Section A-Research paper
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OBTAINING THE REPRESENATIVE CONDUCTION CYCLE WITHIN THE ESPOCH FACILITIES BY COLLECTING DATA ON POLLUTANT EMISSION FACTORS"

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Abstract- The following work consists of carrying out micro trips made at the Polytechnic High School of Chimborazo, this is given to calculate the busiest routes in the same sector, we also proceed to calculate the vehicles that enter and are in circulation also thanks to In micro trips, an almost exact estimate of fuel consumption can be made. The analysis and estimation are carried out using tools, programs for a better proximity to the real data.
Keyboard: REPRESENATIVE CONDUCTION CYCLE, DATA ON POLLUTANT AND EMISSION FACTORS

INTRODUCTION

The evolution of the automotive field has a progressive growth over time. This affects the development of automotive technologies capable of supplying the demand with high quality standards and friendly to the environment. Therefore, state entities in developed countries establish policies and regulations based on the rational use of available resources and that regulate the free movement of automobiles for the benefit of the ecosystem.

At present, the problem of environmental pollution has become one of the most important problems of society. More specifically, air pollution caused by gases emitted by internal combustion engine vehicles is a sensitive issue because, in addition to obviously affecting the biosphere, it causes a large number of diseases, such as respiratory diseases and health problems. The easiest to get to.

Ecuador, within its development plan for a good living aims at a society where energy efficiency plays an essential role for the development of the Ecuadorian community. If, rather, the country still depends on fossil fuel resources, it is necessary to find guidelines that favor their optimal use in the automotive sector. That is why, the Ecuadorian Energy Efficiency Law is focused on making incentives to companies and people that formulate cleaner systems for transport.

In contemporary times, more emphasis is placed on controlling the aforementioned emissions to reduce and avoid the harmful effects of these emissions on the environment and people. Therefore, useful tools have been developed to analyze and determine the amount of polluting gases present in the air. One of these tools is the driving cycle, which can be broadly defined as a typical driving style that exists in a given geographical area; This helps to obtain routes with high traffic of vehicles and then, with a specific procedure, obtain the amount of emissions that automobiles are releasing into the air.

The emissions released by a vehicle depend on a number of regulatory factors, such as the driver's age, distance traveled, control technology of each unit, degradation of emission control instruments, environmental conditions, site temperature and altitude.

In addition to the above, computer tools, such as applications for measuring and visualizing specific data obtained by different vehicle instruments, in this case data obtained through an OBD II connection, to be able to perform specific calculations and to be able to establish a reliable value for a subsequent evaluation.

MATERIALS AND METHODS

Materials

1) ELM 327: The ELM327 interface is a device that allows the connection to the computer or mobile phone to the vehicle, for the diagnosis of vehicles equipped with OBD II systems (Vaquero G, 2015). In this study, the OBD II WiFi-type device, ELM327, is used with the management of the following communication protocols:

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Fig. 1 ELM327 MINI

Torque Pro

This proprietary Android application uses Bluetooth and WiFi technology to connect to the vehicle's computer, through an OBD II device, and sends useful information about the status of the vehicle through PIDs requested by the researcher.

Fig. 2 Torque Pro interface

2) Excel: It is a spreadsheet that allows us to manipulate numerical and text data to analyze information, generate reports, among other useful applications.

Fig. 4 Microsoft Excel

Minitab: It is a powerful computer tool that allows us to perform statistical analysis with graphical representations through pre-programmed mathematical calculations.

Fig. 5 Minitab Features

Tableau: It is a visual analysis platform that is capable of transforming the way we use data to solve

Fig. 6 Tableau Functions

ESPOCH VEHICLE COUNT

In this study it is to analyze the number of vehicles that enter through the different doors of the ESPOCH, for the representation of the fuel consumption of the vehicles entered.

Doors of the ESPOCH

Main entrance "Av. Pedro M"

Alternate Door 1 "Av. Canonigo"

Alternate Door 2 "Av. Milton R"

Average vehicle income

470 vehicles every hour

5356 vehicles (6:30 AM - 18:30 PM)

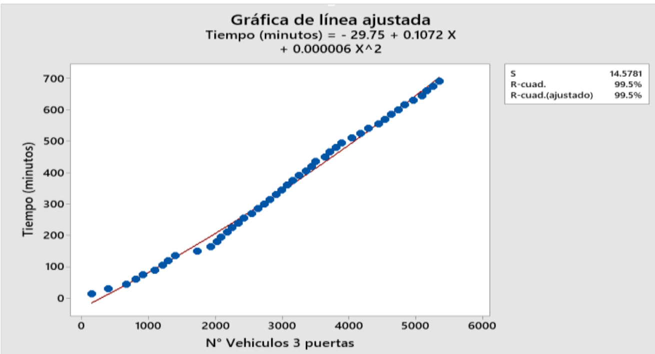

Fig. 7 Equation of time vs number of cars

Number of vehicles entering through the 3 gates of the Espoch

ENTRADAS			Puerta Principal	Puerta Medicina	Puerta Milton Reyes		
TIEMPO			FRECUENCIAS ABSOLUTAS				
HORA		Tiempo (minutos)	Numero de vehículos principal	Numero de vehículos Milton Reyes	Numero de vehículos Medicina	TOTAL 3 PUERTAS	FRECUENCIA ACUMULADA
6:30	6:45	15	60	32	55	147	147
6:45	7:00	30	61	57	127	245	392
7:00	7:15	45	105	63	101	269	661
7:15	7:30	60	50	33	59	142	803
7:30	7:45	75	27	36	43	106	909
7:45	8:00	90	40	98	38	176	1085
8:00	8:15	105	33	25	67	125	1210
14:30	14:45	495	16	35	35	86	3892
14:45	15:00	510	15	103	38	156	4048
15:00	15:15	525	33	60	40	133	4181
15:15	15:30	540	24	50	37	111	4292
15:30	15:45	555	46	70	35	151	4443
15:45	16:00	570	38	27	31	96	4539
16:00	16:15	585	41	34	25	100	4639
16:15	16:30	600	30	34	37	101	4740
16:30	16:45	615	33	31	40	104	4844
16:45	17:00	630	39	28	62	129	4973
17:00	17:15	645	36	27	61	124	5097
17:15	17:30	660	25	29	21	75	5172
17:30	17:45	675	27	26	42	95	5267
17:45	18:00	690	26	27	36	89	5356
TOTAL AUTOMOVILES			1641	1812	1903	5356	103245

Fig. 8 ESPOCH vehicle count

Applying logarithmic regression

For data collection, the peak hour was selected from 6:30 a.m. to 6:30 p.m., having a duration of 12 hours, where there is the greatest vehicular entry through the different doors of the ESPOCH.

Formula N Vehicles

$$N\ Vehículos = 1156{,}7\ *Tiempo\ Minutos\ (15) - 3579{,}4$$

Absolute Error Formula

$$Error\ Abs = frecuencia\ acum - N\ Vehículos$$

Relative Error Formula

$$Error\ Relativo(\%) = Error\ Abs / \ frecuencia\ acum$$

DATOS DE VEHÍCULOS APLICANDO UNA REGRSIÓN LOGARÍTMICA					
HORA		TIEMPO (MINUTOS)	NÚMERO DE VEHÍCULOS Y=1156.7*LN(X) - 3579.4	ERROR ABSOLUTO	ERROR RELATIVO
30	6:45	15	**-447**		
45	7:00	30	**355**	200	36%
00	7:15	45	**824**	101	11%
15	7:30	60	**1157**	116	11%
30	7:45	75	**1415**	271	24%
45	8:00	90	**1626**	269	20%
00	8:15	105	**1804**	292	19%
15	8:30	120	**1958**	347	22%
30	8:45	135	**2095**	328	19%
45	9:00	150	**2216**	124	6%
00	9:15	165	**2327**	51	2%
15	9:30	180	**2427**	86	4%
30	9:45	195	**2520**	109	5%
45	10:00	210	**2606**	87	3%
:00	10:15	225	**2685**	91	4%
:15	10:30	240	**2760**	106	4%
:30	10:45	255	**2830**	72	3%
:45	11:00	270	**2896**	2	0%
:00	11:15	285	**2959**	52	2%
:15	11:30	300	**3018**	61	2%
:30	11:45	315	**3075**	87	3%
:45	12:00	330	**3128**	107	3%
:00	12:15	345	**3180**	136	4%
:15	12:30	360	**3229**	138	4%
:30	12:45	375	**3276**	160	5%
:45	13:00	390	**3322**	207	6%
:00	13:15	405	**3365**	250	7%
:15	13:30	420	**3407**	268	7%
:30	13:45	435	**3448**		
:45	14:00	450	**3487**		
:00	14:15	465	**3525**		
:15	14:30	480	**3562**		
:30	14:45	495	**3597**		
:45	15:00	510	**3632**		
:00	15:15	525	**3665**		
:15	15:30	540	**3698**		
:30	15:45	555	**3730**		
:45	16:00	570	**3761**		
:00	16:15	585	**3791**		
:15	16:30	600	**3820**		
:30	16:45	615	**3848**		
:45	17:00	630	**3876**		
:00	17:15	645	**3904**		
:15	17:30	660	**3930**		

Fig. 9 Obtaining vehicle data by applying logarithmic regression

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Average relative error	9%
Number of vehicles entering from 6:30 to 18:30	5356

Fig. 10 Result of the average relative and total error of vehicles

METHOD OF OBTAINING DATA

The instrumentation technique used in the research is, On board from a direct method, which facilitates the instrumentator the collection of data from the test vehicles, for the reason of precision and reliability of the technique.
This technique has the following characteristics:

- Direct collection
- Data is obtained directly from the vehicle
- High accuracy / High reliability
- Requires a large sample to ensure representativeness
- Time-consuming demand for data collection

MICRO TRAVEL METHOD

The operating cycle is classified into zones of movement and stop, taking into account as microcycle the evolution of the speed between two continuous stops. As a purpose, it is postulated to generate polygonal speed cycles, consecutive records are divided into microcycles consisting of sections of acceleration, speed (including engine idling) and deceleration, see figure 5-3 (Jiménez, et al., 2006).
This allows:

- Compare v–t curves divided into cycles in which vehicles start from a Vo = 0 followed by periods of acceleration until they reach rest again (Vf = 0), this includes idling periods until accelerating again.
- Apply Minitab's clusters tool, which allows you to eliminate microcycles that are extended to the boundaries of the microcycle chain, in turn forming clusters that are sets of microcycles.
- To obtain the driving cycle, with the help of clusters, perform cluster filtering and micro trips randomly. Micro trips that are close to the total average speed (±5% range) should be used prior to filtration.
- The total driving cycle encompasses different microcycles with a margin of 800±60s

PARAMETERS FOR OBTAINING DATA

The On-Board technique allows to obtain real information of the operating parameters of the automobile. To apply this technique it is required to match through instruments such as Datalogger, GPS, vehicle scanner, sensors, the fifth wheel and others. "With these devices it is possible to obtain information on: speed, acceleration, stopping time, distance traveled, among other related (Quinchimbila, and others, 2017 pages). ("Obtaining the urban driving cycle for the city of Riobamba in ...") 15-16)
For this case, the ELM327 Wi-fi device will be used. This item is an interface scanner that works over Wi-fi networks can be paired with Android or Apple devices. With this interface it is possible to monitor engine revolutions, intake manifold pressure, time advance, airflow range, oxygen sensor voltage reading, fuel flow and pressure, air intake temperature, load, speed and other parameters.

Fig. 11 Parameters for Torque Pro

OBTAINING CONDUCTION CYCLES BY MICROCYCLES

To obtain the conduction cycle by the microcycle method, a series of steps must be used.
The sequence of steps exposed by the researcher is worked on in software such as Excel and Minitab.
The statistical program Microsoft Excel allows to distribute in an orderly manner the characteristic parameters of the routes, elaboration of microcycles. At the end of data leakage by Minitab, it enables the construction of the conduction cycle.
The Minitab program performs the filtration of microcycles (extensive microcycles of others, they are eliminated), obtaining clusters (set of microcycles), checking the standard deviation of the data of the variables that represent the driving cycle (speed and acceleration).
Development of the construction of a driving cycle

In order to establish a quality driving cycle, possible characteristic routes traveled daily by drivers were taken into account. Data on the driving characteristics and engine parameters of a vehicle were obtained through the aforementioned instruments (ELM 327).
Several measurements of each route were taken separately in order to build a total cycle and then analyze each route individually.

DATA PROCESSING

For the determination of the driving cycle, several variables are taken into account, these are calculated from the data obtained by the GPS, during the routes of the microcycles. Additional variables are required to continue with the analysis and subsequent selection of the driving cycle. These additional variables are calculated from the base data obtained by the GPS.

Acceleration (a):
It is the positive or negative variation that is marked in each second, is calculated from the velocity and is expressed in the following equation.

$$a = vf - vo / tf - to$$

Where:
VF: Final velocity in meters (m/s)
VO: initial velocity (m/s)
TF: Final time in seconds(s)
to: initial time(s)

Immediate distance (d):
The distance traveled in each second is calculated taking into account the calculated data of speed and distances, and is expressed in the following equation.

$$d = v(tf - to)$$

Slope (θ):
It is the positive or negative slope calculated in the course for one second, height and distance data is required, for its calculation the following expression is used.

$$\theta = asen\ (Af - Ao / d)$$

Where:
Af: Final height (m)
Ao: initial height (m)

Calculation of physical variables

It calculates the forces that act when the vehicle is in motion, which define the variables of power output and energy required for the movement of the bicycle. It is calculated from the base data obtained by the GPS.

Rolling resistance (Rx).

The resistance faced by the vehicle, depending on the ground on which it circulates and the tires, in this force intervene the mass of the passenger plus that of the vehicle, gravity and slope. (Cedillo). It is calculated using the following equation:

$$Rx = fr * M * g * \cos(\cos\theta)$$

Where:
fr: Rolling resistance constant.
M: Mass (kg)
g: Acceleration constant of gravity (m/s2)

Aerodynamic force (Fd).

It is the force that acts on the vehicle, affecting the power and energy required for the movement of the vehicle, this force is calculated using the following equation, taking into account the density, frontal area and speed. Next, the equation for the calculation (Cedillo) is expressed.

$$Fd = 1/2 * Cd * \rho * A * v2$$

Where:
Cd: Drag coefficient (dimensionless).
ρ: Density of air. (kg/m3)
A: Frontal area (m2)

Resistance due to inertia (Ri).
Taking into account the 2nd. Newton's law we have the following equation, in this force the total mass and acceleration intervene. It is calculated as follows.

$$Ri = M\alpha$$

Mass due to slope (Rg).
The slope influences the weight of the moving vehicle, this force is calculated through the following equation.

$$Rg = M * g * sen\ \theta$$

Total strength (F).
It is the sum of all the forces to be counteracted to provide the movement to it, it is expressed in the following equation.

$$F = Rx * Fd * Ri * Rg$$

Power and Energy
To obtain the power (P) required by the vehicle to travel a microcycle, the following formula is applied:

$$P = v * F$$

Where:
P: Power in watt (W)
F: Out in newton (N)

For the calculation of the Energy (EWh) used for the route of a microcycle is obtained as follows:

$$EWh = P * \Delta t$$

To facilitate the manipulation of data and units the variable can be

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transformed from Wh to Kcal, using a conversion constant, through the following equation.

$$E = EWh * 0,860421$$

CHARACTERISTIC PARAMETERS

According to (Restrepo, et al., 2007), the parameters to be considered for obtaining a driving cycle are:

- Distance (km).
- Average speed (km/h).
- Maximum speed (km/h).
- Time traveled(s).
- Positive average acceleration (m/s2).
- Time with positive acceleration(s).

ANALYSIS AND DEVELOPMENT OF RESEARCH

In order to establish a quality driving cycle, possible characteristic routes traveled daily by drivers were taken into account. Data on the driving characteristics and engine parameters of a vehicle were obtained through the aforementioned instruments (ELM 327 and Gas Analyzer). Several measurements of each route were taken separately in order to build a total cycle and then analyze each route individually.

COMPARISON OF ON-BOARD TECHNIQUE AND VEHICLE CHASING.

Technique	Advantages	Limitations
ON BOARD	Direct collection of driving data	High cost of instrumentation (Data equipment per vehicle)
	Development of representative driving profiles	Study of the driving characteristics of a single driver
	Suitable for countries where driving behaviour is irregular and aggressive	Requires a large sample to ensure the representativeness of the database
	This method can be economically maintained if representative routes are selected using a possible traffic database	Time-consuming demand for data collection
VEHICLE CHASE	Study of the driving characteristics of different drivers on a single route	Violation of speed limits
	Low cost of instrumentation	Driver's perception of the target vehicle
	Collection of driving patterns of some vehicles in a single trip	Indirect data collection with a high margin of error
	Representativeness of the sample	Laser equipment loses its effectiveness when passing through potholes, pen teeth and curves
	A single vehicle is used to collect driving data	Differences in driving behaviour between the hunting vehicle and the vehicle studied
		The hunting vehicle can easily lose the study vehicle when its driving behavior is aggressive.

Total Cycle Route

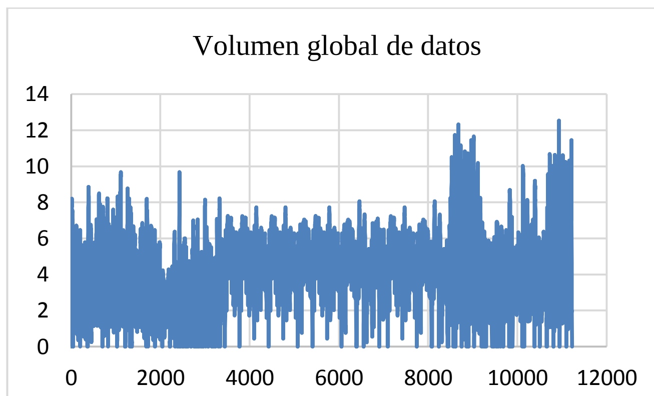

Fig. 12 Total cycle collected

All these data were analyzed using an Excel spreadsheet and extracted their absolute and relative errors in order to verify which route presented a lower error compared to the total. The cycle that has a lower relative error with respect to the total would be the one that best represents the characteristic and predominant driving cycle of the institution's facilities. The data showed that cycle 5 is the most representative.

Table 1 Characteristic parameters

Characteristic parameters	Values	Units

Average speed	4,38	
Maximum speed	12,53	m/s
Max acceleration	3,33583333	m/s^2
Medium acceleration +	0,36972127	m/s^2
Medium acceleration -	-0,36675793	m/s^2
Idling percentage	26,76	%

Fig. 13 Driving cycle parameters

Table 2 characteristic parameters with less error

% Average Speed	6.08427629 m/s
% Max Speed	30.658332 m/s
% acceleration Max	16.4216045 m/s2
%MED + acceleration	6.64415524 m/s2
% Acceleration MED -	8.30810496 m/s2
% Idle	2,1741506
Average	11,7151039

Fig. 14 Driving cycle parameters with lower error

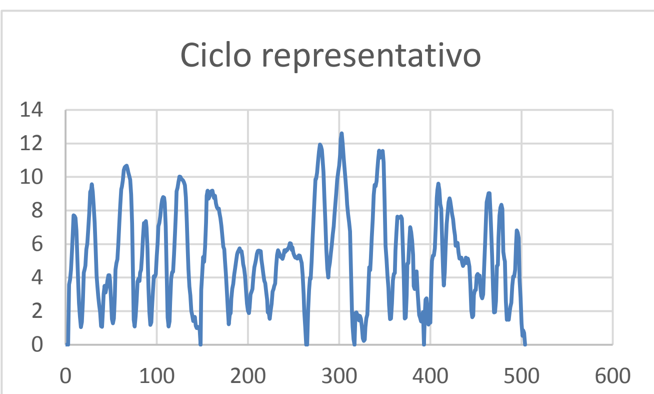

Fig. 15 Representative driving cycle

For the representative cycle we made an average of times based on the global data which is a percentage of the general cycle, for this cycle the K-MEANS method was used through CLUSTER with the elbow method which gave us 5 groupings giving an average time of 504 seconds that gives us 8 minutes 40 seconds which the busiest car within the facilities is the Aveo 1600 Cc Due to this we will identify the consumption generated within the facilities with a count that was carried out for three weeks to complete 12 hours of data collection, in which we will have the emissions of polluting gases obtained through a polluting gas analyzer.

Data analysis methodology in Python software.

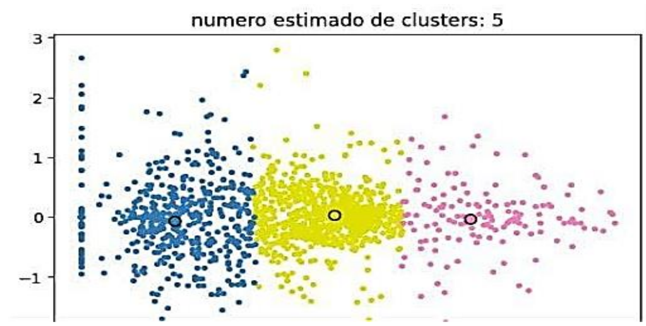

Fig. 16 Cluster analysis

LT Driving Cycle Path

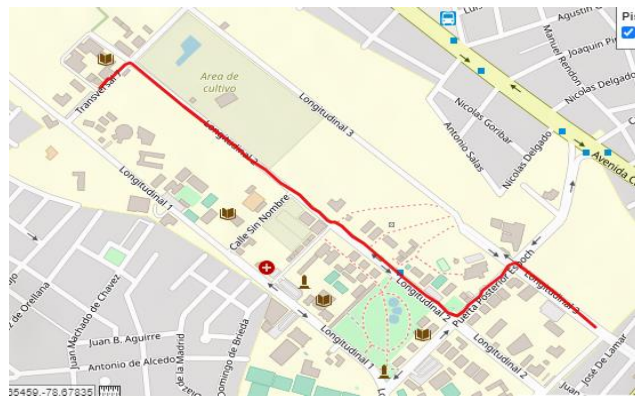

Fig. 17 Side Door To Forest

STUDY AND ANALYSIS OF GAS POLLUTION FROM A COMBUSTION ENGINE.

According to the European Environment Agency's report called "Do lower speed limits on motorways reduce fuel consumption and pollutant emissions?" published in 2011, they expect that setting lower speed limits on motorways will reduce both fuel consumption and pollutant emissions, according to the study "Reducing motorway speed limits from 120 to 110 km/h could generate fuel savings for technology passenger vehicles. current 12-18%, assuming smooth driving and 100% compliance with speed limits. However, taking these assumptions to a more realistic environment implies savings of only 2-3%."

In the amount of emissions:

According to the European Environment Agency report, they show that reducing speed in the above range has a beneficial effect on all pollutants, except for CO (in the case of diesel vehicles) and NOx (in the case of gasoline vehicles). The benefits of reducing the average speed from 100 km/h to 90 km/h range from 25% (gasoline CO) to 5% (diesel Particulate matter or PM). Fundamentally, slowing down reduces the two currently most important pollutants in Europe: diesel NO x and PM.

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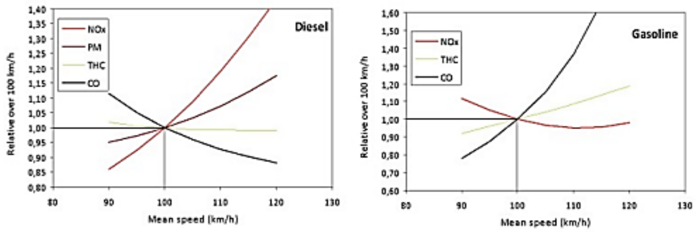

Figure 18 Impact of travel speed of various pollutants for diesel and gasoline (Euro 4 engine capacity 1.4-2.0 liters)

Source: *www.google.com.ec/search?hl=es-419&biw=831&bih=767&tbm=isch&sa=1&ei=*

This is all about motivating drivers to maintain a constant speed and restrict their speed (eco-driving) to achieve significant fuel savings. Speed reduction can also significantly reduce pollutant emissions, particularly NOx and particulate matter (PM) output from diesel vehicles. The safety gains of slower driving are also indisputable, the study concludes.

New European Driving Cycle (NEDC)

The European Driving Cycle (NEDC) is a driving cycle, designed to assess emission levels of car engines and fuel economy in passenger cars, does not include light trucks or commercial vehicles. The NEDC, which is supposed to represent typical car use in Europe, is repeatedly criticised for delivering unrealistic figures.

(Lincango, y otros, 2019 págs. 12-14), indicate that incomplete combustion occurs in the Otto cycle combustion engine, which causes polluting gases that affect human health. The gases generated in the reaction are classified into:

- Toxic: Exhaust gases include: carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NOx), ozone (O3) and sulfur oxide (SO).
- Harmless: Molecular oxygen (O2), molecular nitrogen (N2), carbon dioxide (CO2) at levels of 2000 ppm and Water (H2O).

(INEC, 2016), indicates that, in 2016, Ecuador has registered a total of 2 056 213 vehicles, in which the province of Chimborazo (Riobamba as cantonal capital) registers 32 960 registered vehicles.
(IEA, 2020), an organization based in France, publishes annually an analysis of emissions according to the level of energy use, states that there is an emission of 289.3 kilo-tons (kt) of CO2 in 2014 by the combustion of fuel in vehicles in Ecuador.

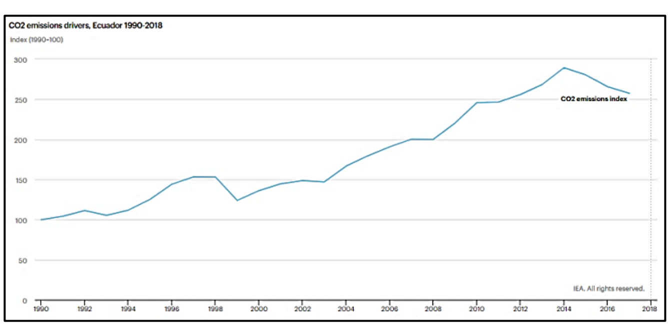

Figure 19 Figure 5- 2. Annual CO2 emissions in Ecuador

Conducted by: (IEA, 2020)

(Urbina, 2016 págs. 12-16), points out that exhaust emission control systems have been created with the purpose of minimizing the polluting elements produced by the automotive in the combustion cycle and are:

- Electronic ignition: consists of an electronic system that interrupts the current of the primary of the coil to generate by self-induction the high voltage required by the coil.
- Combustion control (oxygen sensor): consists of a sensor housed at the exhaust outlet of the engine that registers the combustion gases and constantly feeds back to the engine control unit that adapts the air-fuel mixture according to the operating state of the vehicle.
- Electronic control unit: it consists of a control unit associated with MAP sensor, throttle position sensor, temperature and oxygen sensor and others, which monitors and determines the appropriate amounts of fuel quantity, ignition point and other parameters.
- Additional exhaust air injection system: it is responsible for injecting fresh air into the exhaust manifold of the engine, reducing incomplete combustion products.
- Positive crankcase ventilation system (PCV): it is composed of a PVC valve, which extracts the gases from the crankcase. The valve is located in the valve cover and communicates directly with the intake manifold and works according to the load of the manifold. This is how a quantity of the gases that flow to the intake manifold are part of the gases of the engine crankcase, the same ones that are used for combustion and reduce harmful emissions of gases.
- Evaporative emissions system (EVAP): this system is responsible for collecting the gases that are formed when the fuel is stored in the tank. The gases are carried by means of a set of valves to the carbon canister for storage until they are purged to the engine for combustion.
- Exhaust gas recirculation (EGR) system: its purpose is to reduce nitrogen oxide emissions, introducing the exhaust gases into the combustion chamber through a gas recirculation valve between the exhaust and the intake manifold
- Catalytic converter: this device works ideally between 400º and 700º, it is responsible for transforming polluting gases through the technique of catalysis into inert gases and reducing harmful elements.

Energy efficiency of the internal combustion engine

(Paykani & Shervani-Tabar , 2011) , indicate that a gasoline-powered MCI fails to achieve 100% thermal efficiency. 30% of the heat energy they contain is transformed into movement and the rest is dissipated into the atmosphere. The Sankey diagram in Figure 19 allows us to appreciate the balance of input and output energy.

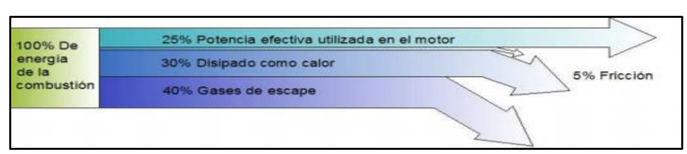

Figure 20. MCI Efficiency

Made by:

(https://www.ecured.cu/Motor_de_combusti%C3%B3n_interna)

CONTAMINATION

Active elements of fuels such as: lead, sulfur and residues produced by combustion (carbon monoxide, sulfur monoxide, nitrogen oxides, ozone) are the main causes why automobiles occupy the first places in terms of environmental pollution, by mobile sources because these elements are characterized by causes of affection to human health (heart and lung diseases) hence the importance of a thorough control For the determination of the degree of environmental pollution caused by vehicles and with these data of the emission of gases of said elements, implement in a timely manner corrective actions such as adjusting them to the tolerances given in the laws in force in the country and establish maintenance controls and review periods. (Tong & Hung , 2010)

Emission controls have successfully reduced the gases emitted by cars in terms of the amount of pollutants per distance traveled. However, the substantial increase in the distances travelled by each vehicle, as well as the increase in the number of vehicles in circulation, results in the total decrease in emissions being less and less.

ANALYSIS OF THE RESULTS

TORQUE CURVE

In Excel you get the equation of the curve for each instant of rpm.

Through the catalog we obtain the data of the torque versus RPM curve, where we generate an equation and a characteristic curve to use in the process of analysis of drag forces, internal forces, specific vehicle power and in the same way it helps us for the analysis of the polluting emissions that are being generated within the institution (ESCUELA SUPERIOR POLITÉCNICA DE CHIMBORAZO) through the equations that are generated by the TABLEAU software with each of the gases we obtained from the analyzer.

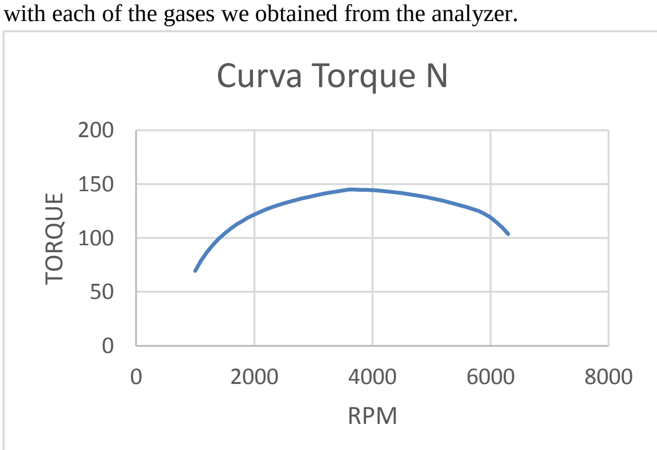

Figure 21 Engine power

TRAVEL AND CONSUMPTION IN THE DRIVING CYCLE THROUGH QSS SOFTWARE

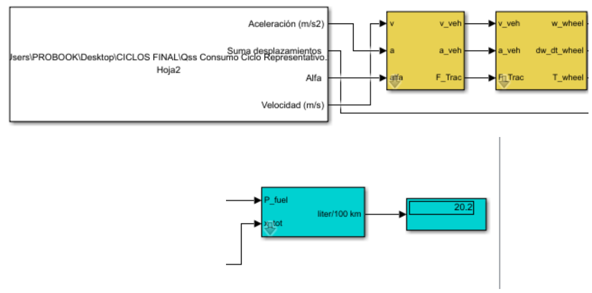

Fig. 22 QSS Software Consumption

Cycle distance 2.6 km	
20.2 Lt	100 km
0.53 Lt	2.64 LT
Cycle consumption 0,5 Lt	

BINES GENERATED THROUGH THE PSV VS EMISSIONS

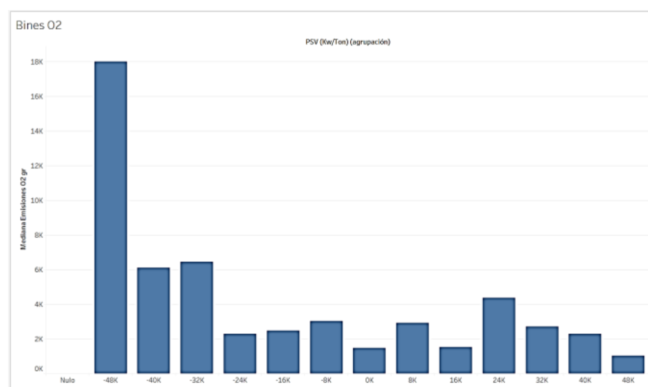

Fig. 23 O2 bins

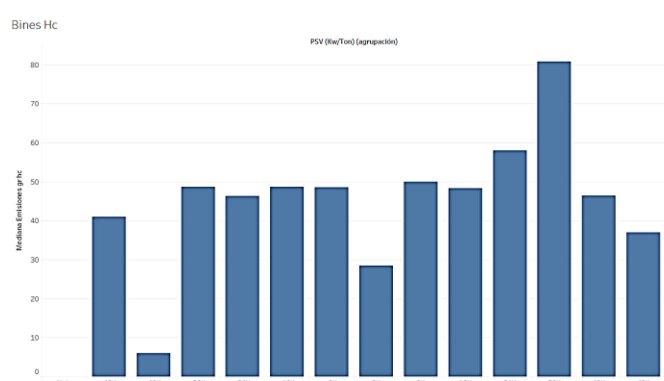

Fig. 24 HC bins

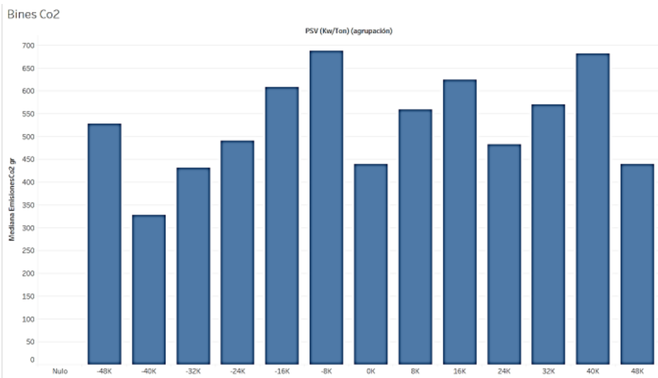

Fig. 25 CO2 bins

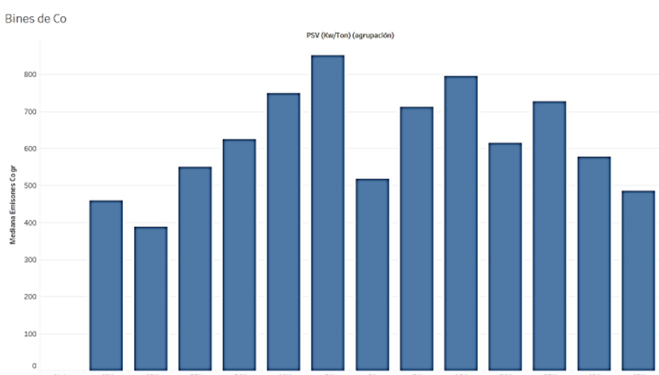

Fig. 26 CO bins

RESULTS

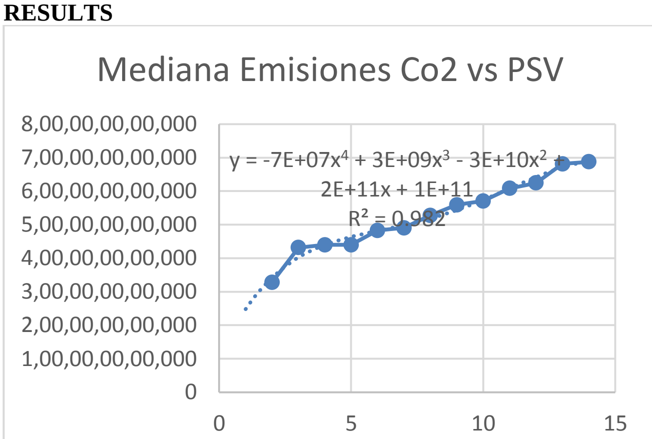

Fig. 27 PSV vs CO2

Through calculations it was obtained that the average of carbon dioxide in the driving cycle taken in the vehicle with the ELM 327 device of 26666.9 g / km of CO2 and applying the regression equation in the FTP-75 driving cycle with the characteristics of the same vehicle an average of 303.09 g of CO2 was obtained.

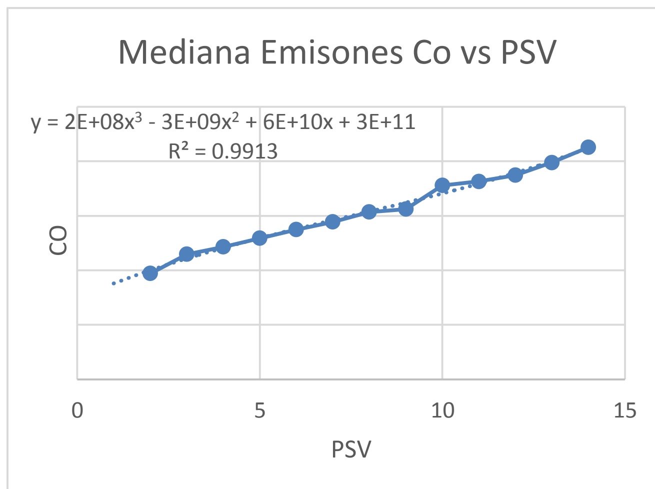

Fig. 28 PSV vs CO

In the calculations carried out it was obtained that the average of carbon monoxide in the driving cycle taken in the vehicle with the ELM 327 device, of 4415.78 g / km of CO and applying the regression equation in the driving cycle FTP-75 with the characteristics of the same vehicle was obtained an average of 5.3137 g / km of CO.

In the calculations carried out it was obtained that the average of hydrocarbons (propylene C3H6) in the driving cycle taken in the vehicle with the ELM 327 device of 147.83 g / km of C3H6 and applying the regression equation in the FTP-75 driving cycle with the characteristics of the same vehicle was obtained an average of 0.2067 g / km of C3H6.

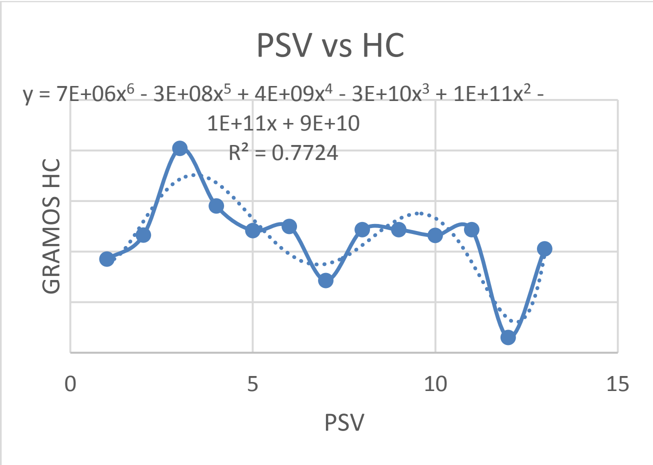

Fig. 29 PSV vs HC

From calculations made it was obtained that the average consumption in the driving cycle taken in the vehicle with the ELM 327 device of 3086.61 kpl of fuel consumption and applying the regression equation in the driving cycle FTP 75 with the characteristics of the same vehicle was obtained an average of 8.38 kpl of fuel consumption.

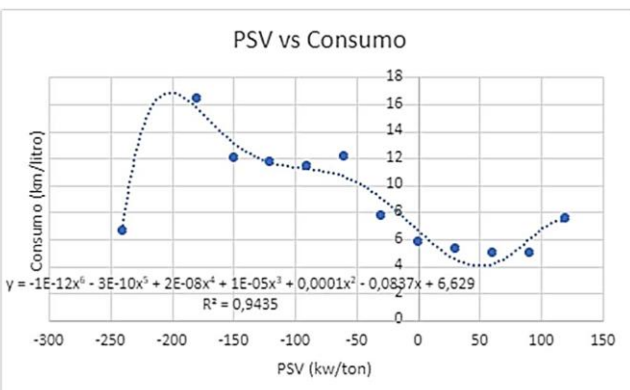

Figure 30 PSV vs Consumption

CONCLUSIONS

- In summary, our work was designed to select a typical driving cycle of a vehicle in the ESPOCH environment, as well as to be able to determine which are the busiest routes at the time the vehicles enter.

- The driving cycles are methodologies with a very wide use there is no single purpose the main characteristic is to determine the representativeness and that depends on the approach given to the research, they are generally used to determine the performance of a vehicle such as its fuel consumption and pollutant emissions, They are also used to determine the operating conditions in real conditions of vehicles such as the driving patterns of drivers at the wheel.

- It is determined that the topology of the route that is followed, specifically the variations of altitude in sections of the track greatly influence the RPM curve of the engine sometimes causing on revolutions, also causes sudden and abrupt changes of instantaneous values of acceleration and deceleration during the trip.

- In short, the contribution of the data obtained can help to carry out analysis of several micro trips on different routes within the ESPOCH, in general to be able to determine in what time and sectors the vehicle comes to idle during its circulation.

- In this way, the OBD II ELM327 device with the cell phone application "Torque Pro", guaranteed us the obtaining of the different data of ALTITUDE, LATITUDE, SPEED, RPM, INSTANTANEOUS CONSUMPTION, ETC. in order to determine how to drive inside the ESPOCH and perform the different respective calculations through the use of various software.

- Finally, the driving mode within the ESPOCH is slow, since there are different parameters that force the driver to adopt this type of handling, through the use of the data obtained it has been determined that for the most part the average acceleration is 0.18, as well as the average speed which is 4.38 (15.76 km / h), This is because there are speed breakers, pedestrian crossings, unforeseen student crossings and slow vehicular traffic.$\frac{m}{s^2}$ m/s

- The factor that most alters the consumption in the institution is the accelerations and decelerations that are generated in it this due to passers-by, breaks speeds, speed limits, therefore, more polluting emissions will be generated within the ESPOCH.

- The different Euro standards help us to control the polluting emissions that are generated within a space through the driving cycle which seeks to mitigate this effect due to the MONTREAL protocol agreed by several countries worldwide.

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