CI engines as a means of reducing (NO_x) .EGR provides a dilution mechanism to reduce the first and third production factors cited above .NOx reductions also are influenced by other factors such as EGR recirculation rate, temperature, and water content, as well as injection timing, and overall air-fuel ratio of the intake charge.

Two major problems with EGR are:
(1) recirculation of dirty soot back to the engine and (2) higher engine gas temperature from EGR. Even though EGR has been successful in spark engines, re-circulating dirty/corrosive diesel exhaust material with its wear-related problems reduces internal component life and, therefore, compromises diesel engine integrity . EGR puts a significant additional heat load on the engine and introduces the need for heat exchangers to cool the gas. More (NO_x) production occurs unless cooling is provided for EGR, which introduces ancillary heat exchanger equipment and a pump to circulate cooling water .In addition, even though EGR is effective in reducing NOx, there are limits to the amount of exhaust gas that can be reintroduced into an engine before power output and fuel economy are adversely affected.Neither of these approaches, SCR nor EGR, has been seen by the diesel industry as being completely satisfactory, and the industry, therefore, has been slow to embrace either technique as a final solution .In addition, three-way catalysts, used to reduce SI engine NO_x emissions, require stoichiometric or oxygen-deficient exhaust gas compositions in order to work and therefore will not work in oxygen concentrations of diesel engine exhausts.Sulfur present in diesel fuel will form sulfur oxides, during combustion.
The SO_x concentration in the exhaust depends on the sulfur content of the fuel . Sulfur dioxide is a colorless toxic gas with a characteristic foul odor .That sulfur oxides are also major contributors to acid rain.

$SO_x + aH_2O \rightarrow bH_2SO_4 + cH_2SO_3$

$S + aO_2 \rightarrow bSO_2 + cSO_3$

Significant sulfur emissions reduction from most diesel engines operating throughout the U.S could result from switching to utilization of low sulfur diesel fuels i.e., less than(0.05 %sulfur). A variety of fuel-engine interface techniques for controlling overall emissions from diesel engines are actively being pursued and include paying attention to the

- Combustion chamber design
- Fuel injector design
- Fuel composition, including additives
- Fuel/air ratio
- Engine selection
- Engine operation conditions

In order to meet all the targeted emissions requirements for current and projected on -and off-road diesel-powered vehicles, it will be a challenge to develop control technologies and/or control system architectures that do not interfere with power and associated fuel economies.

Reducing the discharge of emissions from a diesel without de rating performance will continue to be a goal for the diesel engine designer and manufacturer .Advancements will require more than simply selecting engine types and/or components, using alternative fuels and additives, or discovering the magic exhaust after treatment technique .The Department of Energy/Office of Heavy Vehicle Technologies, for instance, is collaborating currently with industrial partners to achieve very low emissions in heavy trucks.

A three-pronged systematic approach is being employed that simultaneously addresses (1) fuel formulation/quality, (2) in-cylinder combustion control, and(3) exhaust treatment to arrive at the most cost-effective emission strategy without sacrificing efficiency.

The complex environmental challenge facing the diesel engine designer is best illustrated by describing an in-cylinder combustion control for keeping both (NO_x) and (PM) emissions within their specified regulated limit .Any effort that increases combustion efficiency leads to higher combustion temperatures will reduce (PM) and, thus, unfortunately higher (NO_x) emissions .On the other hand, trying to reduce (NO_x) formation by lowering combustion temperature leads to higher (PM) emissions .In-cylinder (NO_x)and(PM) control characteristics are unfortunately linked by the diesel combustion process .As in-cylinder peak bulk gas temperature is increased, more (NO_x) is produced but the diffusion flame temperature necessary for (PM) burnout is also increased, resulting in more oxidized soot and less (PM) emission .Decreasing peak bulk gas temperature will decrease both (NO_x) and (PM) . Adjusting injection to control optimum peak bulk gas temperature by retarding timing results in a tradeoff that affects (NO_X), particulate, and power.

2.5. Effects of Air Pollutants

Air pollution has a detrimental effect on nearly all phases of our lives .Along with the health effects there are many welfare effects of air pollution .These include effects on vegetation, soil, water, manmade materials, climate, and visibility .In this unit we will discuss the effects of air pollution .Exposure to air pollution is associated with numerous effects on human health, including pulmonary, cardiac, vascular, and neurological impairments .The health effects vary greatly from person to person .High-risk groups such as the elderly, infants, pregnant women, and sufferers from chronic heart and lung diseases are more susceptible to air pollution . Children are at greater risk because they are generally more active outdoors and their lungs are still developing .Exposure to air pollution can cause both acute (short-term) and chronic (long-term) health effects .Acute effects are usually immediate and often reversible when exposure to the pollutant ends .Some acute health effects include eye irritation, headaches, and nausea .Chronic effects are usually not immediate and tend not to be reversible when exposure to the pollutant ends .Some chronic health effects include decreased lung capacity and lung cancer resulting from long-term exposure to toxic air pollutants .The scientific techniques for assessing health impacts of air pollution include air pollutant monitoring, exposure assessment, dosimetry, toxicology, and epidemiology .

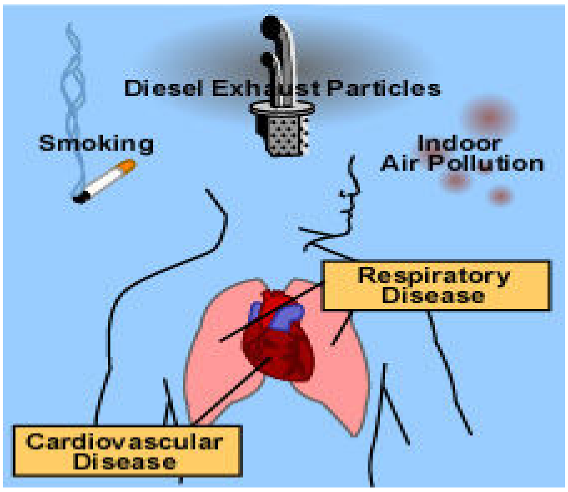


Figure 2.9:Health Effects caused by Air Pollution

Although in humans pollutants can affect the skin, eyes and other body systems, they affect primarily the respiratory system .Air is breathed in through the nose, which acts as the primary filtering system of the body .The small hairs and the warm, humid conditions in the nose effectively remove the larger pollutant particles .The air then passes through the pharynx, esophagus, and larynx before reaching the top of the trachea .The trachea divides into two parts, the left and the right bronchi .Each bronchi subdivides into increasingly smaller compartments .The smallest compartments of the bronchi are called bronchioles, which contain millions of air sacs called alveoli .Together, the bronchioles and alveoli make up the lungs .

Both gaseous and particulate air pollutants can have negative effects on the lungs . Solid particles can settle on the walls of the trachea, bronchi, and bronchioles .Most of these particles are removed from the lungs through the cleansing (sweeping) action of "cilia", small hair like outgrowths of cells, located on the walls of the lungs . This is what occurs when you cough or sneeze.A cough or sneeze transports the particles to the mouth .The particles are removed subsequently from the body when they are swallowed or expelled .However, extremely small particles may reach the alveoli, where it takes weeks, months, or even years for the body to remove the particles .Gaseous air pollutants may also affect the function of the lungs by slowing the action of the cilia .Continuous breathing of polluted air can slow the normal cleansing action of the lungs and result in more particles reaching the lower portions of the lung.The lungs are the organs responsible for absorbing oxygen from the air and removing carbon dioxide from the blood-stream .Damage to the lungs from air pollution can inhibit this process and contribute to the occurrence of respiratory diseases such as bronchitis, emphysema, and cancer .This can also put an additional burden on the heart and circulatory system .

In (**Table 1**)we summarize the sources, health and welfare effects for the Criteria Pollutants .Hazardous air pollutants may cause other less common but potentially hazardous health effects, including cancer and damage to the immune system, and neurological, reproductive and developmental problems .Acute exposure to some hazardous air pollutants can cause immediate death .Human health effects associated with indoor air pollution are :headaches, tiredness, dizziness, nausea, and throat irritation .More serious effects include cancer and exacerbation of chronic respiratory diseases, such as asthma .Radon is estimated to be the second leading cause of lung cancer in the U.S .Environmental tobacco smoke causes eye, nose and throat irritation, and is a carcinogen .Asthma, particularly in children, is associated with poor indoor air quality .

Table 2.1: Sources, Health and Welfare Effects for Criteria Pollutants.

Pollutant	Description	Sources	Health Effects	Welfare Effects
Carbon Monoxide(CO)	Colorless, odorless gas	Motor vehicle exhaust, indoor sources include kerosene or wood burning stoves.	Headaches, reduced mental alertness, heart attack, cardiovascular diseases, impaired fetal development, death.	Contribute to the formation of smog.
Sulfur Dioxide SO_2	Colorless gas that dissolves in water vapor to form acid, and interact with other gases and particles in the air.	Coal-fired power plants, petroleum refineries, manufacture of sulfuric acid and	Eye irritation, wheezing, chest tightness, shortness of breath, lung damage.	Contribute to the formation of acid rain, visibility impairment, plant and water damage,

		smelting of ores containing sulfur.		aesthetic damage.
Nitrogen Dioxide (NO_2)	Reddish brown, highly reactive gas.	Motor vehicles, electric utilities, and other industrial, commercial, and residential sources that burn fuels.	Susceptibility to respiratory infections, irritation of the lung and respiratory symptoms (e.g., cough, chest pain, difficulty breathing).	Contribute to the formation of smog, acid rain, water quality deterioration, global warming, and visibility impairment.
Ozone (O_3)	Gaseous pollutant when it is formed in the troposphere.	Vehicle exhaust and certain other fumes. Formed from other air pollutants in the presence of sunlight.	Eye and throat irritation, coughing, respiratory tract problems, asthma, lung damage.	Plant and ecosystem damage.
Lead (Pb)	Metallic element	Metal refineries, lead smelters, battery manufacturers, iron and steel producers.	Anemia, high blood pressure, brain and kidney damage, neurological disorders, cancer, lowered IQ.	Affects animals and plants, affects aquatic ecosystems.
Particulate Matter (PM)	Very small particles of soot, dust, or other matter, including tiny droplets of liquids.	Diesel engines, power plants, industries, windblown dust, wood stoves.	Eye irritation, asthma, bronchitis, lung damage, cancer, heavy metal poisoning, cardiovascular effects.	Visibility impairment, atmospheric deposition, aesthetic damage

Long before pollutant effects become manifest in human health, they are first seen in the environment .Air pollution impacts in the ecosystem form and function are also a serious concern .Damage to ecosystems from air pollution can exact a significant economic as well as an environmental cost .There are many harmful environmental effects of air pollution :acid rain, the greenhouse effect, depletion of stratospheric ozone, smog, and decreased visibility

2.5.1. Welfare Effects (Acid Rain).

Acid rain "is a broad term used to describe several ways that acids fall out of the atmosphere .A more precise term is acid deposition, which has two parts :wet and dry .Acid deposition occurs when emissions of sulfur dioxide and nitrogen oxides in the atmosphere react with water, oxygen, and oxidants to form acidic compounds . These compounds fall to the earth in either dry form gas and particles or wet form rain, snow, and fog .In the United States, about 63 percent of annual SO_x emissions and 22 percent of NO_x emissions are produced by burning fossil fuels for electricity generation .Latest Findings on National Air Quality, 2002 because it typically takes days to weeks for atmospheric SO_2 and NO_x to be converted to acids and deposited on the earth's surface, acid deposition occurs in a multistate scale hundreds of miles away from its sources.

Acidity is measured in terms of PH on a logarithmic scale from 1.0 to 14.0 .A PH of 1.0 indicates high acidity, whereas a PH of 14.0 indicates high alkalinity; a PH of 7.0 indicates a neutral solution .Precipitation falling through a "clean "atmosphere is normally somewhat acidic, with a PH of about 5.6 .Acid rain, however, can have a PH values below 4.0.

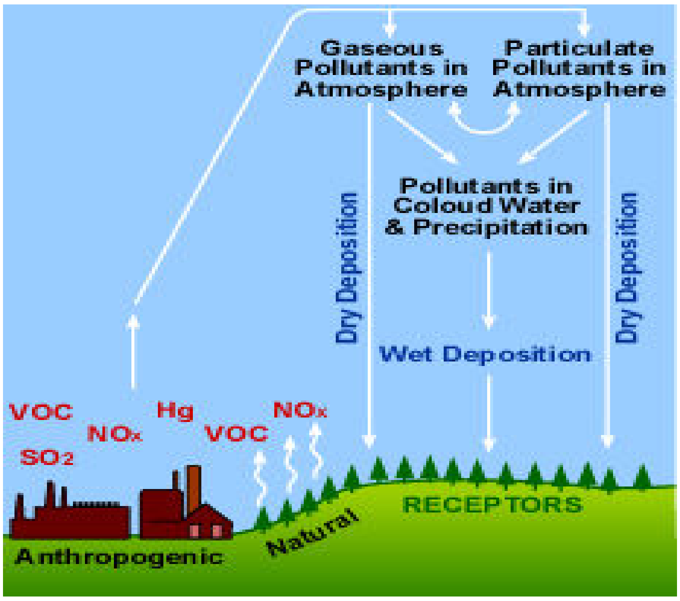


Figure2.10 :Acid rain formation

In the environment, acid deposition causes soil and water bodies to acidify making the water unsuitable for some fish and other wildlife and damages some trees, particularly at high elevations .It also speeds the decay of buildings, statues, and sculptures that are part of our national heritage .The nitrogen portion of acid deposition contributes to eutrophication oxygen depletion of water bodies, the symptoms of which include algal blooms some of which may be toxic, fish kills, and loss of plant and animal diversity .These ecological changes impact human populations by changing the availability of seafood and creating a risk of consuming contaminated fish or shellfish, reducing our ability to use and enjoy our coastal ecosystems, and causing economic impact on people who rely on healthy coastal ecosystems, such as fishermen and those who cater to tourists. Assessing the traffic pollution in a street canyon.

The proposed graduation project addresses a major air pollution problem in Hebron city and mainly in a highly traffic dense road which is Al-Salam Road .The road connects the northern part of Hebron city with it southern part where major industrial sector is located, passing through the heart of the city where commercial buildings are located .The road capacity and the types of vehicles crossing round the clock in addition to the dominant atmospheric conditions are instrumental in assessing the pollution and how pollutants are dispersed and possibly deposited .In the proposed work, a survey campaign will be implemented by which the status of round the clock traffic will be determined in term of the density, types, average speed, waiting time at traffic lights, and traffic categories. Based on the data collected a mathematic model will be used to estimate the total average emission .In addition an experimental work is going to be set and implemented by which emission measurement campaign will in different location within the road will be carried out very close to “emission sources.”Emission measurement will include ten major gases and the noise emission .In order to assess the dispersion based on the dominant wind pattern, the wind speed and direction and the air temperature will be measured during the campaign. The data collected will be used in a specialized and verified mathematical model to assess the pollution pattern .It is intended after the analyses of the data and the interpretation of the results to come out with several recommendations that form a mitigation plan for any adverse traffic pollution in the main Al-Salam road .

Chapter Three

General Information about Al Salam Street & Description

3.1. General introduction for Hebron city.

3.1.1. Geographic Location of Hebron.

3.1.2. Climate Hebron.

3.2. Al Salam street description.

3.2.1. Description Salam Street.

3.2.2. Importance of Salam Street and the areas which are linked to Al Salam Street.

3.2.3. Cars in the Street.

3.1. Background Information.

The Hebron districts located in the south of the West Bank .It is997 km² and has a total population of approximately 542,593 inhabitants)PCBS, 2006 .The district consists of the more than100 cities and villages with the city of Al-Khalil (Hebron) as the district capital .Hebron was named for the Prophet Ibrahim Al-Khalil may God pless him .(The city's population exceeds166.166000 inhabitants living in urban, rural and refugee camps).

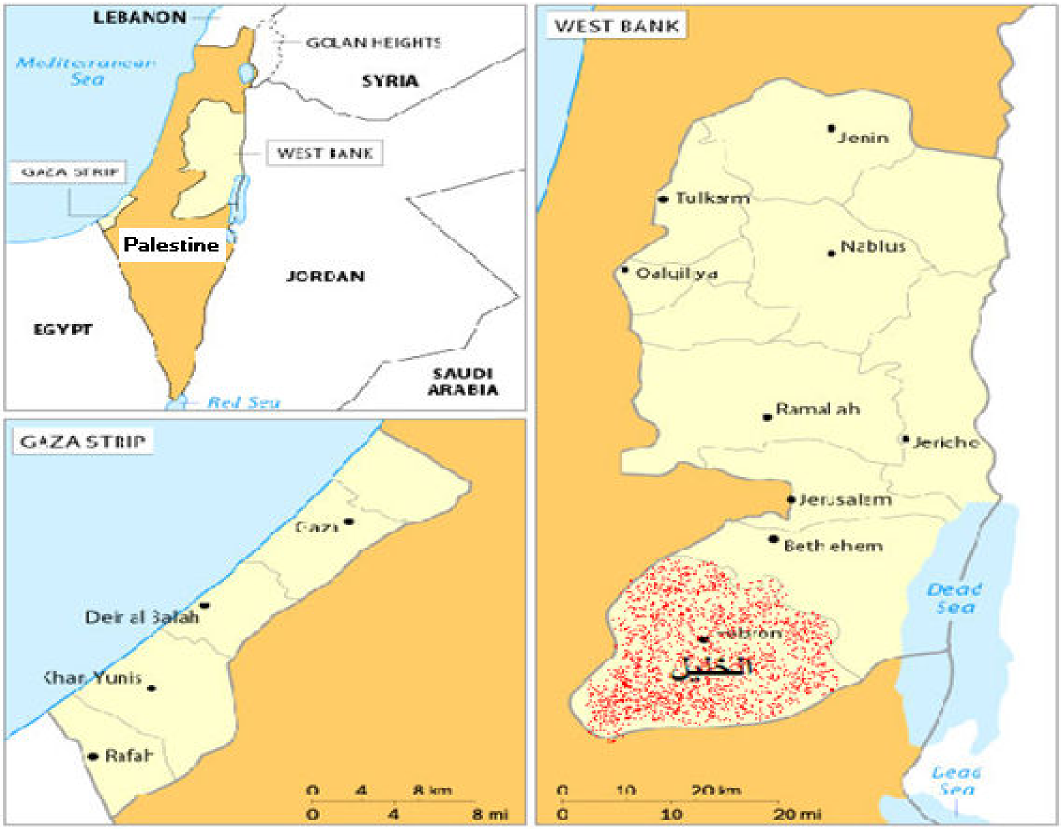


Figure 3.1:Map of Palestine and Hebron in West Bank

3.1.1. Geographic Location of Hebron

The Hebron district, is located between 31.29, 31.23 to 35.4 ,25.70 latitude and longitude with an altitude range of800 -1020 meters above sea level, that include the peaks of Mount Sindas (930 m)and the mountains of sitting (987 m), a trait Boutrk (1020) and Raastorra (1012), called Eastern Highlands of Wilderness of the Hebron.

3.1.2. Climate Hebron

Hebron has a mild climate which is moderately dry in summers and relatively cooled in winters, Hebron economy relies mainly on industrial and commercial sector. Industries such as quarries and stone fabrication, metal cutting, painting and forming, food processing, textile and shoe making, etc. are main types of industries . Commercial buildings are scattered almost in all main streets and roads. Hebron is lively district with traffic of heavy, light and moderate types. The limitation in lands and the increased number in transportation system have lead to an acute problem of traffic induced pollution .It is usual to find a main road the crosses the heart of the city with high traffic density and long traffic stop which in turn increase the adverse impact of pollution resulted from the emissions. One of the major roads that connects the northern part of the Hebron city with its southern part is the Al-Salam road. This road crosses the heart of the city connecting residential and commercial areas with the industrial areas in the southern part of the city and the district .The road has a traffic density that exceeds an average of 600 vehicle /hour .

At Al Salam roads there are many schools and kindergartens and residential houses in addition to several factories for construction materials, aluminum and glass and other workshops which scattered randomly among the residential buildings. It is clearly noticed during the day that traffic and nose emissions are considered a problem .Hence it is of high important to assess the traffic induced pollution conditions in the road and in particular in place where traffic congestion at Sibta

Square, where the traffic diverted usually to the four main directions .i.e .North, South, East and West.

3.2. Al Salam street description.

Al Salam Street, located on the western side of peace in the nearly city of Hebron, and is a main street and up a dynamic between the streets of Jerusalem and Beersheba.

Figure 3.2:Top view for Al Salam street

Street area from the areas of Al-Salam is the nascent formation in the city of Hebron, but the main important areas in Hebron, given its location near the center of the city, and to be a zone of mixed-use area is residential, commercial craft.

3.2.1. Description Salam Street.

Extend the street from the guard and up to Hawooz I, extends on both sides of the street bars of shops, factories, apartment buildings, which lies on the pavement a distance may sometimes up to two meters means that the sidewalks narrow and does not ensure the safe movement of infantry, consisting of the street from the two parts)two sides (between the two islands with a view each side between 7 -8 meters and the island of almost half meter high and planted in the first hand Hawooz the first palm trees high, which gives the street beauty and elegance, and on both sides of the palm trees almost rise up between 1 -1.5 meters is a hindrance sometimes block the view of the driver of the other side of the street, , The other side of the street is similar to the first aspect, and contains a number of street traffic signs to regulate traffic and traffic.

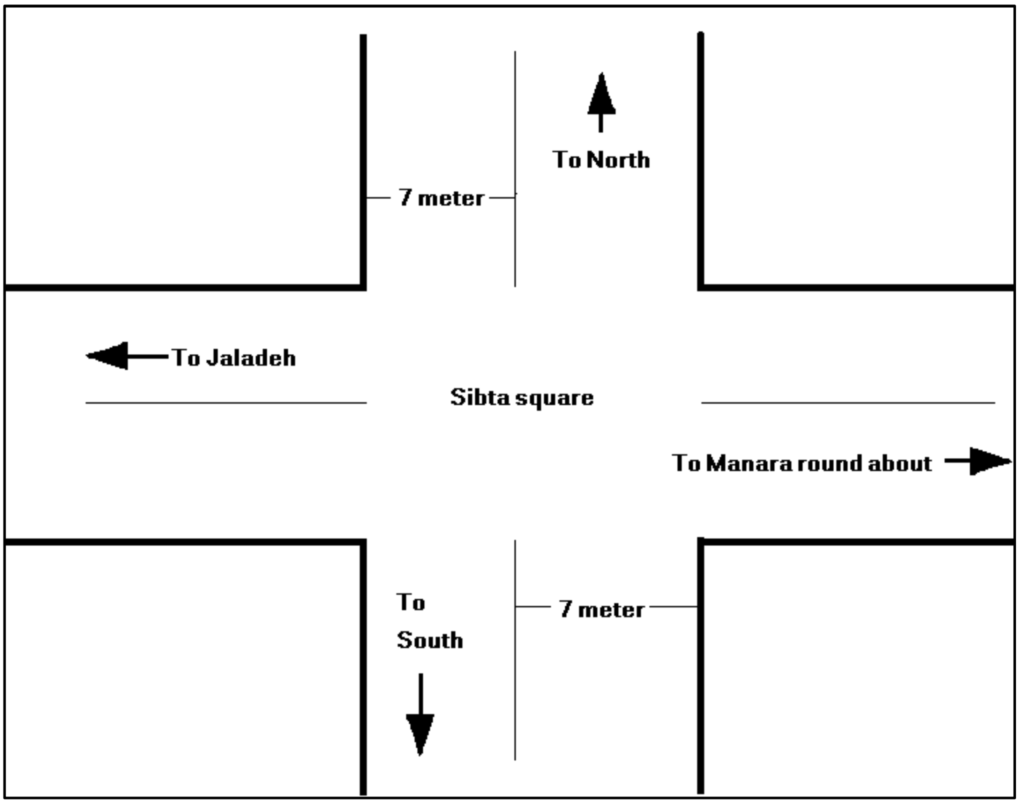


Figure 3.3: Sebta junction

3.2.2. Importance of Salam Street and the Areas Which are linked to Al Salam Street.

Al Salam Street is one of the main arterial in the city of Hebron, connecting the street among many of the key areas in the city of Hebron as a guard north that leads to exit the north and is essential for the city of Hebron also links from the southern region Hawooz the first and the junction which leads to many towns and neighborhoods in the city as mufrq west which leads to Eisa and retail east which leads to the center of the City and also of the in Abu Rumman and Wade Heria and retail south, which leads to Hawouz and then to the main road that leads to the towns and cities in South such as Dora , Fawwar and Yatta,and many villages and small communities, There is a road linking the Al Salam Street, Alseha dizziness.

The region has some of the social institutions, health,& Mosques , educational, we recall some of the following:

Mosques, such as:

1) Ansar mosque.
2) Mother of believers Aisha Mosque.
3) Furqan Mosque.

Schools, such as:

1) School Shaker Natshe main content.
2) Obouhnk School for Girls (affiliated to the Muslim Youth Society).
3) School King Khalid bin Abdul Azez.
4) School Amna Bint Wahab.
5) School of Ibn Khaldun.

Health centers, such as:

Palestinian Red Crescent Society

Universities ,such as:

Hebron University.

3.2.3. Cars in the Street.

Packed car in Al Salam Street view of the importance which we have explained in the previous item in addition to being the easiest and fastest and lightest bottleneck when compared to the street with the main streets in the center of the city, especially street that contains the rotor Alseha Dizziness and Marana Dizziness and the streets that contain the markets and the positions of the car as it is common in the city of Hebron, as the move to private and commercial cars and big trucks back and forth across the street, which creates a large movement and pressure may exceed the other from the streets, especially as we have heavy truck traffic and its attendant inconvenience.

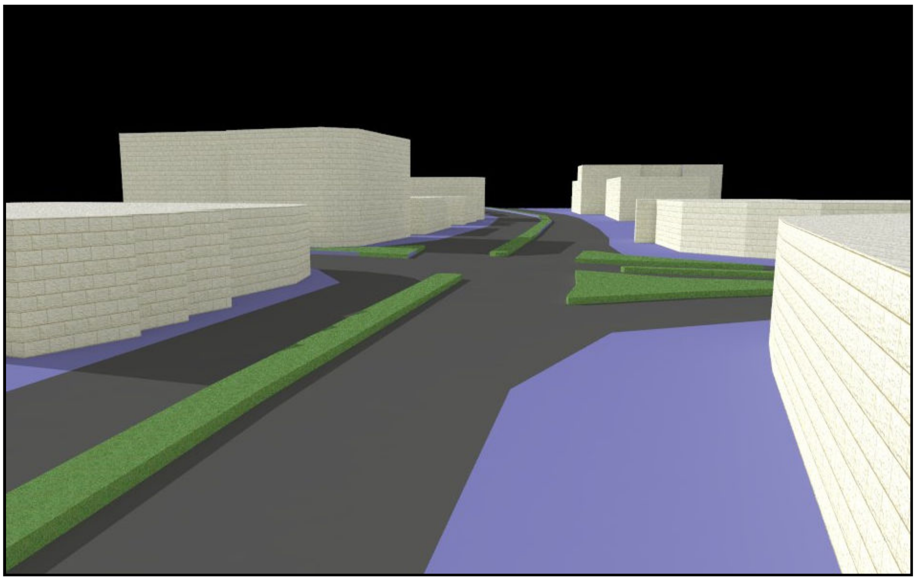


Figure 3.4: front view for Al Salam street

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.

4.5. The Anemometer

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 .

Figure 4.2 :Noise Dosimeter Device

4.5. The Anemometer

An anemometer is an instrument used to measure wind speed .Generally, an anemometer also has a wind vane to measure the wind direction .The most common form of this instrument is a cup anemometer, which has a vertical axis and three cups which capture the wind .Remote sensors then relay the information to the base display .

There are other types of anemometers, but they are not commonly used in consumer-level weather sensors and stations .Ultrasonic anemometers measure the phase shift of sound; laser anemometers measure the phase shift of the laser light, and hot-wire anemometers measure the temperature difference between two wires one in the wind, and one out of the wind

The significant advantage of non-mechanical anemometers may be that they are less sensitive to icing and other mechanical issues, such as corrosion.

Figure 4.3 :The Anemometer

Chapter Five

Estimated Emission Analysis

5.1.Introduction.

- **5.1.1.** Air Pollution Information Service**.**

5.2.Components Selected.

- **5.2.1.** Carbon Monoxide (CO).
- **5.2.2.** Sulfur Dioxide(SO_2).
- **5.2.3.** Volatile Organic Compounds (VOCs).
- **5.2.4.** Oxides of Nitrogen(NO_x).
- **5.2.5.** Particular Matter 10 microns or less(PM_{10}).

5.3.Equation used to Estimated of Pollution and Analysis.

- **5.3.1.** Road Transport Vehicles.
  - **5.3.1.1.** For Small Car.
  - **5.3.1.2.** For Light Goods Vehicles.
  - **5.3.1.3.** For Heavy Goods Vehicles.

5.1. Introduction:

In this chapter the estimated amounts of traffic induced emission components from the surveyed area in Hebron will be presented and further compared to the available standards for urban air quality.

5.1.1. Air Pollution Information Service.

Index and Bands:

In the UK most air pollution information services use the index and banding system approved by the Committee on Medical Effects of Air Pollution Episodes (COMEAP). The system uses 1-10 index divided into four bands to provide more detail about air pollution levels in a simple way:

- 1-3 (Low).
- 4-6 (Moderate).
- 7-9 (High).
- 10 (Very High).

The overall air pollution index for a site or region is calculated from the highest concentration of five pollutants:

- Nitrogen Dioxide.
- Sulphure Dioxide.
- Carbon Monoxide.
- Particles < 10µm (PM10).
- VOCs.
- Air Pollution Forecasts.

Air Quality Forecasts are issued on a regional basis for three different area types:

- In towns and cities near busy roads
- Elsewhere in towns and cities
- In rural areas

Forecasts are based on the prediction of air pollution index for the worst-case of the five pollutants listed above, for each region.

Table 5.1: Boundaries Between Index Points for Each Pollutant.

Band	Index	VOCs		Nitrogen Dioxide		Sulphur Dioxide		Carbon Monoxide		PM10 Particles	
		Running 8 hourly or hourly mean *		hourly mean		15 minute mean		Running 8 hourly mean		Running 24 hour mean	
		$\mu g m^{-3}$	ppb	$\mu g m^{-3}$	ppb	$\mu g m^{-3}$	ppb	$mg m^{-3}$	ppm	$\mu g m^{-3}$	$\mu g m^{-3}$
Low	1	0-33	0-16	0-95	0-49	0-88	0-32	0-3.8	0.0-3.2	0-21	0-19
	2	34-65	17-32	96-190	50-99	89-176	33-66	3.9-7.6	3.3-6.6	22-42	20-40
	3	66-99	33-49	191-286	100-149	177-265	67-99	7.7-11.5	6.7-9.9	43-64	41-62
Moderate	4	100-125	50-62	287-381	150-199	266-354	100-132	11.6-13.4	10.0-11.5	65-74	63-72
	5	126-153	63-76	382-477	200-249	355-442	133-166	13.5-15.4	11.6-13.2	75-86	73-84
	6	154-179	77-89	478-572	250-299	443-531	167-199	15.5-17.3	13.3-14.9	87-96	85-94
High	7	180-239	90-119	573-635	300-332	532-708	200-266	17.4-19.2	15.0-16.5	97-107	95-105
	8	240-299	120-149	636-700	333-366	709-886	267-332	19.3-21.2	16.6-18.2	108-118	106-116
	9	300-359	150-179	701-763	367-399	887-1063	333-399	21.3-23.1	18.3-19.9	119-129	117-127
Very High	10	360 or more	180 or more	764 or more	400 or more	1064 or more	400 or more	23.2 or more	20 or more	130 or more	128 or more

Table 5.2 : Air Pollution Bandings and Index and the Impact on the health of People who are Sensitive to Air Pollution.

Banding	Index	Health Descriptor
Low	**1, 2, or 3**	Effects are unlikely to be noticed even by individuals who know they are sensitive to air pollutants
Moderate	**4, 5, or 6**	Mild effects, unlikely to require action, may be noticed amongst sensitive individuals.
High	**7, 8, or 9**	Significant effects may be noticed by sensitive individuals and action to avoid or reduce these effects may be needed (e.g. reducing exposure by spending less time in polluted areas outdoors). Asthmatics will find that their 'reliever' inhaler is likely to reverse the effects on the lung.
Very High	**10**	The effects on sensitive individuals described for 'High' levels of pollution may worsen

5.2. Components Selected .

5.2.1. Carbon Monoxide (CO):

is a colorless, odorless, poisonous gas. A product of incomplete burning of hydrocarbon-based fuels, carbon monoxide consists of a carbon atom and an oxygen atom linked together.

Carbon monoxide enters the bloodstream through the lungs and forms carboxyhemoglobin, a compound that inhibits the blood's capacity to carry oxygen to organs and tissues. Persons with heart disease are especially sensitive to carbon monoxide poisoning and may experience chest pain if they breathe the gas while exercising. Infants, elderly persons, and individuals with respiratory diseases are also particularly sensitive. Carbon monoxide can affect healthy individuals, impairing exercise capacity, visual perception, manual dexterity, learning functions, and ability to perform complex tasks

5.2.2. Sulfur Dioxide(SO_2):

Sulfur dioxide is a colorless gas with a characteristic, irritating, pungent odor. Sulfur dioxide is released when compounds containing sulfur, such as fossil fuels like coal are burned. Sulfur dioxide is a highly toxic gas which poisons its victims via inhalation through the lungs. SO_2 combines with water to form sulfuric acid (H_2SO_4). It is for this reason sulfur dioxide can burn the respiratory tract upon inhalation. High doses of sulfur dioxide can cause death quite rapidly.

5.2.3. Volatile Organic Compounds (VOCs):

Volatile organic compounds are compounds that have a high vapor pressure and low water solubility. Many VOCs are human-made chemicals that are used and produced in the manufacture of paints, pharmaceuticals, and refrigerants. VOCs typically are industrial solvents, such as trichloroethylene; fuel oxygenates, such as methyl tert-butyl ether (MTBE); or by-products produced by chlorination in water treatment, such as chloroform. VOCs are often components of petroleum fuels, hydraulic fluids, paint thinners, and dry cleaning agents. VOCs are common ground-water contaminants.

5.2.4. Oxides of Nitrogen(NO_x):

(NO_x)formation occurs from three fundamentally reactions and is released from the exhaust system. The first formation of fuel (NO_x) occurs from the evolution and reaction with oxygen of fuel –bound nitrogen compounds .natural gas has negligible chemically bound nitrogen in the fuel ,and essentially all (NO_x) formed is thermal (NO_x). Second formation from the maximum thermal (NO_x) production occurs with a slightly Lean fuel /air mixture ratio because of the excess availability of the oxygen reaction; control of fuel /air stoichiometry is critical in the achieving thermal NOx reductions.

The finally formation of (NO_x) from pre-mixing in lean burn engines is effective in suppressing (NO_x) relative to rich burn engines. The thermal (NO_x)

generation decrease rapidly as the temperature drops below the adiabatic temperature.

5.2.5. Particular Matter 10 microns or less(PM_{10}) :

The amount of PM_{10} generated from combustion engines and released via the exhaust system varies considerably . Liquid particular matter is generally categorized as white smoke and appears during a cold start ,idling or low load operation and occurs when the temperature within the quench layer is not high enough to promote ignition .Blue smoke is prevalent when there are oil leaks present and oil undergoes partial combustion in the cylinder . black smoke ,called soot is the most prevalent constituent of PM_{10} and is essentially carbon particles formed from oxygen deficiency in the cylinder.

5.3. Equation used for Estimated Emission .

5.3.1. Road Transport Vehicles .

For road transport vehicle pollutant emission theoretically estimations requires data concerning the vehicle type and distance travelled by the vehicle required inputs to estimate pollutant emissions.

The amount of emissions for each category can be calculated as:

$$E_{kpy,i} = L_Y \times EF_i$$

where:

$E_{kpy,i}$ = emission of pollutant i for aspecific type of engine ,kg/yr.

L_y = distance tarvelled in reporting year , km/yr .

EF_i = emission factor for pllutant i, for given engine and fuel type ,kg/km .

i = pollutant type .

The distance L_Y reflects the distance that a vehicle travels during the reporting year and it is determined from the vehicle odometer reading at the end of reporting period less the odometer reading at the start of the reporting period . Such data can be obtained from the vehicle log –books or maintenance records .

Table 5.3 emission factors for both petrol and diesel automotives measured in kg/km

Pollutant	Petrol(kg/km)	Diesel (kg/km)
CO	5.55E-03	3.52E-04
NOx	9.02E-04	3.43E-04
PM_{10}	1.80E-05	6.190E-05
SO_2	4.05E-05	3.63E-05
VOCs	6.76E-04	5.87E-05

Table 5.4 : Emission factors for road –transport vehicles – light goods vehicles (LGV).

Pollutant	Diesel (kg/km)
CO	7.78E-04
NOx	6.63E-04
PM_{10}	1.93E-04
SO_2	6.70E-05
VOCs	2.08E-04

Table 5.5: **Contain emission factor for the heavy Goods vehicle (HGV).**

Pollutant	Diesel (kg/km)
CO	7.78E-04
NOx	6.63E-04
PM_{10}	1.93E-04
SO_2	6.70E-05
VOCs	2.08E-04

Table5.6 : Contains total distance travelled 200m through Al Salam street and total amount of emission

Type	Transport Vehicle **(Gasoline)**	Transport Vehicle **(Diesel)**	Light goods Vehicle **(Diesel)**	Heavy Goods Vehicle **(Diesel)**	Total
#of cars per 1 hour	**262**	**626**	**107**	**56**	**1051**
#of cars per 1 year	**459024**	**1096752**	**187464**	**98112**	**1841352**
Amount of (CO)	**2547.58**	**386.0567**	**145.847**	**245.28**	**3823.482**
Amount of (NO_x)	**414.039**	**376.18594**	**119.2271**	**625.9546**	**1535.407**
Amount of (PM_{10})	**6.885**	**67.888949**	**36.18055**	**48.46733**	**183.3355**
Amount of (SO_2)	**18.590**	**39.812098**	**12.56009**	**16.87526**	**101.0136**
Amount of (VOCs)	**310.3002**	**64.379342**	**38.99251**	**201.1296**	**707.0219**

5.3.1.1. For Light Automobile:

Amount of carbon monoxide (CO) in gasoline engine:

$$E_{kpy,i} = L_Y * EF_i$$

$$E_{kpy,i} = 5.55E-05 * 459024 = 2547.5 \text{ (kg/year)}$$

Amount of carbon monoxide (CO) in diesel engine:

$$E_{CO,diesel} = L_Y * EF_i$$

$$E_{CO,diesel} = 3.52E-04 * 1096752 = 386.05 \text{ (kg/year)}$$

Amount of nitrogen oxide (NOx) in gasoline engine:

$$E_{NOX,gasoline} = L_Y * EF_i$$

$$E_{NOX,gasoline} = 9.02E-04 * 459024 = 414 \text{ (kg/year)}$$

Amount of nitrogen oxide (NOx) in diesel engine:

$$E_{CO,diesel} = L_Y * EF_i$$

$$E_{CO,diesel} = 3.43E-04 * 1096752 = 376.5 \text{ (kg/year)}$$

Amount of particular matter (PM_{10}) in gasoline engine:

$$E_{PM10,gasoline} = L_Y * EF_i$$

$$E_{PM10,gasoline} = 1.8E-05 * 459024 = 6.9 \text{ (kg/year)}$$

Amount of particular matter (PM_{10}) in diesel engine:

$$E_{PM10,diesel} = L_Y * EF_i$$
$$E_{PM10,diesel} = 6.19E-05*1096752 = 67.9 \text{ (kg/year)}$$

Amount of Sulphure dioxide (SO_2) in gasoline engine:

$$E_{SO2,gasoline} = L_Y * EF_i$$
$$E_{SO2,gasoline} = 4.05E-05*459024 = 18.6 \text{ (kg/year)}$$

Amount of Sulphure dioxide (SO_2) in diesel engine:

$$E_{SO2,diesel} = L_Y * EF_i$$
$$E_{SO2,diesel} = 3.63E-05*1096752 = 39.8 \text{ (kg/year)}$$

Amount of volatile organic compound (VOCs) in gasoline engine:

$$E_{VOCs,gasoline} = L_Y * EF_i$$
$$E_{SO2,gasoline} = 6.76E-04*459024 = 310.3 \text{ (kg/year)}$$

Amount of volatile organic compound (VOCs) in diesel engine:

$$E_{VOCs,diesel} = L_Y * EF_i$$
$$E_{VOCs,diesel} = 5.87E-05*1096752 = 64.4 \text{ (kg/year)}$$

5.3.1.2. For Diesel Light-Goods Vehicle (LGVs)

Amount of carbon monoxide (CO) in diesel engine:

$$E_{CO,diesel} = L_Y * EF_i$$
$$E_{CO,diesel} = 7.78E-04*187464 = 145.8 \text{ (kg/year)}$$

Amount of nitrogen oxide (NO_x) in diesel engine:

$$E_{CO,diesel} = L_Y * EF_i$$
$$E_{CO,diesel} = 187464*6.63E-04 = 119.2 \text{(kg/year)}$$

Amount of particular matter (PM_{10}) in diesel engine:

$$E_{PM10,diesel} = L_Y * EF_i$$
$$E_{PM10,diesel} = 187464 * 1.93E-04 = 36.2 \text{ (kg/year)}$$

Amount of Sulphure dioxide (SO_2) in diesel engine:

$$E_{SO2,diesel} = L_Y * EF_i$$
$$E_{SO2,diesel} = 187464 * 6.7E-05 = 12.5 \text{ (kg/year)}$$

Amount of of volatile organic compound (VOCs) in diesel engine:

$$E_{VOCs,diesel} = L_Y * EF_i$$
$$E_{VOCs,diesel} = 187464 * 2.08E-04 = 38.9 \text{ (kg/year)}$$

5.3.1.3. Diesel Heavy Goods Vehicle (HGVs):

Amount of carbon monoxide (CO) in diesel engine:

$$E_{CO,diesel} = L_Y * EF_i$$
$$E_{CO,diesel} = 98112 * 2.5E-03 = 245.3 \text{(kg/year)}$$

Amount of nitrogen oxide (NO_x) in diesel engine:

$$E_{CO,diesel} = L_Y * EF_i$$
$$E_{CO,diesel} = 98112 * 6.38E-03 = 626 \text{(kg/year)}$$

Amount of particular matter (PM_{10}) in diesel engine:

$$E_{PM10,diesel} = L_Y * EF_i$$
$$E_{PM10,diesel} = 98112 * 4.94E-04 = 48.5 \text{ (kg/year)}$$

Amount of Sulphure dioxide (SO_2) in diesel engine:

$$E_{SO2,diesel} = L_Y * EF_i$$
$$E_{SO2,diesel} = 98112 * 1.72E-04 = 17 \text{ (kg/year)}$$

Amount of of volatile organic compound (VOCs) in diesel engine:

$$E_{VOCs,diesel} = L_Y * EF_i$$
$$E_{VOCs,diesel} = 98112 * 2.05E-03 = 201 \text{ (kg/year)}$$

Summing up of all calculated emission components from all automotive surveyed at AL-Salam main road produces the following:

Total Amount of carbon monoxide (CO)

$$TotalCO = CO(\text{fromsamllcar}) + \text{CO(fromLVGS)} + \text{CO(fromHGVs)}$$

$$TotalCO = 3657 kg / year$$

Total Amount of nitrogen oxide (NO_x)

$$Total\ NOx = NOx\,(\text{from samll car}) + \text{N}Ox(\text{from LGVs}) + \text{N}Ox\,(\text{from HGVs})$$

$$Total\ N\text{Ox} = 1689\, kg / year$$

Total Amount of particular matter (PM_{10})

$$Total\ \text{PM}_{10} = \text{PM}_{10}\ (\text{from samll car}) + \text{PM}_{10}(\text{from LGVs}) + \text{PM}_{10}\ (\text{from HGVs})$$

$$Total\ \text{PM}_{10} = 175.3\, kg / year$$

Total Amount of Sulphure dioxide (SO_2):

$$Total\ \text{SO2} = \text{SO2}(\text{from samll car}) + \text{SO2}(\text{from LGVs}) + \text{SO2}\,(\text{from HGVs})$$

$$Total\ \text{SO2} = 96.6\, kg / year$$

Total Amount of volatile organic compound (VOCs):

$$Total\ \text{VOCs} = \text{VOCs}\ (\text{from samll car}) + \text{VOCs(fromLGVs)} + \text{VOCs(fromHGVs)}$$

$$Total\ \text{VOCs} = 676.3 kg / year$$

It is required to convert results to gram/m^3.hr units as it is a regularly used unit, hence.

(g/m^3.hr) =

$$\frac{\text{kg}}{\text{year}} * \frac{1000\text{g}}{\text{kg}} * \frac{1\text{year}}{365\,\text{day}} * \frac{1}{21000\,\text{m}^3} * \frac{\text{day}}{24\,\text{hr}} = 5.436 * 10^{-6} * (kg / year)$$

Amount of carbon monoxide (CO) in [g/m^3 .hr]:

$$\text{Total CO} = 5.436E-06*3657*1000 = 2018 \ (mg/m^3)$$

Amount of nitrogen oxide (NOx) in [g/m3 .hr]:

$$\text{Total NOx} = 5.436E-06*3657*1000000 = 8346 \ (\mu g/m^3)$$

Amount of particular matter (PM_{10}) in [g/m3 .hr]:

$$\text{Total } PM_{10} = 5.436E-06*183.3*1000000 = 997 \ (\mu g/m^3)$$

Amount of Sulphure dioxide (SO_2):

$$\text{Total SO2} = 5.436E-06*183.3*1000000 = 997 \ (\mu g/m^3)$$

Amount of volatile organic compound (VOCs):

$$\text{Total VOCs} = 5.436E-06*707*1000000 = 384.3 \ (\mu g/m^3)$$

By comparing the resulted theoretical outputs to the standards ranges shown in Table 5.1, there is a clear indication that the traffic induced emissions at Al-Salam main road are several times higher than that acceptable rage. This is of course need to be assessed through a real measurement campaign and a possible emission dispersion scenarios which is going to be implemented in the next semester.

Chapter Six

Traffic Emission Measurement and Analysis

6.1 Introduction.

6.2 Targeted Area.

6.3 Methodology.

6.4 Main Findings.

6.4.1 Emission Measurement**.**

6.4 Dispersion of Emission.

6.6 Conclusions.

6.1 Introduction.

The assessment of traffic emission could be done theoretically but more precisely it could be attained by conducting in-situ measurements for the possibly emitted exhaust gases thus having credible figures that reflect the specific area, e.g. a road.

In the following, a measurement campaign for an identified traffic dense main street will be presented. In addition to the survey on transportation flow in rush hours, few important gas emissions were measured, analyzed. The environment of the area, i.e. wind speed and direction, temperature and humidity were also measured. Combining the readings of emission and environmental settings, pollutants dispersion scenario was also suggested.

6.2 Targeted Area

Hebron is the largest populated city in the West Bank. It is also highly densed with traffic which intensifies in it center with ground transportation of different types; i.e. light private and commercial to heavy transportation. The selection was based on identifying a main road or street that is characterized with heavy traffic The research done previously in 2010x (Reference, 2010) has been implemented on Al-Salam main street and in particular the Sebta street junction as it is a junction where two main street canyons with buildings from both sides are presented. The research outputs showed that traffic emissions were high in terms of carbon monoxide and nitrogen dioxide. The date when such research has been conducted showed that the highest percentage of transportations surveyed were those relatively old made. Nowadays Hebron area is witnessing favoring new transportation means (passenger cars, light and heavy vehicles, etc) over old ones. This in turn should play a major role in decreasing possible emissions.

For the reasons mentioned above Al Salam main street area was chosen. The street itself links northern and southern parts of Hebron city and it hosts huge number of commercial buildings residential, some industrial premises, kindergarten and schools in addition to being the major link to the industrial zone in the south.

At Sebta junction (see Figure 6.1), four return lanes links south-north and west – east. These are:

- Al-Gorah lane to north.
- Al-Hawooz lane to south
- Bab Al-Zawieh lane to west
- Al-Galadeh lane to east.

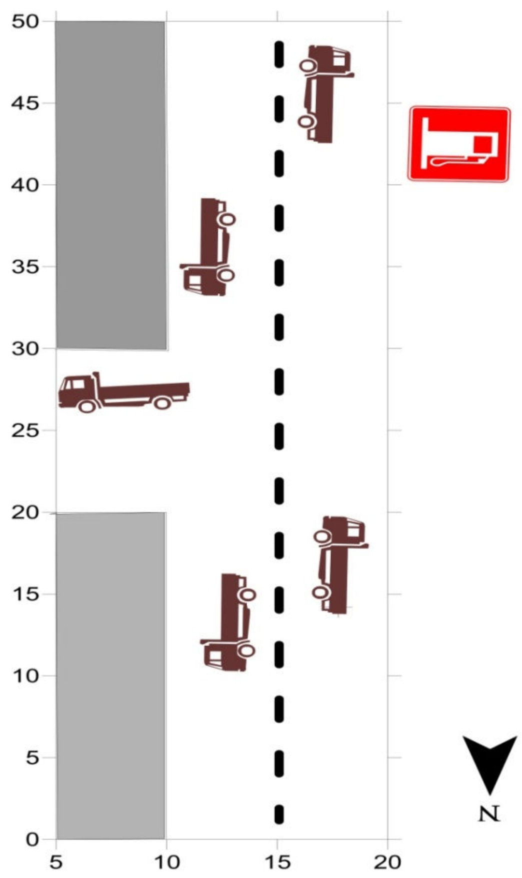


Figure 6.1: Sebta Junction

6.3 Methodology.

In order to assess the traffic density in terms of quantity and types, an onsite survey where conducted. The survey was done over 7 days constituting one week. This was done to identify the number and types of the transportation means and assess how modern are the traffic. In addition the onsite survey, a measurement campaign was designed to measure three major emissions. Three of which are the regular exhaust emissions including carbon mono and dioxides, nitrogen dioxide and the third emission is the hydrogen cyanide, a gas possibly emitted from burning diesel fuel with other hydrocarbon additives.

Measurements are done using the measuring instrument of the laboratory of air pollution of the renewable energy and environment research unit (REERU) at PPU. Measurements were done over seven successive days over two hours (12:00 – 14:00) around noondays which is the identified as the rush hour time.

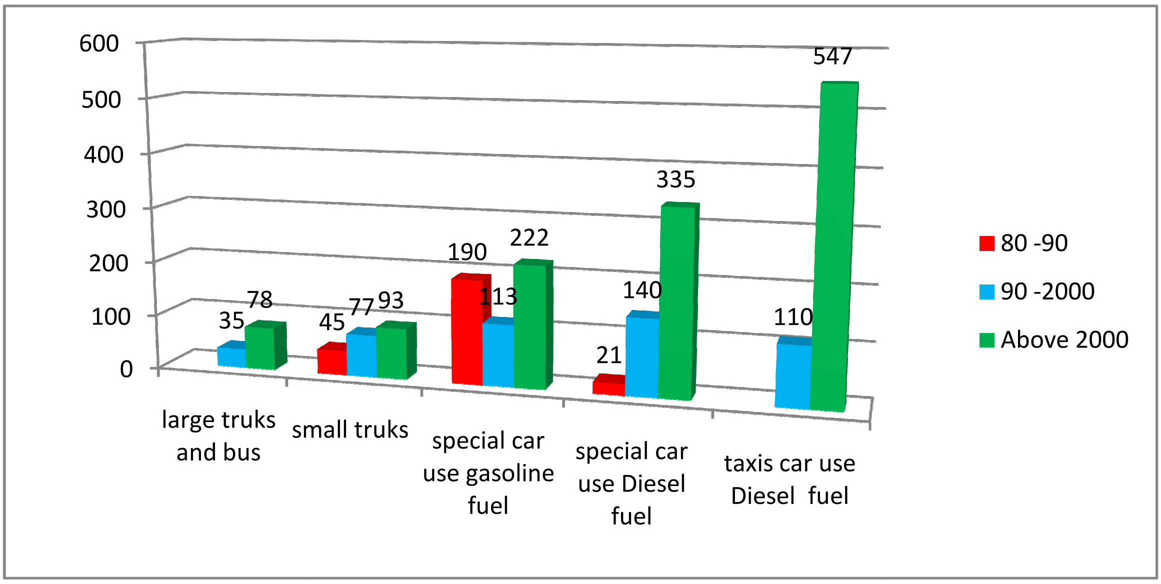
It is worth mentioning

6.4 Main Findings.

The traffic weekly density is averaged in table 6.1 below. The table shows also the type of transportation means and how modern each type is, where old models are those of prior to 1990 made vehicles, and modern ones are those during 1990-2000 and those new are made after 2000. It was found that the traffic density is high with more than 2000 vehicle passing over a two hours period. More than 33% of the flowing traffic are public transportations (Taxis), whereas 16% are light and heavy trucks and the rest are domestic vehicles. The interesting outcomes came from the fact that some 84% of the public transportations are new ones. This may reflect a "flourishing" business or it may reflect the facilities that the Palestinian Authority has provided for that sector. However, it should be pointed out here that domestic vehicles and light and heavy trucks favor modern and new models.

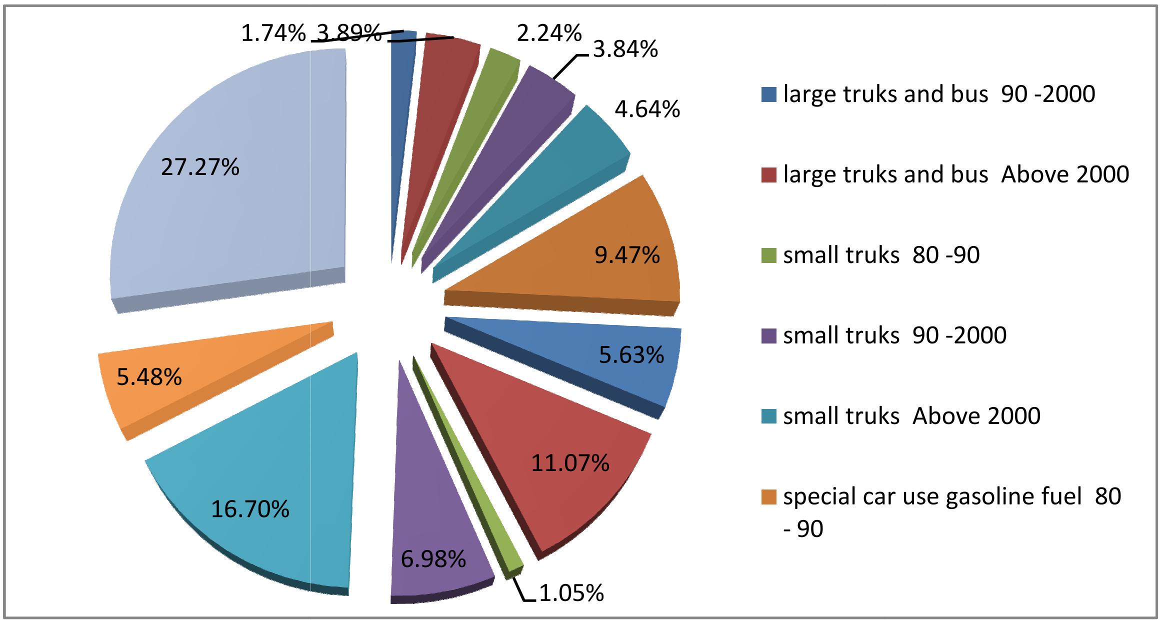
Table(6.1):Average number of vehicle and type for 7th day

Type	model		
	80 -90	90 -2000	Above 2000
Heavy trucks and buses	0	35	78
Light Trucks	45	77	93
Domestic Gasoline Vehicles	190	113	222
Domestic Gasoline Vehicles	21	140	335
Public transportation Vehicles	0	110	547



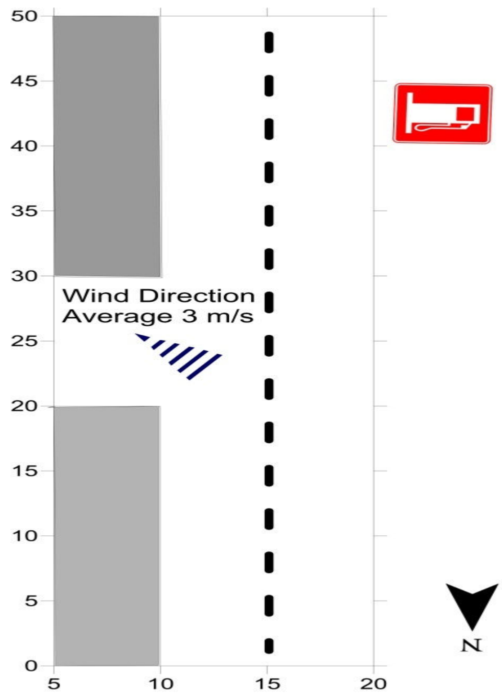
Figure(6.2):Diagram for type and number of vehicle.

Also been the representation of these values are also in the form of a percentage in the following figure in next page.



Figure(6.3):Diagram for type and number of vehicle in percentage (mean value for 7th days)

For the assessment of the emission dispersion, the wind speed and direction was measured in different places and found to be a calm wind with an average value of (3m/s) and southwest directed wind (See Figure 6.4)



Figure(6.4):Wind speed and direction

6.4.1 Emission Measurement

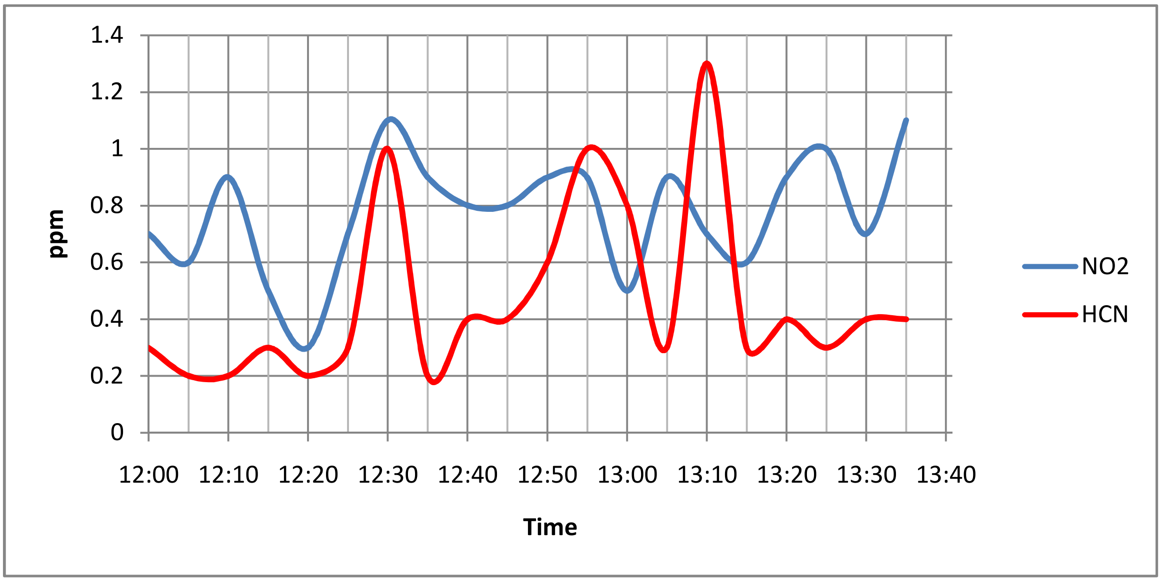
An area of 1250 m^2 were covered in the emission measurement extended over the north-west to eact-south of the Sebta junction. Measurements were done using the measuring instrument calibrated and set to measure emission values of: CO, CO2, NO2 and HCN.

Each measured value was commenced over five minutes with time interval of one minute each and an average value was calculated over the time. In Table(6.2 , 6.3, 6.4 ,6.5 ,6.6) are the results tabulated.

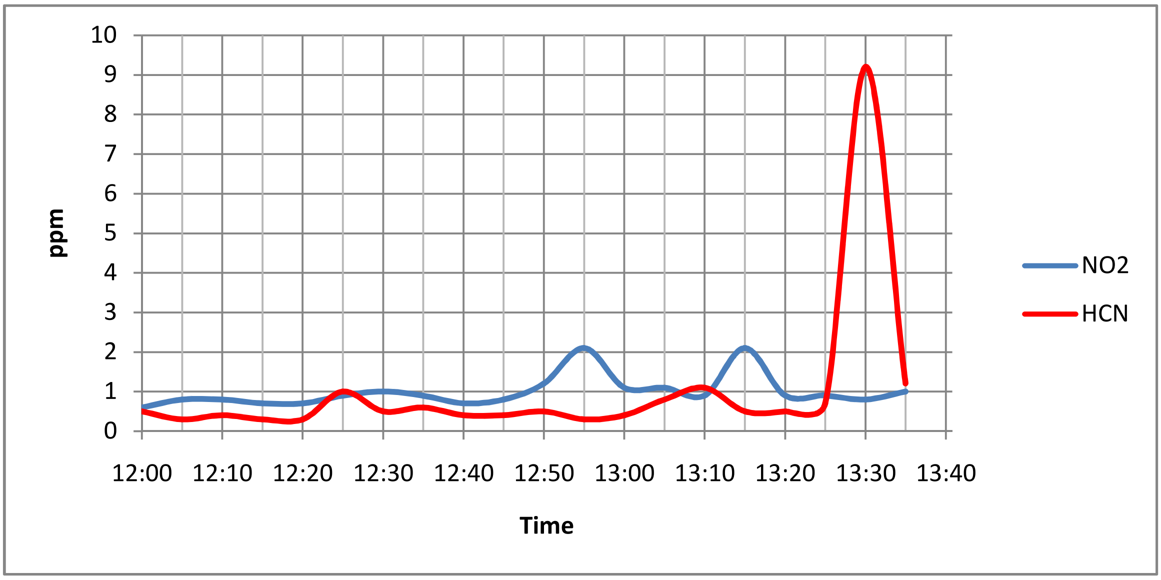
Table (6.2) Measurement data for 1st &2nd day

Time	NO_2 (ppm)	HCN (ppm)	NO_2 (ppm)	HCN (ppm)
12:00	1	0.2	1	0.3
12:05	1	0.3	1	0.2
12:10	1.1	0.2	1.1	0.2
12:15	1	0.2	15.1	0.7
12:20	0.9	0.3	1	0.6
12:25	1	0.4	1.4	0.5
12:30	3.2	0.3	1.4	0.6
12:35	1.1	0.3	1.2	0.4
12:40	0.7	0.5	1.5	2.6
12:45	1.1	0.3	1.4	0.4
12:50	0.9	0.3	1.3	0.9
12:55	1	0.2	1.4	0.4
13:00	1.3	0.2	1.4	0.3
13:05	1.2	0.4	1.3	0.6
13:10	0.9	0.7	1.4	1.1
13:15	0.8	0.3	1.4	2.5
13:20	1.1	0.3	1.3	0.7
13:25	1	0.3	1.4	0.4
13:30	1.1	0.5	2	0.3
13:35	1.2	0.5	1.4	0.4

Figures (6.5, 6.6…..etc) are the course of each measured value over the successive measuring days and around noon hours.



Figure(6.5):Curves of NO2 &HCN for 1st day

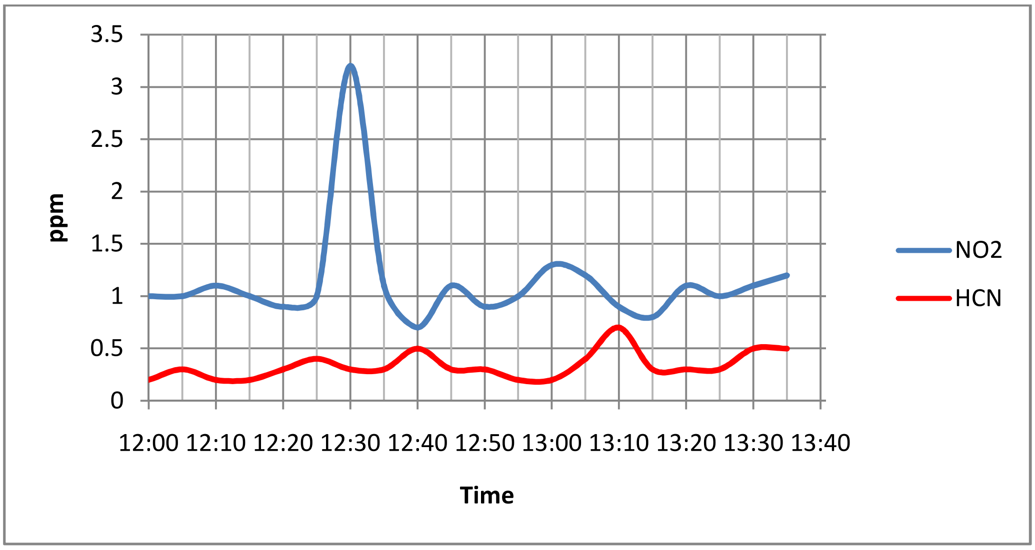


Figure(6.6):Curves of NO2 &HCN for 2nd day

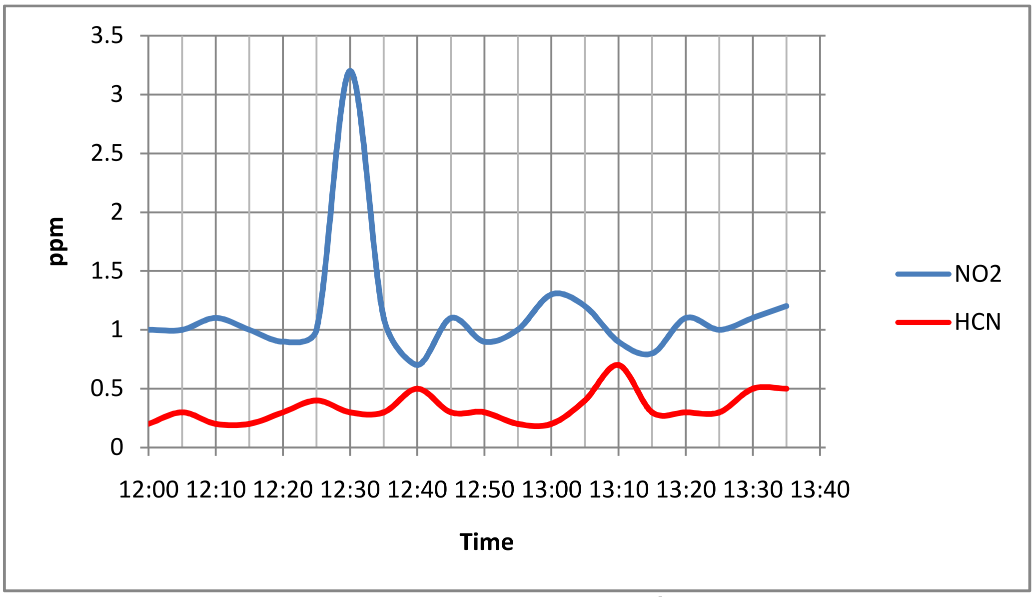
The following table shows the values of the gases have been measured.

Table (6.3) Measurement data for 3rd &4th days

Time	3rd day		4th day	
	NO_2 (ppm)	HCN (ppm)	NO_2 (ppm)	HCN (ppm)
12:00	0.6	0.2	1	0.3
12:05	0.8	0.3	1	0.2
12:10	0.8	0.2	1.1	0.2
12:15	0.7	0.2	15.1	0.7
12:20	0.7	0.3	1	0.6
12:25	0.9	0.4	1.4	0.5
12:30	1	0.3	1.4	0.6
12:35	0.9	0.3	1.2	0.4
12:40	0.7	0.5	1.5	2.6
12:45	0.8	0.3	1.4	0.4
12:50	1.2	0.3	1.3	0.9
12:55	2.1	0.2	1.4	0.4
13:00	1.1	0.2	1.4	0.3
13:05	1.1	0.4	1.3	0.6
13:10	0.9	0.7	1.4	1.1
13:15	2.1	0.3	1.4	2.5
13:20	0.9	0.3	1.3	0.7
13:25	0.9	0.3	1.4	0.4
13:30	0.8	0.5	2	0.3
13:35	1	0.5	1.4	0.4



Figure(6.7):Curves of NO2 &HCN for 3rdday

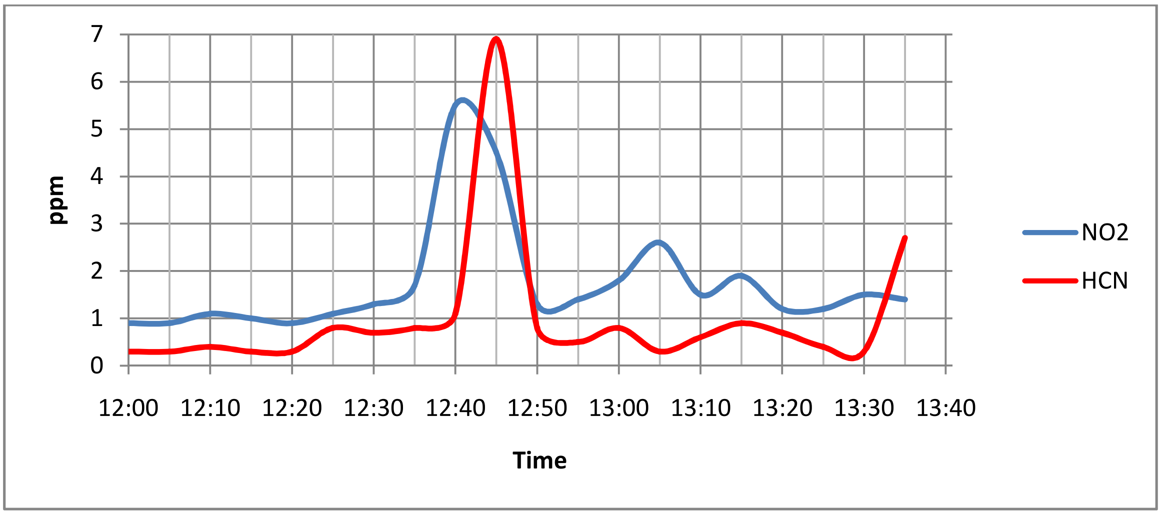


Figure(6.8):Curves of NO2 &HCN for 4thday

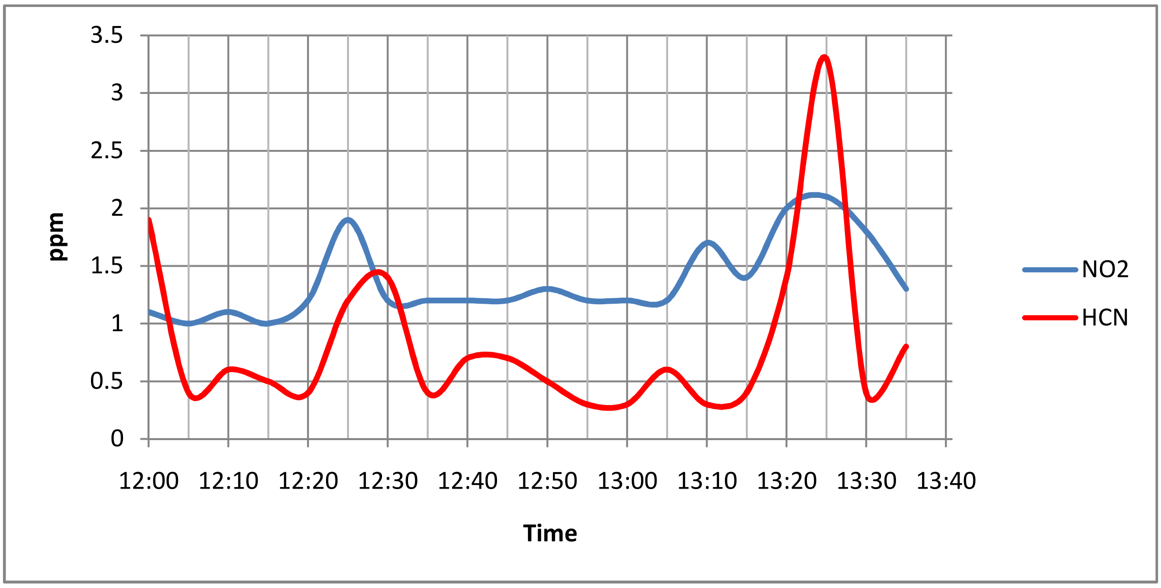
Table (6.4) Measurement data for 5th &6th days

Time	5th day		6th day	
	NO_2 (ppm)	HCN (ppm)	NO_2 (ppm)	HCN (ppm)
12:00	0.9	0.3	1.1	1.9
12:05	0.9	0.3	1	0.4
12:10	1.1	0.4	1.1	0.6
12:15	1	0.3	1	0.5
12:20	0.9	0.3	1.2	0.4
12:25	1.1	0.8	1.9	1.2
12:30	1.3	0.7	1.2	1.4
12:35	1.7	0.8	1.2	0.4
12:40	5.5	1.1	1.2	0.7
12:45	4.5	6.9	1.2	0.7
12:50	1.3	0.8	1.3	0.5
12:55	1.4	0.5	1.2	0.3
13:00	1.8	0.8	1.2	0.3
13:05	2.6	0.3	1.2	0.6
13:10	1.5	0.6	1.7	0.3
13:15	1.9	0.9	1.4	0.4
13:20	1.2	0.7	2	1.4
13:25	1.2	0.4	2.1	3.3
13:30	1.5	0.3	1.8	0.4
13:35	1.4	2.7	1.3	0.8

This data is plotted in the form of curve as shown in the following figures.



Figure(6.9):Curves of NO2 &HCN for 5th day



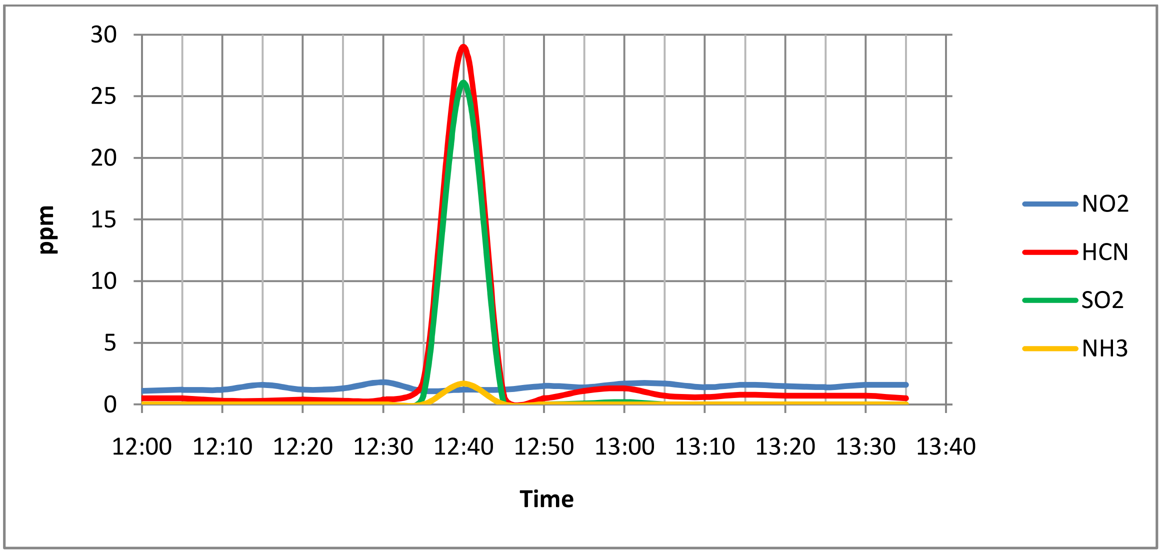
Figure(6.10):Curves of NO2 &HCN for 6th day

This table to the last day to take measurements is the seventh day.

Table (6.5) Measurement data for 7th day

Time	7th day	
	NO_2 (ppm)	HCN (ppm)
12:00	1.1	0.5
12:05	1.2	0.5
12:10	1.2	0.3
12:15	1.6	0.3
12:20	1.2	0.4
12:25	1.3	0.3
12:30	1.8	0.4
12:35	1.1	1.9
12:40	1.2	29
12:45	1.2	0.7
12:50	1.5	0.5
12:55	1.4	1.1
13:00	1.7	1.3
13:05	1.7	0.7
13:10	1.4	0.6
13:15	1.6	0.8
13:20	1.5	0.7
13:25	1.4	0.7
13:30	1.6	0.7
13:35	1.6	0.5

This data is plotted in the form of curve as shown in the following figure.



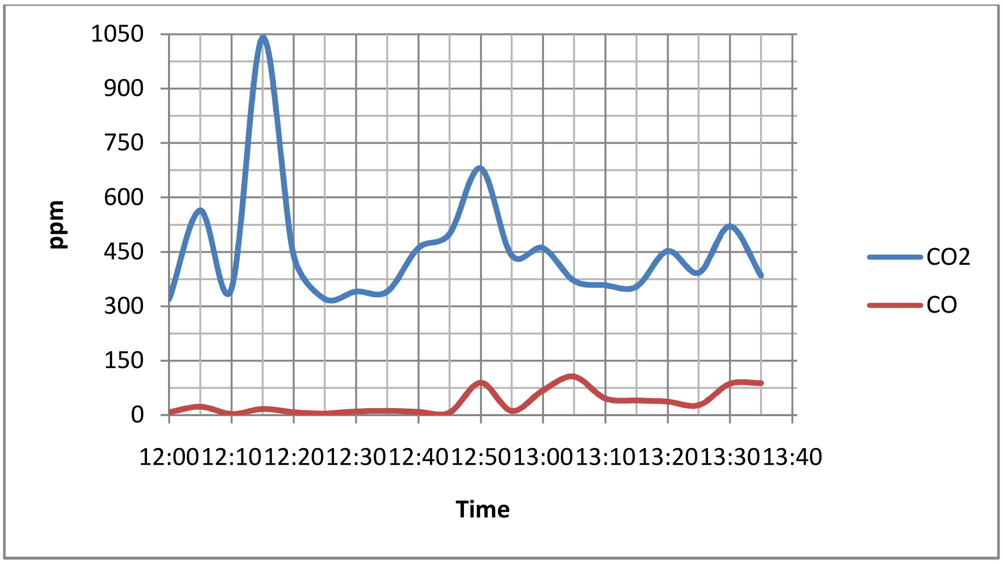
Figure(6.11):curves of NO2 &HCN for 7th day

The following table shows the average value of measurements of gases CO and CO_2

Table (6.6) average data for 7th days for CO &CO2

time	CO2 (ppm)	CO (ppm)
12:00	320	8
12:05	564	23
12:10	346	3
12:15	1040	17
12:20	440	8
12:25	320	4
12:30	340	10
12:35	340	11
12:40	460	9
12:45	500	7
12:50	680	89
12:55	440	11
13:00	460	68
13:05	370	106
13:10	358	46
13:15	354	40
13:20	452	37
13:25	392	27
13:30	520	86
13:35	384	88

This data is plotted in the form of curve as shown in the following figure.



Figure(6.12):Curves of CO2 &CO for 7th day(mean value)

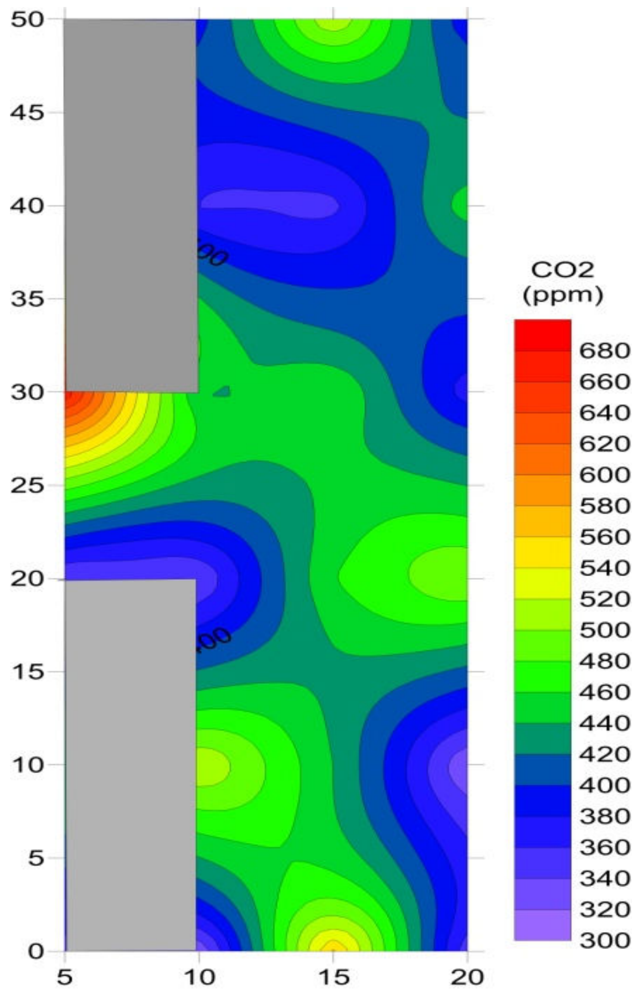
It could be seen that HCN traces were found in the measurements with high concentrations exceeding the 0.3 ppm identified threshold. This gas is highly toxic and could lead if inhaled by human being regularly will lead to serious health problems. The gas emitted when adding additives to the fuels and in particular to diesel fuel. This could indicate that no specific monitoring by the authorized department on gas filling station is done.

Other emission and although relatively high but showed very minor reduction compared to those done in (Reference ---Graduation project previously done). This is may indicate that the increase in modern and new vehicles over old ones did not bring much improvement to the situation and that this could be due to the type of fuel additives used and the lifestyle of those vehicle owners regarding the frequent maintenance of their vehicles.

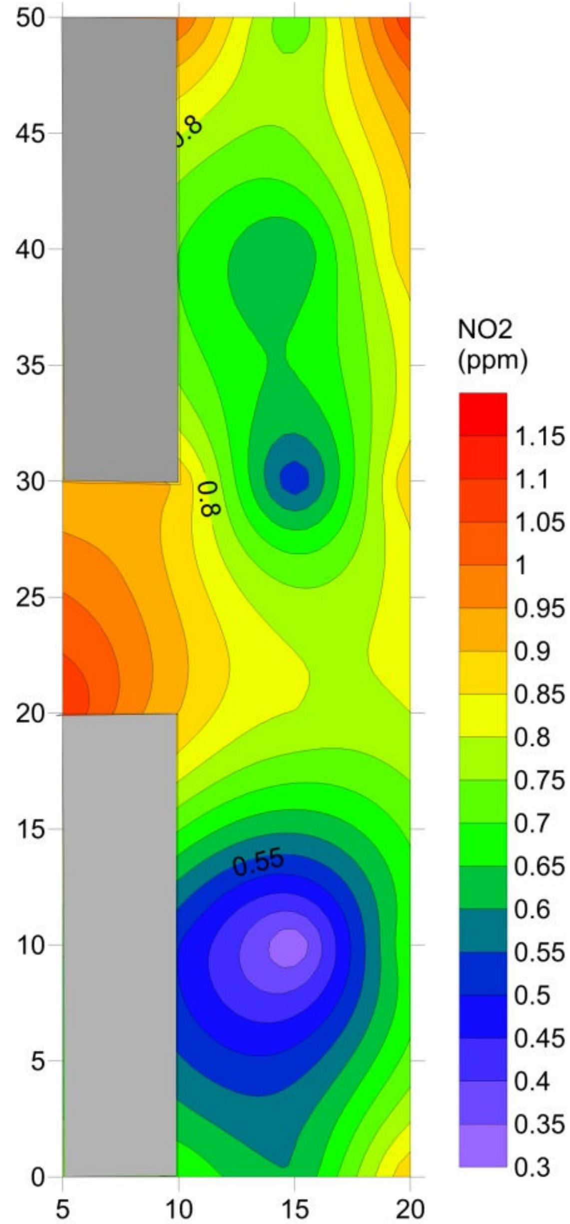
6.5 Dispersion of Emissions

The figures (6.13, 6.14 ,..etc)show the dispersion of emitted gases. It could be seen that the effect of calm wind on the dispersion of all three gases are not much seen as wind of almost 10km/hour will not provide the needed "clean" mechanism and hence gases disperse by the effect of moving transportation tends to concentrate on the pavement thus intensifying the possible adverse effect on the public health and in particular to those residing in the shops and houses there.

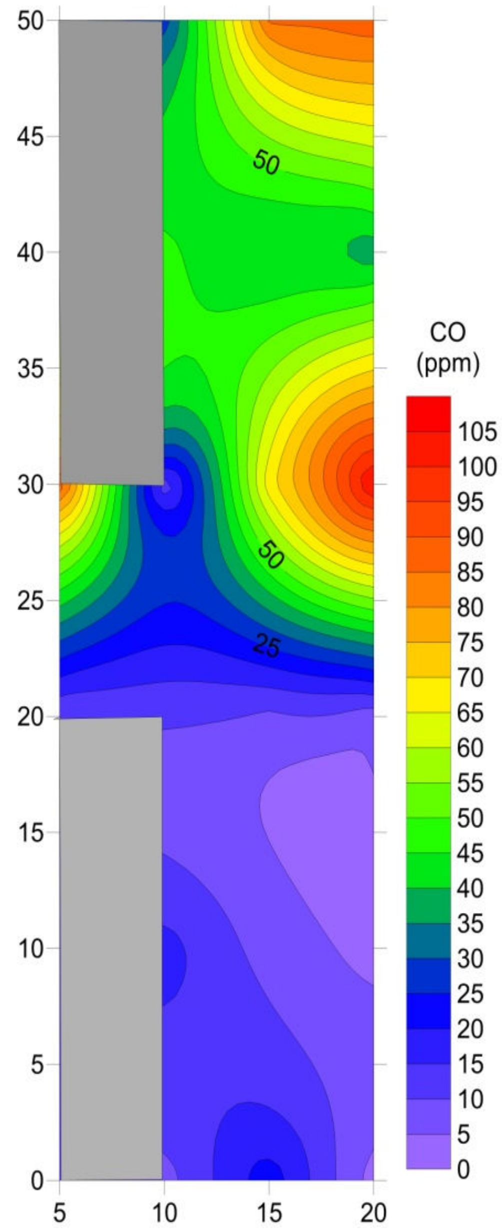
We did a simulation of the dispersion of gases in the search area as in the following figures.



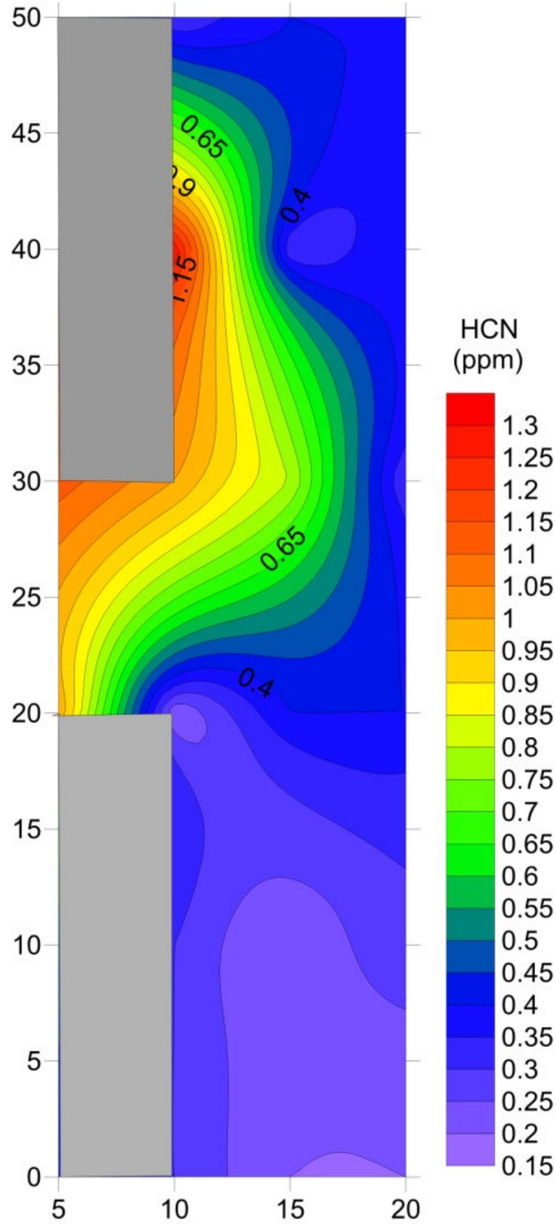
Figure(6.13):Dispersion of CO_2 in sebta junction



Figure(6.14):Dispersion of NO_2 in sebta junction



Figure(6.15):Dispersion of CO in sebta junction



Figure(6.16):Dispersion of HCN in sebta junction

6.6 Conclusions:

The research done showed that Al-Salam street; although populated with domestic, commercial and some industrial buildings, is a major dense street with all ground transportation means. Comparing the results of the emissions done recently with those done three years ago showed that not much improvement have been attained although modern and new vehicles are more compared to the past situation. This may lead to a conclusion that the fuel types and additives are decisive is the emission potential and in addition the maintenance of transportation means is not frequently done properly.

One of the main findings showed high concentration trance of hydrogen cyanide HCN with values above the accepted thresholds. This is a serious problem that should be talked by the authority as such emission adversely affect the human health.

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