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Estimation of Emitted vehicles Emissions in Palestine

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Abstract

Air pollution is one of the most important problems facing our societies, through the increasing of pollution sources, and it causes many problems and diseases for humans, animals and plants. Vehicles are considered to be the most important source of pollution due to their increasing numbers and there is no specific emission standards,The pollutant such as Carbon monoxide (CO), Nitrogen Oxides (NOx), Particulate Matters (PM),HydroCarbons (HC),Volatile Organic Compounds (VOCs) and sulphur dioxide (SO_2) and this emission cause many problems like acid rain, health hazards and destroy the Ozone .

In this project study was made about the traffic emissions estimated in West Bank relying on the emission factors as input together with vehicle types, annual traveled distance, etc.,The amount of pollution was large because air pollution is growing with increasing number of vehicles and with absence of the censorship a large quantity of air pollution resurrect in air,this indanger the environment.

Key words: Vehicle emission, emission factors, emission estimation.

إن تلوث الهواء من أهم المشاكل التي تواجه مجتمعاتنا ، لأنها تسبب العديد من المشاكل والأمراض على مستوى الأنسان والحيوان والنبات , وتعتبر المركبات من أهم مصادر التلوث بسبب تزايد أعدادها وأيضا عدم وجود معايير محددة للانبعاثات , حيث أن هذه الإنبعاثات بأنواعها المختلفة (أول أكسيد الكربون وأكاسيد النيتروجين والهيدروكربونات وثاني أكسيد الكبريت والمركبات العضوية المتطايرة) تسبب العديد من المشاكل مثل الأمطار الحمضية وتدمير الغلاف الجوي وغيرها .

في هذا المشروع يتم تقدير كمية الانبعاثات المرورية في الضفة الغربية بالاعتماد على نوع المركبة وأيضا المسافة السنوية المقطوعة , كمية هذه الانبعاثات سوف تكون كبيرة وذلك بسبب التزايد الكبير في أعداد المركبات وأيضا غياب الرقابة .

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CHAPTER ONE

Introduction

1.1: Emissions

The exhaust of automobiles is one of the major contributors to the world's air pollution problem. Recent research and development has made major reductions in engine emissions, but a growing population and a greater number of automobiles mean that the problem will exist for many years to overcome.

The common exhaust emitted from engine are Carbon dioxide, Carbon monoxide, lead, Nitrogen oxide, Hydrocarbons, this coming as a result of burning fuel in the combustion chamber.

1.2: Vehicle Population

From 1980, the annual growth rate of the global vehicle population has been about 3%, while in some developing countries this rate is much greater. For example, in China the annual increase in vehicle population has been up to 15% in recent years. In 1960 the more developed countries accounted for nearly all of the world's vehicles. Today, the number of vehicles in developing countries has grown to nearly 30% of the world total. The number of vehicles in the world is expected to reach 1.1 billion in 2020, with developing countries accounting for 44% of the total. However, the number of vehicles per driving age population in developing countries is currently well below the 954 vehicles per 1000 in more developed nations. According to projections, these ratios will remain largely unchanged in 2020 [1].

1.3: Combustion

Combustion in a reciprocating internal combustion engine is initiated at some point towards the end of the compression stroke, and ends during the expansion stroke, when most of the fuel has been oxidized. It is the combustion, i.e. the conversion of reactants into products and chemical energy into thermal energy. The Figure below shows the combustion components and combustion product for gasoline engine and diesel engine.

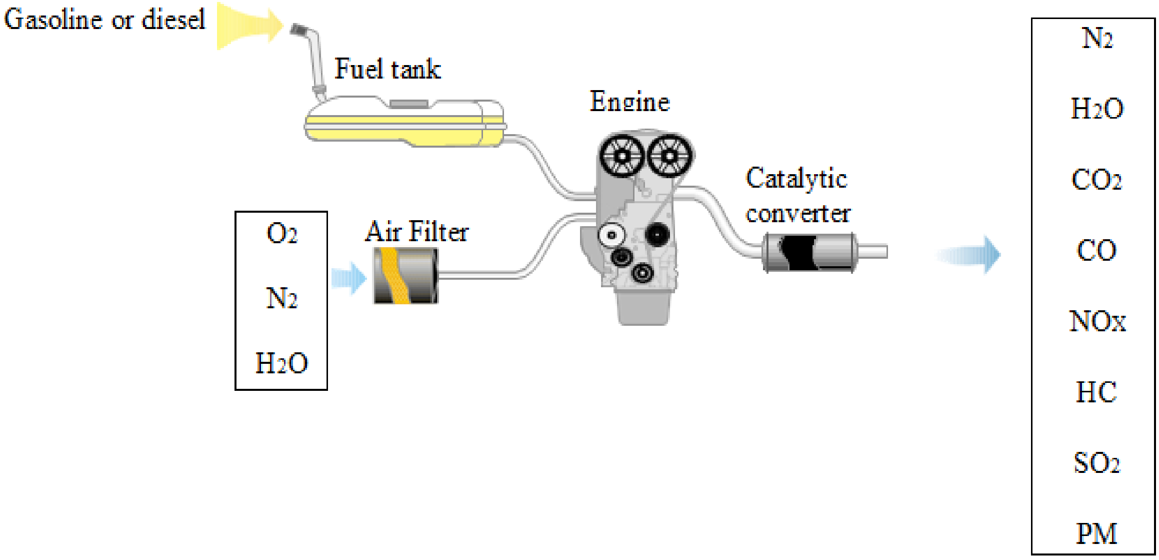

Figure 1.1: Combustion components and combustion product [2]

1.4: Sources of Auto Emissions

The major causes of emissions in internal combustion engine are non-stoichiometric combustion, dissociation of CO_2, NO_2 and impurities in the fuel and the control of combustion process.

The power to move a car comes from burning fuel in an engine. Pollution from cars comes from by-products of this combustion process (exhaust) and from evaporation of the fuel itself, the figure below show the sources of auto emissions.

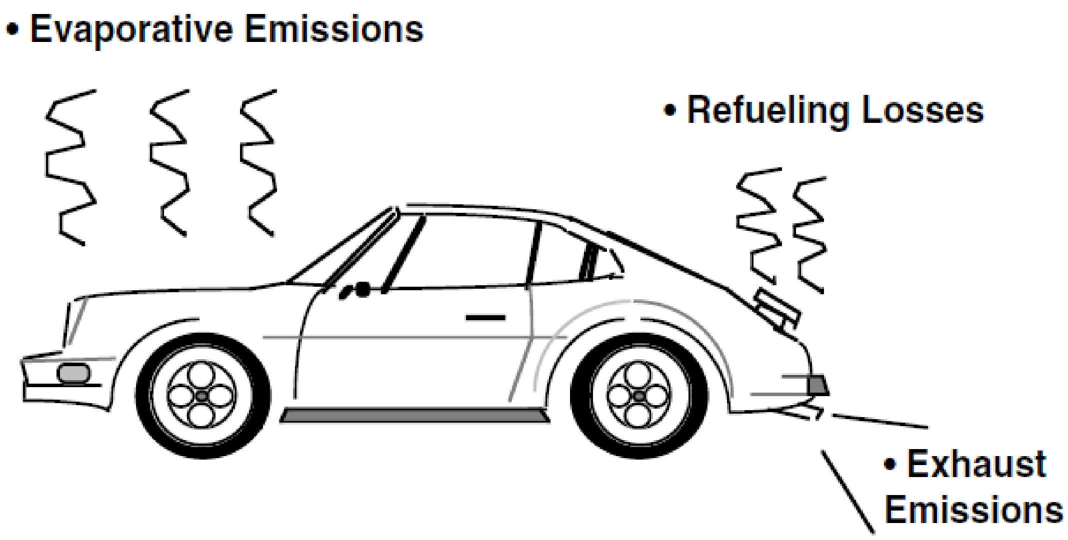

Figure 1.2: Sources of auto emissions

1.4.1: Exhaust Emission

An internal combustion engine produces the following exhaust components:

1-Nitrogen (N_2):

Nitrogen gas is non-flammable, colorless and odorless, and makes up 78% of the air we breathe. While most of the Nitrogen drawn into the combustion chamber during the intake stroke is expelled during the exhaust stroke, a small portion of the nitrogen can combine with Oxygen (O_2) to form oxides of Nitrogen (NO_x).

Figure 1.3: Chemical Structure of Nitrogen [2]

2-Oxygen:

Oxygen (O_2) gas is colorless, odorless, and tasteless it comprises 21% of the air we breathe.

Figure 1.4: Chemical structure of Oxygen [2]

3-Water (H_2O):

Water may be present in the combustion chamber in either gaseous (due to atmospheric humidity) or liquid (via the fuel injectors when low quality fuel is used) forms. Water is a normal by-product of combustion.

Figure 1.5: Chemical structure of water [2]

4-Carbon Dioxide (CO_2):

Carbon dioxide gas is colorless and non- flammable, and is a by-product of the combustion process. Carbon dioxide traps a portion of this outgoing energy, retaining heat. The higher the concentration of Carbon dioxide released into the atmosphere, the greater the impact on the world's climate. The emissions of Carbon dioxide (CO_2), however, are directly proportional to fuel consumption.

Figure 1.6: Chemical structure of Carbon dioxide [2]

5-Carbon Monoxide (CO):

Carbon monoxide is a colorless, odorless, tasteless, and extremely toxic gas produced by the incomplete combustion of intake components containing carbon. When released into the open, carbon monoxide quickly oxidizes to form carbon dioxide. In very small concentrations, carbon monoxide can cause respiratory problems and impair visual perception, manual dexterity and learning function. In slightly greater concentrations, it can be lethal.

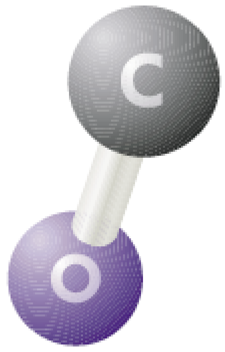

Figure 1.7: Chemical structure of Carbon monoxide [2]

6-Oxides of Nitrogen (NO_x):

Oxides of Nitrogen are compounds of Nitrogen (N_2) and Oxygen (O_2) (e.g. NO, NO_2, N_2O, etc.). Oxides of Nitrogen are produced by high pressure, high temperature, and a surplus of Oxygen in the engine during the combustion cycle. Several Oxides of Nitrogen are harmful to health. Action taken to reduce fuel consumption has, unfortunately, often led to a rise in Nitrogen Oxide concentrations in exhaust emissions. This is because a more efficient Combustion process generates higher temperatures.

Figure 1.8: Chemical structure of (NOx) [2]

7-Hydrocarbons (HC):

Hydrocarbons are unburned fuel components which occur in the exhaust emissions after incomplete combustion. Hydrocarbons occur in a variety of forms, including C_6H_6 (Benzene) and C_8H_{18} (Octane). Each has different effects on humans; some irritate sensory organs, while others, such as Benzene, are cancer causing.

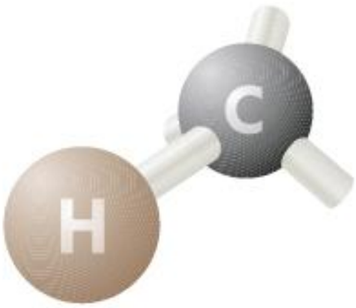

Figure 1.9: Chemical structure of Hydrocarbons [2]

8-Sulphur Dioxide (SO_2):

Sulphur dioxide gas is colorless, pungent and non-flammable. It is present in very low concentrations in exhaust gases, and can cause respiratory illness. Sulphur dioxide emissions can only be reduced by lowering the Sulphur content of fuel [2].

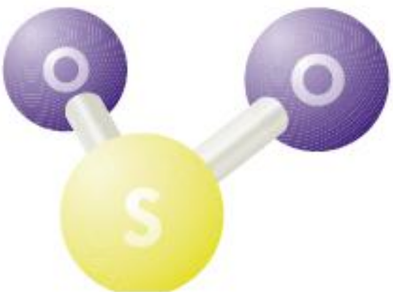

Figure 1.10: Chemical structure of Sulphurdioxide [2]

9-Lead (Pb):

Lead is extremely toxic and was once used in gasoline to prevent knock. In 1985, 3000 tons of leads were released into the atmosphere. Today’s gasoline's substitute environmentally friendly additives in place of lead [2].

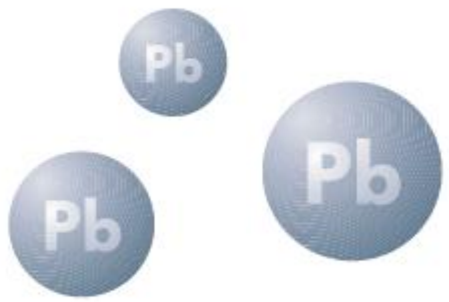

Figure 1.11: Chemical structure of lead [2]

10-Particulate Matter (PM)

Particulate Matter is mainly produced by diesel engines. It consists of a core and several attached components. One of the attached components, Hydrocarbons, are oxidized in the catalytic converter. The remainder of the particulate matter can only be collected by specialized particulate filters [2].

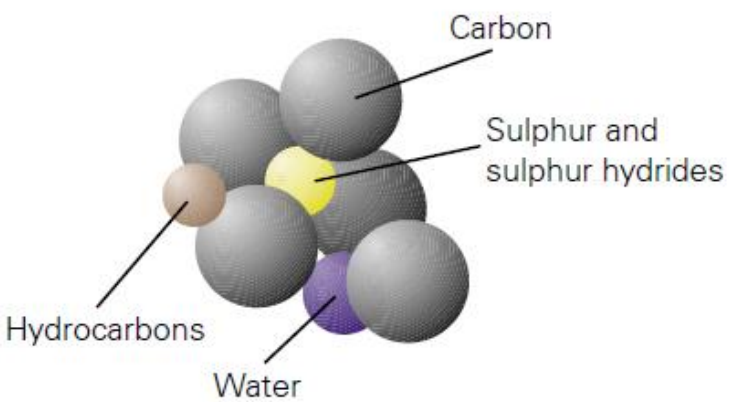

Figure 1.12: Chemical structure of particulate matter[2]

1.4.2: Evaporative Emissions

Hydrocarbon pollutants also escape into the air through fuel evaporation. With today's efficient exhaust emission controls and today's gasoline formulations, evaporative losses can account for a majority of the total hydrocarbon pollution from current model cars on hot days when Ozone levels are highest. Evaporative emissions occur several ways [4]:

1-Diurnal:

Gasoline evaporation increases as the temperature rises during the day, heating the fuel tank and venting gasoline vapors.

2-Running Losses:

The hot engine and exhaust system can vaporize gasoline when the car is running.

3-Hot Soak:

The engine remains hot for a period of time after the car is turned off, and gasoline evaporation continues when the car is parked.

4-Refueling:

Gasoline vapors are always present in fuel tanks. These vapors are forced out when the tank is filled with liquid fuel.

1.4.3: The Problems of Emissions

1-Global warming: are terms for the observed century-scale rise in the average temperature of the Earth's climate system and its related effects,and that scientists were more than 95% certain that global warming is mostly being caused by human (anthropogenic) activities, mainly increasing concentrations of greenhouse gases such as Methane and Carbon dioxide (CO_2) [3].

2-Acid rain: rain that contains a high concentration of pollutants, chiefly Sulphurdioxide and Nitrogen oxide, released into the atmosphere by the burning of fossil fuels such as coal or oil

3-Smog.

4-Health Hazards.

5- Destroy the Ozone.

6- Produce colorless, gases, toxic harmful.

1.5: Project idea

This project aims to estimate traffic-induced pollutant in West bank by using emissions factors. Vehicles are a significant source of emissions of air pollutants the number of vehicles is increasing rapidly with the continuous development of economy, and vehicle emission pollution in the world is more serious than ever personal vehicles are a major cause of global warming and other problem on the world.

1.6: Project objective

-Emission estimation in West Bank State of Palestine.

1.7: Project Schedule and Time Plan

Task 1: Select the idea.

Task 2: Collecting data looking for previous research, understanding the concept of the project.

Task 3: Studying previous research Collecting and studying previous research to take a background about the project.

Task 4: Writing and arranging the chapters.

Task 5: Preparing the presentation.

Task 6: Editing the introduction of the project.

Task 7: Determination of the stratified sample in Palestine .Ask drivers about the distance traveled per year to some areas.

Task 8: Collecting data and document.

Task 9: Collecting data and writing and arranging the chapters.

Task 10: Write a conclusion and preparing the presentation.

Table 1.1: First semester time plan.

Week / Task	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
T1																
T2																
T3																
T4																
T5																

Table 1.2: Second semester time plan.

Week / Task	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
T6	■	■	■													
T7			■	■	■	■	■	■	■	■	■					
T8									■	■	■	■	■			
T9											■	■	■	■	■	
T10															■	■

CHAPTER TWO

Factors Affecting Vehicle Emissions

2.1 Introduction

Societal and governmental pressure to reduce vehicle exhaust emissions is reflected in the existing and projected future. Various factors affect the amount of emissions produced by Internal Combustion Engines in any given situation such as vehicle class and weight, vehicle vocation, fuel type, engine exhaust after treatment, vehicle age, the terrain traveled and engine control effects (such as injection timing strategies) on measured emissions can be significant.

2.2 The Factors Affecting Vehicle Emissions

2.2.1 Vehicle Weight

The effect of vehicle weight on emissions is significant. Increases in engine weight are matched by an increase in the supply of fuel to the engine as the driver shifts to lower gears. This increases the fuel-air ratio of the engine which in turn affects the emission rates of the combustion process. NO_x emissions will increase as the combustion temperature and pressures increase to accommodate the combustion of the fuel-rich mixture in the chamber and an increased engine load. CO emissions will increase as the amount of excess Oxygen in the combustion chamber decreases and more of the Carbon from the fuel fails to convert into CO_2 [5].

2.2.2 Vehicle Vocation

The particular vocation or specific use of a vehicle can have an effect on the emissions produced. The transients and cruising behavior of each vehicle vocation, along with the load carried, can be reproduced in testing by changing the testing weight. The analysis of vehicle weight using the road-load equation disregards the fact that the vehicle has to accelerate to the assumed steady-state condition. Under acceleration, it is assumed that a heavy vehicle is customarily using the maximum power available from its engine, thus producing the maximum amount of exhaust gas and typically high rates of NO_x and PM. So then, over a typical day of use for any vehicle, one that stops and then accelerates more often will produce higher distance-specific emissions, providing all else is held constant. This effect is from the differences in the use of the vehicle, also called the vehicle's vocation [5].

2.2.3 Fuel Type

There are different components and proportion of the exhaust gases from one fuel to another because of the different in chemical structure of each fuel chemistry has a direct impact on combustion properties but also affects downstream exhaust chemistry as well. In particular, different Hydrocarbon species in the fuel lead to different "unburned" Hydrocarbons in the exhaust as emissions, and the oxidation efficiency of catalysts varies for different hydrocarbon species. Thus, understanding exhaust chemical composition and the species-based dependencies of catalysis processes is critical to insure emission control over a range of fuel types [5].

2.2.4 Vehicle Age

There are two separate factors of vehicle age that affect the emissions produced. First, it is assumed that, as a vehicle ages and accumulates high mileage, the engine will slowly wear and produce higher emissions even though engine deterioration is recognized to be slow for purposes of certification. The second factor is the change in technology. The changing technology implies that the engines produced today are different than older ones and must meet more stringent emissions standards [5].

2.2.5 The Terrain Traveled

The effects of the terrain traveled by a vehicle are referred to as grade effects. The chassis testing performed uses power absorbers and inertial flywheels to provide a load to the vehicle based on a road-load equation. For this equation, it is assumed that there are no hills, and the load is calculated for perfectly flat, level terrain. For a comparison of emissions produced from a vehicle traveling varying terrain, the theoretical power requirement can be determined. The power can then be related to the emissions rate for a particular vehicle from experimental brake-specific emissions data [5].

2.2.6 Injection Timing Variances

Emissions of NO_x and PM are known to be affected strongly by the timing of the in-cylinder fuel injection in engines. Indeed, it is common to present a hyperbolic NO_x-PM tradeoff curve for an engine, with more advanced timing at the same speed and load leading to higher NO_x and lower PM. Within a reasonable operating range, there is also a tradeoff between NO_x and efficiency, with advanced timing leading to a higher NO_x and higher thermal efficiency [5].

2.2.7 Engine load

The engine load or the generated engine torque has different effects on the pollutant components Carbon monoxide (CO), unburnt Hydrocarbons (HC) and Nitrogen oxides (NO_X) [3].

2.2.8 Engine speed

Higher engine speeds lead to greater friction losses within the engine as well as increased power consumption by auxiliary systems (e.g.,water pump). Under these conditions the power output per consumed unit of energy decreases [3].

2.2.9 Mixture Formation

In the interests of optimal combustion efficiency, the fuel destined for combustion should be thoroughly dispersed to form the most homogeneous mixture possible with the air. In manifold-injection engines, this refers to the overall combustion chamber, Consistent distribution of uniform mixture to all cylinders is important for low pollutant emissions [3].

2.2.10 Compression Ratio

Compression ratio is the ratio of the total volume of the combustion chamber when the piston is at the bottom dead center to the total volume of the combustion chamber when piston is at the top dead center, increases in compression ratio lead to improved thermal efficiency and concomitantly increased specific power and reduced specific fuel consumption. Compression ratio can be linked to combustion chamber shapes and in combination these parameter can have a signification impact on emissions [3].

2.2.11 Moment of Ignition

The ignition of the air/fuel mixture, i.e., the period of time between flashover and the formation of a stable flame front, is of decisive significance to the combustion sequence. The character of the ignition process is shaped by the timing of the flashover, the ignition energy, and the composition of the mixture at spark plug. A large quantity of ignition energy translates into stable ignition with positive effects, both on the consistency of the consecutive combustion cycles and the composition of the exhaust gases [3].

2.3 Emission control Technologies

Automotive emission control technology are used to reduce the amount of toxic exhaust emission by these vehicle , There are many types of these technology like Catalytic Converter, Exhaust gas recirculation (EGR), Diesel particulate filter (DPF) and others [3] .

2.3.1 Catalytic Converter:

A catalytic converter is a device that uses a catalyst to convert three harmful compounds in car exhaust into harmless compounds, in the catalytic converter; there are two different types of catalyst at work, a reduction catalyst and an oxidation catalyst. Both types consist of a ceramic structure coated with a metal catalyst, usually platinum, rhodium and/or palladium. The reduction catalyst is the first stage of the catalytic converter. It uses platinum and rhodium to help reduce the NOx emissions; the oxidation catalyst is the second stage of the catalytic converter. It reduces the unburned hydrocarbons and carbon monoxide by burning (oxidizing) them over a platinum and palladium catalyst. Figure 2.1 shows the layout of Catalytic Converter [3].

Figure 2.1: Catalytic Converter.

2.3.2Exhaust gas recirculation (EGR):

EGR works by reducing the amount of oxygen in the cylinder, which lowers combustion temperatures. It's an efficient process for reducing NOx, Exhaust gas recirculation (EGR) is used to reduce the levels of NOx emitted by the engine. By recirculating exhaust gases into the engine's cylinder, this process lowers the combustion temperature due to the reduced amount of oxygen which, in turn, reduces the amount of NOx formed. Figure 2.2 shows the layout of EGR [3].

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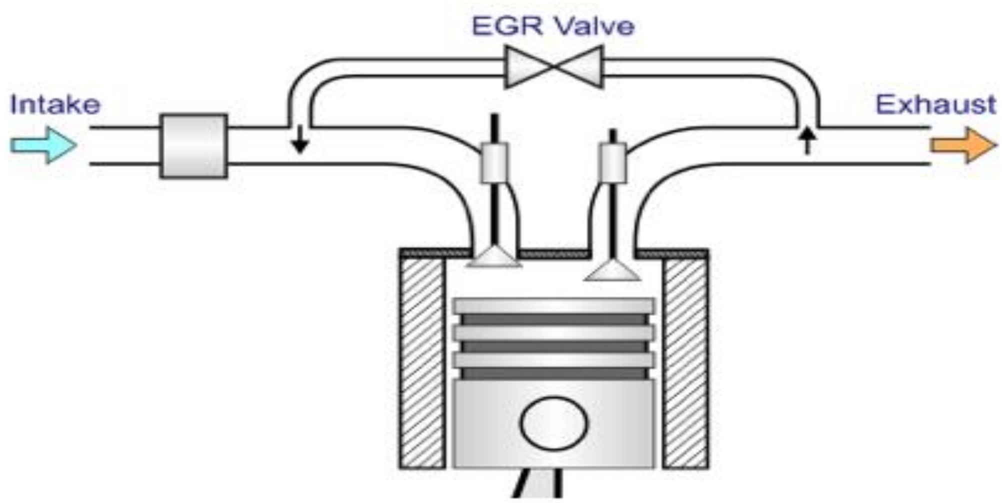

Figure 2.2: Exhaust gas recirculation (EGR).

2.3.4Diesel Particulate Filter (DPF):

A Diesel Particulate Filter (DPF) is a device designed to remove diesel particulate matter or soot from the exhaust gas of a diesel engine. Figure 2.3 shows the layout of Diesel Particulate Filter [3].

Figure 2.3: Diesel Particulate Filter (DPF).

CHAPTER Three

Vehicle Emissions Estimation Techniques

3.1: Introduction

Theoretical and complex equations or models based on the chemical and physical steps of combustion within the combustion engine can be used to estimate pollutant emission levels. However, the theoretical equations and models are often not developed to the stage where pollutant emission levels of acceptable accuracy can be estimated. Additionally, theoretical and complex equations or models require more detailed inputs, but may provide emission estimation based on facility-specific conditions. Use of theoretical equations and models to estimate emissions from combustion engines is more complex and time consuming than the use of emission factors based on simple engine characteristics such as power or fuel consumption and may not provide a better estimation of pollutant emissions. Direct measurement is likely to be a more accurate method of estimating pollutant emissions than other EETs. Collection and analysis of samples can be very expensive, and complicated and measuring instruments must be available [8].

3.2: Types of Emission Estimation Technique

3.2.1 Mass balance

A mass balance identifies the quantity of substance going in and out of an entire facility, process or piece of equipment. Emissions can be calculated as the difference between input and output of each listed substance. Accumulation, depletion and chemical reactions of the substance within the equipment should be accounted for in your calculation. This is a very useful technique for certain classes of pollutant, but is often a difficult technique to apply in the case of combustion engines.

3.2.2 Fuel analysis or other engineering calculations

An engineering calculation is an estimation method based on physical/chemical properties the substance and mathematical relationships. The main combustion engine pollutant for which this is a useful technique is SO2. The amount of SO2 emitted may be predicted based on the amount of sulfur in the fuel.

3.2.3 Sampling or direct measurement

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

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

3.2.4 Emission factors

An emission factor is a tool that is used to estimate emissions to the environment. Emission factors are expressed as kilograms of emission per ton of activity. This method used in our project [8, 9].

Calculations can be made for the quantity of emissions through the following equation:

$$Ek_{py,i} = L_Y \cdot EF_i$$

Where:

- $Ek_{py,i}$ = emissions of pollutant i for a specific type of engine, kg/yr.
- L_Y = distance travelled in reporting year, km/yr.
- EF_i = emission factor for pollutant i, for given engine and fuel type, kg/km.
- i = pollutant type.

The following tables show the Emission factors for each type of vehicle and each pollutant

Table 3.1: Emission factors for private vehicles (cars)

Pollutant	Emission factor (kg/km)
CO	5.55E-03
NO_x	9.02E-04
PM	1.80E-05
VOC_s	6.76E-04
SO_2	4.05E-05

Table 3.2: Emission factors for public vehicles (taxi)

Pollutant	Emission factor (kg/km)
CO	3.25E-04
NO_x	3.43E-04
PM	6.19E-05
VOC_s	5.87E-05
SO_2	3.63E-05

Table 3.3: Emission factors for light duty vehicles

Pollutant	Emission factor (kg/km)
CO	7.78E-04
NO_x	6.36E-04
PM	1.93E-05
VOC_s	2.08E-04
SO_2	6.70E-05

Table 3.4: Emission factors for heavy duty vehicles

Pollutant	Emission factor (kg/km)
CO	2.51E-03
NO_x	6.38E-03
PM	4.94E-04
VOC_s	2.05E-03
SO_2	1.72E-04

Table 3.5: Emission factors for buses

Pollutant	Emission factor (kg/km)
CO	5.06E-03
NO_x	1.00E-02
PM	5.69E-04
VOC_s	1.81E-03
SO_2	2.65E-04

CHAPTER Four

Vehicle Emissions Induced Estimation
-Study Case, West Bank-

4.1: Introduction.

Traffic-related air pollution is a serious problem with significant health impacts in both urban and suburban environments, This project aims to estimating traffic-induced pollutant in west bank by using emissions factors ,Transportation is the major source of air pollution in the West Bank. Three factors make traffic pollution more serious. First, most of the used vehicles are in poor conditions and of old models. Second, low quality fuels are mostly used. Third, the road networks in the West Bank are in poor conditions. This pollution is not assessed and there are no surveys about air pollutants. Burning of fuel in internal combustion engines releases different pollutant to air, such as NO_x, VOC_s, CO, PM and others.

The road network in the West Bank is in poor conditions where it is not rehabilitated or maintained for many years. The poor conditions of the roads increase the congestion and hence emissions from the vehicles. Traffic congestion, fumes, noise and parking are problems, common to all West Bank urban areas.

For all previous reasons and because there is no specific emission standards for air pollutants which are the main instrument in any air pollution control program, this project tries to introduce an assessment of the traffic induced emission and its substantial seriousness concerning public health and the environmentally impact in West Bank areas.

4.2: Case study

One of the common methods for estimating emissions is using emission factors which seem to be the simplest method [7]. Emission factors may be used to estimate pollutant emissions in the environment. [8, 9]:

$$Ek_{py,i} = LY \cdot EF\ i$$

Where

- $Ek_{py,i}$ = emissions of pollutant i for a specific type of engine, [kg/yr]
- L_Y = distance travelled in reporting year, [km/yr]
- EF_i = emission factor for pollutant i, for given engine and fuel type, [kg/km]
- i = pollutant type

A sample stratified from each city was taking in the west bank such as (Hebron, Bethlehem, Jenin, Nablus, Ramallah, Tulkarm, Qalqilia, Salfit, and Tubas) representative from the total number of vehicles in West Bank The sample represents five categories:
(1) Private cars.
(2) Light public vehicles.
(3) Light duty vehicles.
(4) Heavy duty vehicles.
(5) Buses and others.

Such that the total number of vehicle for stratified sample 9797 vehicle. And the total number of the vehicle for west bank 216152 vehicle, the below table show the total number of registered vehicles in West Bank

Table 4.1: Total number of registered vehicles in West Bank

Private	165701
Public vehicles	9548
Light-duty vehicles/under 7000Kg	23815
Heavy-duty vehicles/above 7001Kg	15002
Buses	2086

In this sample stratified, the Drivers were asked about the amount of distance traveled each year (Km/year) districts is illustrated in below table 4.2

Table 4.2: Number of vehicles of a stratified sample and its categories in West Bank districts

Type of vehicles	Number of vehicles	Average driven distance (Km/year)	Range (km)	District
Private vehicles	1150	25875	9000-62000	Hebron
	316	15022	8000-34500	Bethlehm
	450	14334	6000-21000	Jenin
	1220	19540	11000-39500	Nablus
	887	19644	7500-37000	Ramallah
	205	13709	7000-30000	Tulkarm
	196	14660	8000-34000	Qalqilia
	184	13027	6000-27000	Salfit
	185	16159	8200-26000	Tubas
Public vehicles	1210	70447	45000-11000	Hebron
	127	91000	38000-12800	Bethlehm
	187	48955	27000-75000	Jenin
	1114	72035	35000-13500	Nablus
	340	75088	48000-90000	Ramallah
	117	63991	28000-95000	Tulkarm
	137	72266	25000-10100	Qalqilia
	192	65301	28000-84000	Salfit
	118	55551		Tubas

Light-duty vehicles	247 108 86 215 120 45 37 33 29	40933 32185 26825 25828 40375 26777 32783 29212 28417	15000-65000 11000-42000 14300-37000 17000-36000 9000-57000 11000-40000 13000-45000 12000-43000 11000-42000	Hebron Bethlehm Jenin Nablus Ramallah Tulkarm Qalqilia Salfit Tubas
Heavy-duty vehicles	127 23 25 106 25 18 16 20 21	49507 40913 30535 35338 40240 33444 34281 32825 39461	35000-63000 15000-58000 22000-40000 25500-49300 25000-55000 18000-55000 17000-43000 19000-54000 20000-55000	Hebron Bethlehm Jenin Nablus Ramallah Tulkarm Qalqilia Salfit Tubas
Buses	43 17 13 32 19 11 9 9 8	73642 83352 64424 90000 79789 60000 70666 80111 59050	50000-10000 40000-10800 35000-11000 45000-11500 30000-10100 22000-75000 35000-98000 38000-10500 42000-75000	Hebron Bethlehm Jenin Nablus Ramallah Tulkarm Qalqilia Salfit Tubas

Then we calculate the average distance for every categories, also by using the emission factors (Ekpy,i = LY · EF i) we estimated and calculated values of traffic emission for sample stratified in west bank for private vehicles (cars) Kg/year Table 4.3.Also for Public Vehicles Table 4.4,and for Light duty vehicles Kg/year Table 4.5, and for heavy duty vehicles Kg/year Table 4.6,and for vehicles(buses) Kg/year Table 4.7.

For simplifying calculations, the various parameters such as engine speed in the traffic flow, engine load, driving patterns (deceleration and acceleration), unregistered vehicles and traffic management conditions were not taken into considerations which are estimated to increase the emission concentrations of about 20%.

Table 4.3: Estimated and calculated values of traffic emission for private vehicles (cars) Kg/year for sample stratified.

CO	5.18E+05
NOx	8.41E+04
PM	1.68E+03
VOCs	6.31E+04
SO2	3.78E+03

Table 4.4: Estimated and calculated values of traffic emission for Public Vehicles (taxi) Kg/year for sample stratified.

CO	3.86E+04
NOx	9.81E+04
PM	7.60E+03
VOCs	3.15E+04
SO2	2.65E+03

Table 4.5: Estimated and calculated values of traffic emission for Light duty vehicles Kg/year for sample stratified.

CO	2.37E+04
Nox	1.94E+04
PM	5.89E+02
VOCs	6.34E+03
SO2	2.04E+03

Table 4.6: Estimated and calculated values of traffic emission for heavy duty vehicles Kg/year for sample stratified.

CO	3.86E+04
Nox	9.81E+04
PM	7.60E+03
VOCs	3.15E+04
SO2	2.65E+03

Table 4.7: Estimated and calculated values of vehicles (buses) Kg/year for sample stratified

CO	6.23E+04
Nox	1.23E+05
PM	7.00E+03
VOCs	2.23E+04
SO2	3.26E+03

Then we estimated and calculated values of traffic emission for sample stratified in the west Bank (Kg/year) Table 4.8, also (tons/year) Table 4.9

Table 4.8: Estimated and calculated values of traffic emission for sample stratified in the West bank (Kg/year).

CO	7.23E+05
NOx	4.10E+05
PM	3.22E+04
VOCs	1.38E+05
SO2	2.07E+04

Table 4.9: Estimated and calculated values of traffic emission for sample stratified in the West bank (Tons/year).

CO	7.23E+02
NOx	4.10E+02
PM	3.22E+01
VOCs	1.38E+02
SO2	2.07E+01

The attached tables below explain the amount of emissions per category in the west bank .Where we have generalized the stratified sample for all number of vehicle in west bank.

Table 4.10: Estimated and calculated values of private vehicles (cars) Kg/year

CO	1.79E+07
NOx	2.91E+06
PM	5.81E+04
VOCs	2.18E+06
SO2	1.31E+05

Table 4.11: Estimated and calculated values of Public Vehicles (taxi) Kg/year

CO	2.17E+05
Nox	2.29E+05
PM	4.14E+04
VOCs	3.93E+04
SO2	2.43E+04

Table 4.12: Estimated and calculated values of Light duty vehicles Kg/year

CO	6.14E+05
NOx	5.02E+05
PM	1.52E+04
VOCs	1.64E+05
SO2	5.29E+04

Table 4.13: Estimated and calculated values of heavy duty vehicles Kg/year

CO	1.52E+06
NOx	3.86E+06
PM	2.99E+05
VOCs	1.24E+06
SO2	1.04E+05

Table 4.14: Estimated and calculated values of vehicles (buses) Kg/year

CO	8.07E+05
NOx	1.59E+06
PM	9.07E+04
VOCs	2.89E+05
SO2	4.23E+04

The attached table below explains the amount of emissions in the west bank.

Table 4.15: Estimated and calculated values of traffic emission in the Best Bank (Kg/year) for West bank

CO	2.11E+07
NOx	9.10E+06
PM	5.05E+05
VOCs	3.91E+06
SO2	3.54E+05

Table 4.16: Estimated and calculated values of traffic emission in the Best Bank (tons/year) for West bank

CO	2.11E+04
NOx	9.10E+03
PM	5.05E+02
VOCs	3.91E+03
SO2	3.54E+02

4.3: Conclusions.

According to the estimated results of emissions,the amount of emissions from internal combustion engines is very large ,Especially CO, NOx, PM, VOCs, SO2.and the problem of traffic pollution is very serious and cause many problems at the level of human and animal or plant, some of these gases are toxic produce colorless gases, toxic harmful and cause health hazards also some of them cause the Smog and Destroy the ozone.

The amount of these emissions is expected to be significant in the coming years due to the large increase in the number of vehicles

Many factors and reasons help to increase the amount of emissions and make the air pollution from transportation more serious. The most important of which is no specific emission standards for air pollutants The road network in the West Bank is in poor conditions and of old models ,low quality fuels are mostly used So transportation in the West Bank is a major source of air pollution.

4.4: Recommendations.

The stratified sample and the interview with drivers may also affect the result. The objective of this project is to estimate the traffic induced emissions, the amount of the emission is large .So it should be a continuous inspection and install pollution monitoring to reduce the level of these pollutants. Provision of exhaust meters and air pollutants to the competent authorities and their use to measure and control the movement and pollution of vehicles in all Palestinian cities and along highways. Encourage the proper planning of Palestinian cities, which takes into account the reduction of environmental pollution caused by overcrowding, traffic and poor and dilapidated road networks.

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