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RESEARCH ARTICLE

AIR POLLUTION INDEX RESULTED FROM PEUGEOT 405 AND PRIDE SABA

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ABSTRACT

Nowadays, regarding to motor vehicle roll in air pollution in major cities, evaluating the contaminant from vehicles is a critical. Therefore, in this study the contaminant of hydrocarbons, carbon monoxide and carbon dioxide produced by Pride Saba and 405 Peugeot were checked during the years 2006-2010. Primary data was collected from light vehicles inspection centers. Also it is used for statistical analysis and compared mean values by Excel software and Duncan's multiple range test at a confidence level of 5% ($p < 0.05$). The results showed that peugeot, compared to Pride, produces more carbon monoxide significantly, while it creates lower levels of pollutants, hydrocarbons and carbon dioxide. The decline in the emissions of hydrocarbons and carbon monoxide, unlike carbon dioxide, of both vehicles were inspected among 2006-2010. Since carbon dioxide, are not among the pollutants measured in safety inspection centers, Pride Saba is a better vehicle in point of energy and environmental standards compared Peugeot 405. We hope to solve air pollution problem in the near future by regularly review and improve the technical performance of domestic vehicles.

INTRODUCTION

Weather is one of the key factors in the environment and human being could not survive even a minute or two without air, while a person can live without food for weeks and without water for several days (Kebriyaee Zade and Nejad Kooraki, 2011). According to Mohammadi (2012), an average adult breathes 20,000 liters of air in a single day, and it is the inalienable right of every person to breathe in clean air. Although millions of tons of harmful gases and aerosols enter into the atmosphere each year due to incomplete combustion of fossil fuels and it deprived the natural right of persons (Mohammadi, 2012). Even today in many major cities all around the world, the air pollution problems will be found. Water pollution is the cause of environmental problems, is considered as one of the main concerns raised by humans and its importance increases every day (Rouhani *et al*., 2006). Air pollution means emissions in the air exceeded from quality level which it exposed the life for human and other animals at risk (Hassan Khani Ghavam, 2011; Vafaei *et al*, 2014). Air pollution classified into two categories: natural and artificial sources.

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Natural air pollution agent is negligible compared artificial agents (Hassan Khani Ghavam, 2011; Gharony, 2013). Most air pollutants, primarily as a result of incomplete combustion of fossil fuels into the atmosphere is a chemical reaction in the combustion chamber of vehicles, industries, refineries, commercial and domestic resources are available. According to Mohammadi studies (2012), even home furnaces also have a role in causing air pollution. However, drug released from automobile exhaust make up more than 75% toxic materials in air pollution of large cities and the most effect resulted from light vehicles (Falahaty *et al*., 2013). Gas produced from vehicles includes ozone (O3), carbon monoxide (CO), nitrogen oxides (NO2), hydrocarbons (HC), oxides of sulfur dioxide (SO2), etc. Each of them could endanger human health (Darvishi *et al*., 2012; Jafari *et al*., 2014). Although some of these pollutants are produced after leaving the vehicle due to chemical reactions in the atmosphere. So that they are classified into two categories: primary pollutants such as carbon monoxide released due to incomplete combustion and secondary pollutants such as ozone is produced by photochemical smog (Mohaghegh and Hajeyan, 2013). In addition, several studies indicate effects of air pollution caused by motor vehicles on the health of humans, animals, plants and even cultural cases (JahanTabi and Saba, 2012; Bayat, 2004). According Asgarieh and Arhami (2011), despite the efforts made in the influencing factors on releasing the pollutant from

light commercial vehicles, still statistics indicate a deterioration of air pollution in large cities such as Tehran. They are due to the increased number of trips within the city, transportation conditions, car travel speed, temperature and ambient pressure and temperature, vehicle wear, fuel consumption and vehicle type which it can have a significant impact on emissions. The global vehicle pollutant standards were reviewed and compared with similar models produced domestically based on impact of new technologies such as variable valve timing systems, variable valve timing intelligent system on reducing exhaust emissions. Result shows that standard for vehicle fuel in Iran is far from Europe (Mohammadi, 2012).

Kebriayee Zadeh and Nejad Koorraki (2011) found in their studies in four stations measuring air pollution in Isfahan that there is direct relationship between air pollution and traffic. In addition, there is more correlation between the pollutants change with temperature relative to precipitation and wind speed. Due to the urban transport and industry is the most important factor of air pollution in large cities, it is necessary to control pollution. So, the purpose of this study was to evaluate and compare the performance of Pride Saba and Peugeot 405, as the best-selling vehicle in Iran, about the production of pollutants such as carbon monoxide, unburned hydrocarbons and carbon dioxide between the years 2006-2010. Finally we will identify more appropriate vehicle environmentally.

MATERIALS AND METHODS

In this study, preliminary data collected from Torghabeh and Hafez vehicle technical inspection centers in Mashhad, Khorasan Razavi Province. In this case, the 4464 cars including Pride Saba produced by Saipa and 405 Peugeot produced by Iran Khodro were analyzed about the concentration of pollutants HC, CO, CO2 and also O2 production rate between 2006 to 2010.

It should be noted that the data were analyzed and calculated using Excel software. This means that emissions of HC, CO, CO2 and O2 concentrations were analyzed by several cars in a year. The processes of producing pollutants and oxygen levels in different years by a car were analyzed after incorporating the number of data. It should be noted that because of the variety of experimental data as well as possible outlier among them, the median statistical parameters and mode were used instead of statistical parameters mean and variance (equations 1 and 2). Finally, experimental data was compared with each other by Duncan's multiple range test at 5% confidence level (P <0.05) according to the formula 3 and 4. Also, the Excel software was used to plot graphs.

If n is odd and n=2k-1, midian (M_d) is (1)

$$M_d = x_k$$

$$k = \frac{n+1}{2}$$

If n is odd and n=2k-1, midian (M_d) is

$$M_d = \frac{1}{2}(x_k + x_{k+1})$$

$$k = \frac{n}{2}$$

: Mad= Median_i ($|X_i - \text{Median}_j (X_j)|$) (2)

$$SP = \sqrt{\frac{(n1-1)MAD1+(n2-1)MAD2}{n1+n2-2}} \quad (3)$$

$$t\_test = \frac{Median\ 1 - Median\ 2}{SP \times \sqrt{\frac{1}{n1}+\frac{1}{n2}}} \quad (4)$$

RESULTS AND DISCUSSION

Evaluation of emissions of HC, CO and CO2 by several cars in a year

Fig 1-3 shows the emissions of hydrocarbons, carbon monoxide and carbon dioxide in different cars in 2010. It can be concluded that, compared with 405, Pride Saba produced lower CO pollutant and higher HC. Although increased HC by Pride is not expected due to the possibility of full ignition mechanism. Producing more HC can be caused by several technical factors, including the failure of automobile spark plugs, tightening vehicle exhaust valve filter, making as dual fuel manually and combustor type. If the plug cannot spark on time and wires leak and electricity does not flow well, there is potential to increase the production of hydrocarbons. The opening and closing of the exhaust valve fillers should be regulated, and if filter tightens, the opening and closing is delayed and if it continues, Inlet and outlet fuel ratio by the fillers are spoiled resulted to unburned hydrocarbons. Since gas produces more oxygen, oxygen sensor located in the exhaust path send higher voltage to ECU in the Injected car which made dual fuel manually. ECU increases injector spray time depending on changes voltage leading to higher fuel consumption. In addition, when the vehicle runs on gasoline mode, some unburned hydrocarbons because sensor information is not sent to the ECU correctly, resulting in greater HC production. The air-fuel mixture reacts in the combustion chamber and ignites. If the chamber has the oval-shaped corners and angles, air trapped within the pores and regulation of amount of fuel and air is disrupted and the HC production increased.

It was found that Pride creates higher levels of CO2 emissions significantly compared with 405 car (Fig 3). Results for the years 2006,2007 , 2008 and 2009 are not provided because of the similarity of the results of 2010. This may be due to different mechanisms of combustion (complete or incomplete) in the vehicle. The results of this investigation correspond with Sarayy *et al.* (2011). Insufficient amount of O2 and temperature, mixing fuel with air in the combustion chamber and having enough time are factors that resulted to complete combustion. Thus it leads to the production of CO2. Incomplete combustion occurs when the opposite above factors occur which HC and CO can be produced. The study of the oxygen content of the exhaust on the car is necessary to identify the vehicle ignition mechanism.

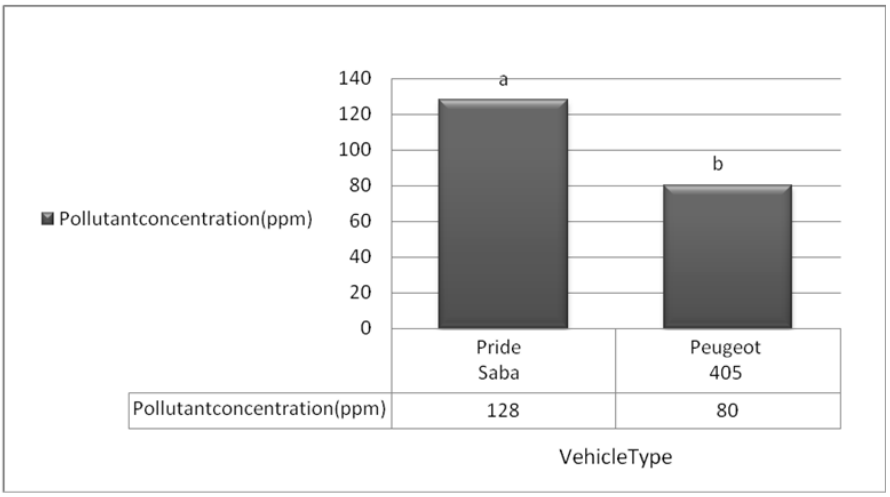

Fig. 1. The emission of hydrocarbons in several cars in 2010Averages that have common letters are not significantly different according to Duncan's test (5%)

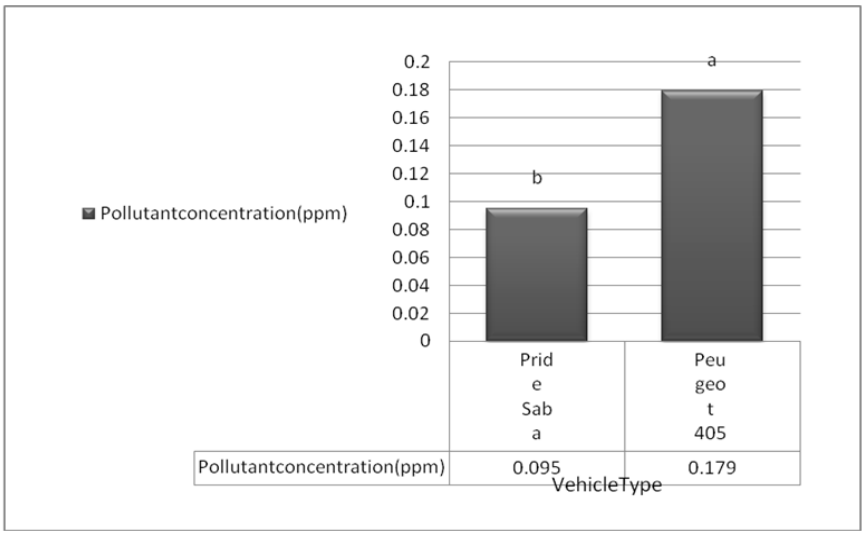

Fig. 2. Emissions of carbon monoxide in various vehicles in 2010Averages that have common letters are not significantly different according to Duncan's test (5%)

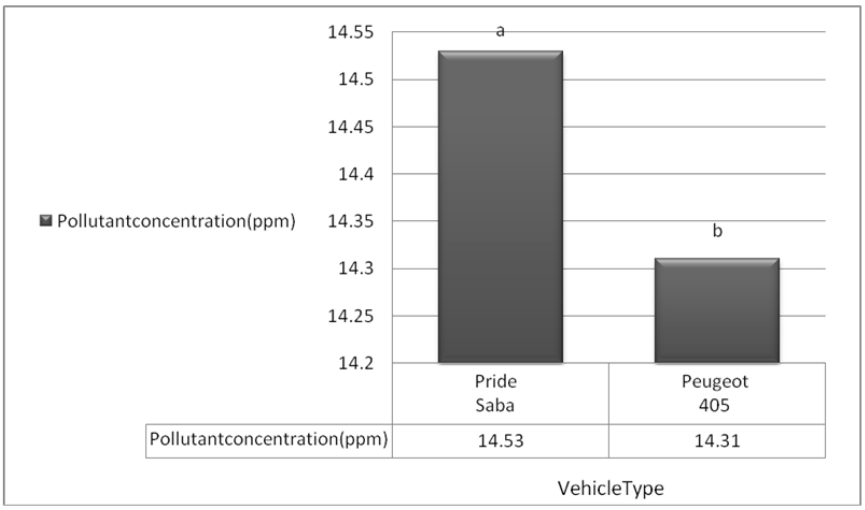

Fig. 3. The amount of carbon dioxide emissions in the various vehicles in 2010Averages that have common letters are not significantly different according to Duncan's test (5%)

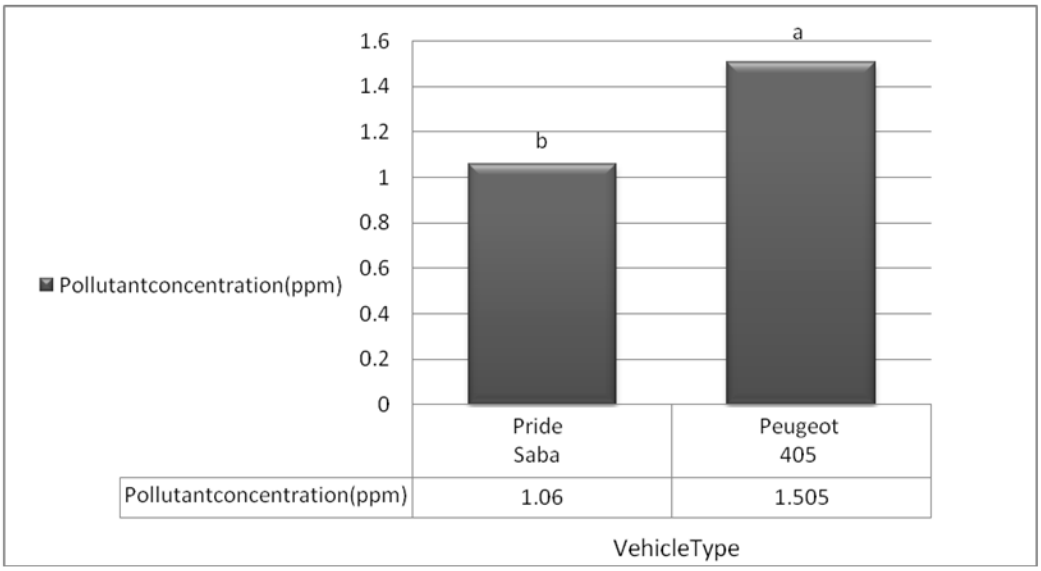

Fig. 4. The amount of oxygen in the exhaust of vehicles in 2010**Averages that have common letters are not significantly different according to Duncan's test (5%)**

The results showed that the highest oxygen content of the exhaust was produced from Peugeot 405 at all (Fig 4). Complete combustion of the fuel and air mixture can occur only if the ratio of these components is precisely in defined limits. For gasoline engines, the required ratio is 7.14 to 1. This means that if 7.14 g air mixed with 1 g fuel, combustion will be complete. Thus, according to the results which demonstrate the highest amount of carbon monoxide in 405 Peupeot, it can be concluded that the combustion of fuel in the Peugeot 405 is incomplete and the Pride is complete.

Based on the approval for determining the vehicle exhaust emissions by Technical examination department of the Interior Ministry, Majlis Research Center and Traffic Authority (2010), the allowable emissions of HC and CO and O2 gas in vehicle inspection centers v are 400- 0 4 0 4 0 ppm respectively . It should be noted that CO2 does not include among emissions due to the safety and permissible limit of its output is not defined. Although there is significant difference in the amount of pollutants produced hydrocarbons, carbon monoxide and carbon dioxide produced by these car (Fig 1-3). So, based on obtained results it can be concluded that Saba Pride is a more appropriate vehicle in term of environmental standards than the Peugeot 405. According to research Sarayy *et al.* (2011), domestic car such as Peugeot 405 still are far from European and American in terms of environmental standards. This resulted from many reasons including engine performance (engine type, engine size, engine power, maximum torque, maximum speed), mechanisms of combustion of fuel (fuel, ignition systems and valves), the efficiency of the engine sensors (gasoline vapor control system, exhaust catalyst, oxygen sensor, manifold air pressure sensor, coolant temperature sensor, camshaft position sensor and input temperature sensor), the size of the ring (wheels), Carpet of floor, window, body design , the weight of the vehicle and pollutant standards (Table 1).

Production process evaluation of emission HC, CO and CO2 at various periods by a car

In review the process of producing vehicle emissions by Pride Saba between the years 2006-2010, it shows clearly that the HC and CO emissions significantly declined, however, CO2 emissions, dramatically increased (Table 2).

Articles offered by organization of sale and after sale services shows that producing the types compatible with environmental standards is an important factor to reduce emission in current year. In addition, changes in Kia Pride Saba led to higher efficiency and better performance of the engine's fuel system. These changes include:

- Maximum torque for the new type of the car has increased. Such that maximum torque of regular Pride and Pride 132 is 103 and 103.3 Newton meters at 2500 rpm, respectively.
- Car roof pillars and doors in the new Pride have reinforced to prevent personal injury in accidents. This increases the weight of Pride 131 and 111 in recent years, resulting in a greater balance than the old Saba Pride. Therefore, the vehicle's fuel consumption is increased and amount of pollution produced is declined if the vehicle works well and complete consumption is occurred.
- There is an output emission system called SCR controls import the hazardous emissions. Catalyst SCR use a different approach to reducing emissions, such that after the removal of gases from the DPF filter, or dust and soot filters, a liquid injected to output gas consisted from a combination of one-third urea and pure two-ionized water (water distilled). It is known as diesel exhaust fluid (DEF) or ddblue. This will change the chemical composition of the exhaust gases, resulting in relatively cleaner air to the atmosphere.

- There is an automatic ventilation system in new models of Pride improved fuel system and reduce the pollution level.
- This applies to the ventilation system inside vehicle. It reduces fuel consumption only when the fan system is used without using air conditioner and heater and windows closed.

Moreover, the trend of emission of HC, CO and CO2 by Peugeot 405 among 1385 to 1389 shows that the HC and CO emissions declined significantly, although CO2 levels increased significantly (Table 3).

Table 1. Factors affecting fuel combustion mechanism and its consequences (Roohi *et al.*, 2012; Zomorodi Sufis, 2006; Marzban Rad and Amrollahi Buicky, 2011; Garshasbi, 2004; Shahabi, 2008; Organization of sales and after sales service of Iran Khodro, 2003)

Technical Specification	Peugeot 405	Pride Saba	Description
Moto kind	XU7 JP/L3	Four Stroke gasoline	Kind of motor in designing the structure of combustion chamber (check the air-fuel ratio) is important which it is regarded in evaluated vehicles.
Motor volume (cc)	1323	1761	The higher the engine size increases, the fuel consumption increases with increasing engine power. But this is not to increase pollution.
Motor power	100 HP on 6000 rpm	36 HP on 6000 rpm	Engine power affected the fuel consumption so that higher engine power, increasing the fuel consumption. However, this is not to increase pollution.
Max. torque	153 NM in 3500 rpm	103 NM in 2500 rpm	The engine torque higher, increased engine power due to increased fuel consumption. However, this is not to increase pollution.
Max. speed (KM/H)	182	170	Increasing the motor speed, fuel consumption also increases. The fuel consumption in Peugeot 405 is more than in Pride.
The average of fuel consumption (Lit/100km)	7	8/98	The fuel consumption increases, the amount of pollutant increased. Accordingly, Peugeot 405 produces more pollution.
Kind of fuel	Unleaded gasoline with octane 95	Unleaded gasoline with octane 91	Fuel type affected the engine performance. The higher the octane number of the gasoline engine, improved efficiency and reduced pollution.
Valve numbers	8	8	Compression ratio (ratio of fuel and air) is other factors in combustion. The higher the compression ratio, improved engine performance and reduced fuel consumption. Changing the design of the combustion chamber and more valves mounted in the cylinder head increases the compression ratio as well as reducing the disadvantages.
Control system of gasoline vapor emission	include	Include	It takes gasoline vapor and prevents their release into the environment and reduces pollution.
Catalytic Converter	include	Include	Catalytic Converter convert HC and CO into CO2 and H2O (complete combustion) and convert nitrogen oxides to nitrogen and oxygen. Useful life of catalytic converters estimated to be 160,000 km in perfect condition. Consequently, the efficiency of the catalyst was as the same in both cars.
Oxygen sensor	include	Include	The oxygen sensor determined combustion condition of motor by measuring the oxygen in the exhaust gases and sends the information to the ECU (Electronic Control Unit).
Sensor of air intake manifold	include	Include	Sensor of air intake manifold convert the manifold air pressure into voltage and it send voltage changes into ECU. ECU calculated the mass of input air by using the sent signals, sensor of input air temperature and Potentiometer of gas valve. Then the fuel injection and spark advance adjusted to ensure complete combustion occurs. The manifold air pressure sensor of Peugeot 405 is located below the fan tray while the it is located directly on the air intake manifold in Pride. This leads to greater efficiency of the sensor is in PRIDE.
Coolant temperature sensor	include	Include	Coolant temperature is used for reporting the water temperature to ECU to adjust the fuel and ignition systems and displaying the engine water temperature. The sensor of Peugeot 405 is a sensor located behind the cylinder as a two-legs sensor. But, two separate sensor is designed in Pride. Type and location of sensors depends on automotive design and it does not affect the performance of the sensor. Therefore it is as the same for both cars.
Camshaft position sensor	include	Include	Camshaft position sensor gives the ignition timing information to control unit of ECU to control fuel system.
Intake air sensor	include	Include	At various temperatures, the weight of air in a particular size is not fixed. Available air in the constant volume at a lower temperature is heavier than it in warm air. So the sensor adjusts input air properly and improved combustion process.
Ring Size (inches)	14	13	If the ring size is inconsistent with the chassis design, the fuel consumption increases.
floor carpet Quality	Desirable	Desirable	Floor car Carpet affected on fuel consumption indirectly through thermal fluctuations between the room and outside the vehicle. Even bad material is effective in the automotive heat exchange impairment. It caused that the heating and cooling systems are functioned and fuel consumption increased.
Car window	include	Include	Car window play a role in fuel consumption by changing the volume of air inside the room indirectly. Such that open window decreased the vehicle speed due to the increased volume of air and fuel consumption decreases.
Car Body Design	The number of occupants in designed vehicle (5 people)	The number of occupants in designed vehicle (4 people)	The special design of the car body caused to focus on the weight in the front of car. It leads to useful friction in running vehicle. In addition, it impact on brakes performance. So that, improving the weight distribution reduces the fluctuation in engine performance.
Approximate weight (kg)	1100	870	Mismatch between the type of motor vehicle and weight increases fuel consumption. So, the Pride weigh is less than Peugeot 405 and the Pride is a better car.
The emission standards	Euro 2	Euro 2	Emission standards represent the allowable limit of vehicle emissions. It includes fuel standards Euro 1, Euro 2, Euro 3, Euro 4 and Euro 5. The higher Euro standards, vehicle emissions rates will be lower.

Table 2. Emissions of hydrocarbons, carbon monoxide and carbon dioxide produced by Pride in different years

Emission Type			Year
CO_2(ppm)	HC(ppm)	CO(ppm)	
	184[a]		1385
	178[b]		1386
	164[c]	0.425[b]	1387
	142[d]	0.441[a]	1388
14.19[d]	128[e]	0.3575[c]	1389
13.94[e]		0.2665[d]	
14.405[b]		0.095[e]	
14.26[c]			
14.53[a]			

Averages that have common letters are not significantly different according to Duncan's test (5% level)

Table 3. emissions of hydrocarbons, carbon monoxide and carbon dioxide by Peugeot 405 in various years

Emission Type			Year
CO_2(ppm)	HC(ppm)	CO(ppm)	
	120[c]		1385
	122[b]		1386
	130.5[a]	0.722[a]	1387
	112.5[d]	0.641[b]	1388
13.45[c]	80[e]	0.631[c]	1389
13.38[d]		0.324[d]	
13.31[e]		0.179[e]	
13.7[b]			
14.31[a]			

Averages that have common letters are not significantly different according to Duncan's test (5% level)

It would be due to optimal production of Peugeot 405 in recent years. Modifications made to this car include

- Using TU5 motor vehicles manufactured by Peugeot in GLX and SLX of model 90would reduce fuel consumption by 30 percent approximately. Thereby the amount of pollution reduced by this type of car significantly.
- A current computerized engine control system, based on multi-sensor information is to regulate engine performance, emissions, and other important functions. If the sensor is not present accurate information, it causes problems such as increasing fuel consumption and emissions. One of the most important sensors is the oxygen sensor.
- This sensor is as the old sensor, but it involves a better mechanism and higher efficiency.
- Create a ventilation system in new model of Peugeot 405 that improves fuel system and reduces the pollution level.

Conclusion

The results showed that the emissions of hydrocarbons, carbon monoxide and carbon dioxide is lower than standard level in Peugeot 405 and Pride Saba. Although Pride Saba is introduces as a better car in term of environmental standards because of the low emissions and complete combustion of fuel. So we shall try to reduce the fuel consumption and air pollution in order to get a safe environment by following task: producing high quality vehicles compatible with global environmental standards, increasing fuel quality, using more proper fuel, equipping the technical examination centers to record and control systems of air emissions, particularly for heavy vehicles, encouraging the initiatives researchers to investigate and control of air pollutants continuously, traffic management, providing facilities for people to replace old vehicles with new one, increase public awareness about effects of air pollution, educating environmental concepts in different levels of education in order to have a new generation, encouraging people to use public transport such as cycling and applying the correct driving method.

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