Study and Analysis Emissions Specifications for Iraqi Automobiles

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Abstract

In this research, focused on the environmental pollution from fuel combustions of automobiles, the study compared the maximum allowable limits for Iraqi emissions standard specification with the European emissions standard specification. Whereas many different between the Iraqi specification and European specification. The first one is limited unlike the second specification, which is dealt with all polluting gases, as well as differences in the measuring units between them. The Iraqi specification measures the emissions in ideal conditions while the European depends on the measurement on different operational conditions.

This study was conducted on 35 automobiles, the emissions data was obtained by using an exhaust gas analyzer and represented by using a qualitative control tool ($\bar{X}$- control charts); Minitab software version 2016 was used to generate quality control charts.

Process capability index applied to measure the degree to which emissions meets the standard specifications.

The results by control charts showed that about 30% of the automobiles emissions exceed the limits of the Iraqi standard specifications. This in turn affects negatively to the Iraqi environment, because emissions affect directly and indirectly to the environment and human health.

Quality assurance requires continuous monitoring and Periodic inspections of automobiles to minimize and reduces harmful emissions from fuel combustion**;** therefore must be updated specification, as appropriate with the Iraqi environment.

Keywords—Emissions, Exhaust automobile, Iraqi standard specifications, Quality control, European standard specifications, Process capability indices, Quality assurance.

1- Introduction

Air pollution can be defined as phenomenon harmful and very important environmental public problem at the same time because its affect on life of begins on the earth; it is a complex problem posing multiple challenges in terms of managing and mitigation of harmful pollutants. Air pollutants are emitted from anthropogenic and natural sources; they may be either emitted directly (primary pollutants) or formed in the environment (as secondary pollutants) [1], [2], [3], [4].

In general, pollution results from modern technologies that add exotic matter to the air or the atmosphere. This, in turn, will affect on the quality of the resources and change the characteristics of the atmosphere to become unsuitable for the humans [5], [6]. However, some define the pollution as the undesirable change in physical, chemical, and biological properties of air. The pollution causes damage for human health, and other organisms in the environment [7].

Benzene is one of the most prominent hydrocarbons that form the gasoline that affect human health. Its breakdown in the body produces toxins that can cause cell mutations (cancer). Its long-term intake can be harming the inner organs and bone marrow, which causes anemia. In humans and animals, benzene accumulates in the brain, bone marrow and fatty tissue [8].

Health scientists in the world divided these pollutants into five groups according to their types and their physiological effects on the human are: irritants, Suffocation, narcotics, toxic substances and suspended solids [9].

Diesel and gasoline automobile exhale large quantities of HC, Nox, CO, CO2, PM, Sox, and Pb. A growing vehicle population and the high emission levels of these automobiles are contributing to the air pollution and health gradually more in the cities of developing countries, According to [10]. Consistent with the global source the middle eastern automotive sector will grow double as fast as that of Western Europe and the U.S between 2012 and 2020 [11].

The automobiles pollution depends on the quality of the fuel. So the characteristics that determine fuel quality also become important. A high pressure in the case of gasoline engine causes a high evaporative emission while an increase in the density results in a simultaneous increase in CO and HC in the exhausts. Likewise, in the case of diesel automobiles, a higher density causes higher smoke, CO and NOx emissions, while enhancing the ignition quality lowers the smoke emission [12].

These pollutants from automobiles exhausts impact on ultraviolet radiation from the sun, causing a chemical reaction of light, resulting in the formation of what is known as dark smoggy smoke, which remains suspended in the atmosphere for long periods, causing a lot of human health damage [13].

The most important pollutants from automobiles exhaust due to the fuel combustion is as follows [14], [15], and [16]:

- Carbon monoxide (CO): If inhaled to more than (2.5 mg / L) within an hour leads to acute poisoning of the person in the case of inhalation, this percentage may lead to direct death and heart failure. This gas constitutes (10%) percent of the emitted gases of automobiles.
- Nitrogen oxide gas (NOx): Increasing of the gas in the atmosphere leads to slow poisoning and difficulty in breathing. This gas account for (12%) of total exhaust gas from automobiles.
- Hydrocarbons (HC): This composites cause of acute poisoning, neurological, respiratory disorders, dysfunction of the heart and lungs and kidneys. As well as, the significant impact on the incidence of cancer in humans. Also, the accumulation of benzoyberin in the human body in large quantities leads to cancer.
- Nitric acid (HNO3): The presence of this gas in the atmosphere leads to serious infections of the respiratory system and eyes. The medical studies confirmed that human could carry Alacroliyn by (0.007 mg) / L for one minute.
- Lead (Pb): Out with the exhaust gas into the air in the form of solid objects with a diameter less than one micrometer, and when they enter the human body in the large quantities lead to serious cases of severity of poisoning.
- Particulate matter (PM): Its ash and soot.

There are many previous studies on environmental pollution from automobiles exhausts; below we will review some of them:

[17] was investigated the impact of automobiles exhaust emission, in particular Carbon Monoxide, on the ambient air quality in Duhok City and displayed content by used Geographic Information System (GIS) technology. The results revealed that the average concentration of carbon monoxide in the most polluted area’s air was found to be 11.6 ppm (8 hr average) in Kani Mahmadke area, which was higher than the local and international standards. She assumed Statistical Package for the Social Sciences (SPSS) techniques, the multi linear regression equation was been set for predicted CO levels.

[18] were studied the causes of environmental pollution result by the exhaust of gasoline and diesel automobiles in the city of Misrata, and they determined the risks that result from the pollutants resulting from the combustion of fuel in the internal combustion engines in the city. The result showed Gasoline exhaust is the main source of both (CO, CO2) pollutants with 56% and 33.5% respectively, and (Pb) with a quantity of 8.622 tons per year at 02. 0%. This amount is not simple if taken into consideration the dangerous effect; while noting that the diesel exhaust is the main source of 86.8% carbon dioxide and soot pollutants 0.52%, sulfur dioxide 1.5% and NOx 6.8%; while these quantities and percentages were marginal for gasoline engines. They also found that the percentage of pollutants from carbon monoxide was 4.19% of the total diesel pollutant. Hydrocarbons were estimated at about 9.7% of benzene pollutant. Sulfur dioxide represented a marginal percentage of benzene pollutants estimated at 0.025%, while the lead (Pb) has not recorded any percentage of diesel pollutants.

[19] Established a relationship between the volume of activity and the movement of automobiles motor of various compounds and contaminants resulted from exhaust pipes, such as sulfur dioxide, particulate matters, oxides of nitrogen, and unburned hydrocarbons. They demonstrated those contaminants were increased during periods of begin and end of working hours for government departments. Some types of sulfur compounds (H2S and SO2) concentrations were at serious health-threatening levels, which was a result of the high sulfur content in the Iraqi fuel.

2- Quality Control Tools

Quality control is one of the statistical methods of process control. Its aim to get the products or service of the best quality according to the required specifications. While the protection of producer and consumer, As well as that quality control leads to a reduction the costs, correcting deviations and errors in the provision of the service, through know the reasons for the deviation that occurred as well as proposed the proper procedures to prevention and treatment **[20].**

Among these methods the control chart which deals with the continuous statistical analysis to study the change and the deviation in the level of quality. Whether, the product or the service provided to the customers. In addition, there is another statistical method called sampling plans and the basis in these two methods. The differences between the production units; control can determine whether the process is acceptable or not, and if there are minor differences or deviations the process is acceptable and under control. If these differences or deviations exceed certain limits, the process can be considered unacceptable **[21], [22].**

Sampling techniques were suggested as a response to the impracticality of inspecting every entry, methods concerning. The performance of samples as an indicator of the actions of the entire population has a strong statistical body of theory to support it **[21].**

Quality control contains the major tools that assist to accomplished the best quality, quality control tools can be classified as (Histogram, scatter diagrams, the Pareto chart, check sheets, cause-and-effect diagrams, control charts, defect-concentration diagrams, experimental design methods, and sampling inspection)**[23].**

This study was focused on the quality control chart whereas any process is subject to inconsistency. Essentially, this inconsistency falls into two categories called (chance causes) and (assignable causes). The process exhibiting only assignable causes is described as being 'out of control.' whereas a process exhibiting chance causes is usually described as being 'in control' or 'in statistical control'. The basic aim of control charts is the enhancement of processes via the detection of variability due to assignable causes. It is then up to people such as process operators or managers to find the underlying cause of the variation and take action to correct the errors in the situation **[24], [25].**

Control charts ($\bar{X}$ chart) consist of a center line or mean ($\bar{\bar{X}}$), a horizontal line above the center line, called UCL (Upper Control Limit), and another horizontal line under the central called the Lower Control Limit (LCL). The centre line ($\bar{\bar{X}}$) refers to the ideal value of the attribute being measured. Ideally, the points should flutter around this value in a random way signifying that only chance variation is present in the process. The upper and lower control limits (UCL, LCL) are selected in such a way that so long as the process is in statistical control, practically all of the points plotted will fall between these two lines. The points are connected so that it is easier to detect and trends present in the data. The fact that a particular control chart shows all of its points lying between the upper and lower limits does not essentially mean that the process is in control **[20], [26].**

The mathematical formula of centre line, upper and lower control limits according to **[26]** represented mathematically as equations below:

$$\bar{\bar{X}} = \frac{1}{n}\sum_{i=1}^{n}\bar{X}_i \qquad (1)$$

$$UCL_X = \bar{\bar{X}} + \frac{3\bar{R}}{d_2\sqrt{n}} \qquad (2)$$

$$LCL_X = \bar{\bar{X}} - \frac{3\bar{R}}{d_2\sqrt{n}} \qquad (3)$$

Where; ($\bar{\bar{X}}$) is the mathematics mean of the measurements for X_1…....n denotes the number of samples.

R charts are related to $\bar{X}$ chart were used to monitor the mean and variation of a process based on samples taken from the process. The measurements of the samples constitute a subgroup. Typically, an initial series of subgroups is used to estimate the mean and standard deviation of a process **[20]**.

The upper and lower control limits of the range chart are determined from the following equations **[27]:**

$$UCL_R = D_4\bar{R} \qquad (4)$$

$$UCL_R = D_3\bar{R} \qquad (5)$$

Where; D3 and D4, which replicate the usual three sigma (σ) limits for various sample sizes, are found in the standard tables for quality control chart.

In this research control charts ($\bar{X}$) are used to illustrate the measured data and show their extent to which they exceeded the acceptable limits of Iraqi standard specifications for automobiles emissions.

3- Process Capability Index

Process capability is the long-term performance stage of the procedure after it has been brought under statistical control. In other words, process capability compares the output of a process to the requirement limits by using capability index. The evaluation is made by forming the ratio of the spread between the process specifications (the specification "width") to the spread of the process values, as measured by 6 process standard deviation units (the process "width") **[28].**

There are a number of statistics that can be used to compute the capability of a process such as Process Capability (C_p), Process Capability Index (C_{pk}) and Process Capability Measure (C_{pm}).

The$\mathbf{C_p}$, $\mathbf{C_{pk}}$ **and** $\mathbf{C_{pm}}$ statistics suppose that the population of data values is normally dispersed. Assuming a two-sided specification, if **μ and σ** are the mean and standard deviation, Upper Specification Limit (**USL)**, Lower Specification Limit **(LSL)**, and Target **(T)**, respectively.

The capability indices according to **[29]** are calculated as following equations:

$$C_p = \frac{USL-LSL}{6\sigma} \qquad (6)$$

$$C_{pk} = \min\left[\frac{USL-\mu}{3\sigma}, \frac{\mu-LSL}{3\sigma}\right] \qquad (7)$$

$$C_{pm} = \frac{USL-LSL}{6\sqrt{\sigma^2+(\mu-T)^2}} \qquad (8)$$

When $\mathbf{C_p} < 1$ mean the process is not capable of meeting specifications, $\mathbf{C_p}$= 1 process is marginally capable, and $\mathbf{C_p}$> 1 process is capable of meeting specifications.

There is another capacity index Part per Million which is represent the ratio between the number of pieces override the specifications limits. When $\mathbf{C_p} > 1.33$ mean the process to some extent capable, $1< \mathbf{C_p} < 1.33$ the process is a barely capable, and $\mathbf{C_p}<1$ mean not capable process **[28].**

4- Experimental Procedure:

In this study, emissions outputs data were collected through the exhaust gas analyser in the Iraqi maintenance and testing centres for 35 types of automobiles within the engine categories-powered by gasoline. The engine size selected as (1.6 - 3.0 liter) within the models (2000 - 2014), which are includes 90 % of the types of automobiles in Iraq.

The study was focused on the polluted gases emitted from the exhaust (Co, Hc, Nox) which are differ from one automobile to another, depending on engine type and conditions such as (operating situation, gasoline type, driving type and catalyst status). The measuring units of exhaust gas analyser device set as to (CO) gas was percentage (%) of volume, while for (Hc, NOx) gases were a Part Per Million (PPM). The emissions data were collected at idle speed; and each type of automobiles were given a specific numbers instead of the company names as shown in **Table (1)**.

By comparing the measured emissions from Iraqi automobiles with the Iraqi standard specifications according to **[30]** as shown in **Table (2).**

The study was found that the Iraqi standard specification has only emissions limit for (CO, HC) gases; and these emissions were determined at idle speed (600-900) Round per Minute (R.P.M). Therefore, the results were compared with Iraqi standard specification for these gases.

It should be noted these gases (CO, HC) are not enough in the direction of computation specifications to determine the pollution of the environment. The combustion outputs contain more gases and contribute to pollution more. After the study European standard specifications shown in **Table (3)** were found some differences in measurement units and specifications limits for all gases, which depend on it to measure the automobiles emissions **[31],[32], [33].**

Table (1): Summery of emissions specifications from tested automobiles

Automobiles NO.	CO (%)	HC (PPM)	NOx (PPM)	Automobiles NO.	CO (%)	HC (PPM)	NOx (PPM)
1	0.12	153	1090	**19**	2.5	223	1155
2	0.133	41	930	**20**	0.03	119	1329
3	1.083	1546	405	**21**	0.43	149	1363
4	0.003	800	201	**22**	0.03	60	193
5	2.67	1248	366	**23**	0.16	63	109
6	2.8	124	1050	**24**	0.76	112	272
7	0.68	52	517	**25**	0.43	246	1968
8	2.6	600	426	**26**	0.52	119	2945
9	0.46	58	408	**27**	0.93	153	2368
10	0.93	681	2115	**28**	5.27	867	62
11	0.93	101	1730	**29**	1.3	517	989
12	0.93	125	204	**30**	2.43	156	1176
13	1.08	806	1097	**31**	0.38	155	1051
14	0.93	138	1829	**32**	0.72	281	1098
15	0.65	146	10	**33**	0.43	156	1172
16	0.3	46	1467	**34**	2.99	178	875
17	0.57	67	1373	**35**	0.12	153	1090
18	2.59	87	932				

Table (2): Iraqi standard specifications for automobiles emissions

Emissions Standards in speed (600-900) R.P.M	
CO (%)	2.5
HC (PPM)	600
NOx (PPM)	N.A
PM	N.A

(Note: PPM: Parts per Million, R.P.M: Rounded Per Minute, N.A: not available value)

Table (3): Europe standard specifications for automobiles emissions

Stage	Year	CO (g/km)	HC (g/km)	NOx (g/km)	PM (g/km)
Euro 1	1992	2.2	N.A	N.A	N.A
Euro 2	1996	2.3	0.20	N.A	N.A
Euro 3	2000	1.0	0.10	0.15	N.A
Euro 4	2005	1.0	0.10	0.08	N.A
Euro 5	2009	1.0	0.10	0.06	0.005
Euro 6	2014	1.0	0.10	0.06	0.005

The development of European standard specifications for the automobiles emissions were represented and discussed in **Figure (1);** notes that the specifications limits were determined from year 1992 which are focused on the CO gas emissions only, while in subsequent years paying attention to the other emissions. Where CO emission limits was reduced to half in early 2000.

The emissions limits of HC gas were identified at 1996 with maximum value (0.2 g/km) and dropped to (0.10 g/km) at the years later.

At the end of the 20 century the limits of Nox gas emissions were assigned by value (0.15 g/km) and keep on reduced after that; because it is considered one of the most dangerous polluting emissions.

Particular Matter limits were activated at 2009 by (0.005 g/km) and continued constancy without change.

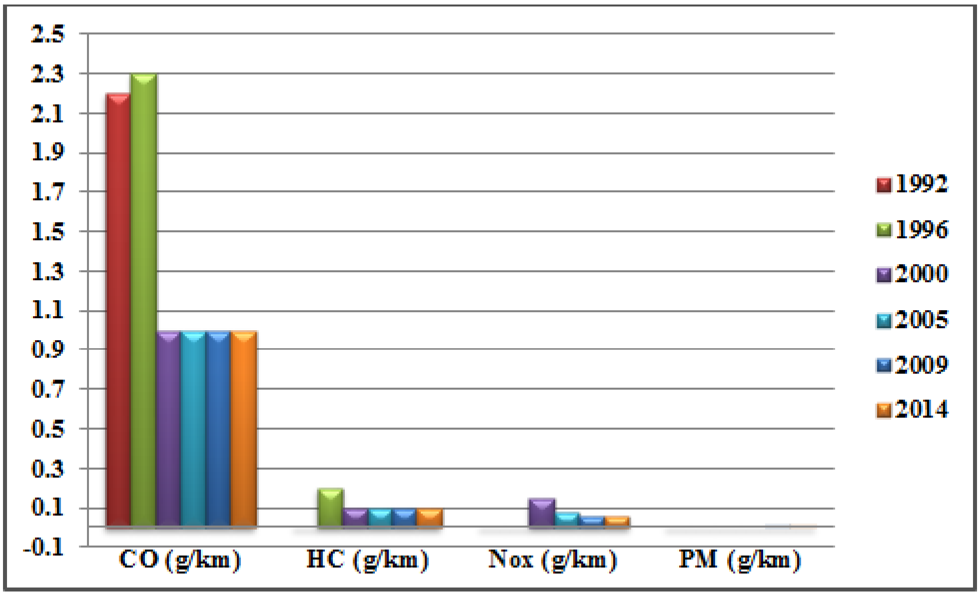

Figure (1): Development of European standard specification for automobiles emissions

Through the above, the study was noticed there are many differences between the Iraqi standard specifications and European standard specifications, where these differences can be illustrated as follows:

Emissions measuring units in Iraqi standard specification was set as a percentage for CO emissions, and other emissions identified measuring units as PPM. While, in European specifications the measuring unit determined as (g/km).

In European specifications, the emissions calculated when vehicle movement at different speeds and not at idle speed like in Iraqi specifications. Therefore, this variance affect the accuracy of the measurement as where as the measuring units in percentage (which are often used to diagnose engine malfunctions) increased with increased emission volume and to clarify it by using this example:

If two automobiles have a same (model, type) were compared, but the difference is only in the engine capacity. International automobiles companies often produce the same automobile, but with a different engine capacity. For example, Hyundai Company produced SENTAVI model 2013, which was manufactured with a 3.3 litre engine capacity and 2.4 litre; The CO emission rate at 900(R.P.M.) is 2% for both automobiles, and it is within the acceptable limit of Iraqi standard emission specifications. However, relative to the engine size, the amount of CO gas emitted from the engine 3.3 litre exceeds the amount of gas emitted from 2.4 litre engine. The emissions rate of CO gas possibly will be approximately to 27%.

So, the study concludes measurement units within the percentage of total volume does not be accurate as pollution parameters.

In addition, the measurements of the gas (CO, HC) in the fuel combustion outputs of the Iraqi specifications are not sufficient to identify the exhaust pollutants of automobiles. This is because the exhaust contains a large set of gases (CO, HC, NOx, PM, CO2) are among the standard emissions to be adopted and conducted periodic inspections to reduce pollution.

Detailed notes and results of emissions specifications of testing automobiles are shown below as a quality control chart ($\bar{X}$ chart), in **Figures (2 - 4)** {Knowing that the red line indicates to the upper and lower control limits and the green line indicates to centre line or means the blue line indicates to Iraqi standard specification} generated employing Minitab software (version 16).

For CO gas emissions the maximum acceptable limits of Iraqi standard specification is (Co = 2.5%), while in European standard specifications a maximum limit is (1.0 g/km for Euro 2014); **Figure (2)** shown the emissions of Co gas from the tested automobiles. **Figure (2)** represents the emissions for six types of automobiles number (5, 6, 8, 18, 29 and 34) exceed the allowable limits of the Iraqi specifications, which the amount of their emissions (2.67, 2.8, 2.6, 2.59, 5.27 and 2.99) respectively. While, the emission of automobile number (29) is fallen outside upper quality control limits which is calculated by **Equation (2)** and the value of UCL equal to (4.019).

Where any exceeds in emissions beyond the acceptable limit lead to pollution of the environment, especially if external effects were added such as increase in speed, poor quality of fuel or under any impressive conditions, which is can be increases the amount of harmful emissions.

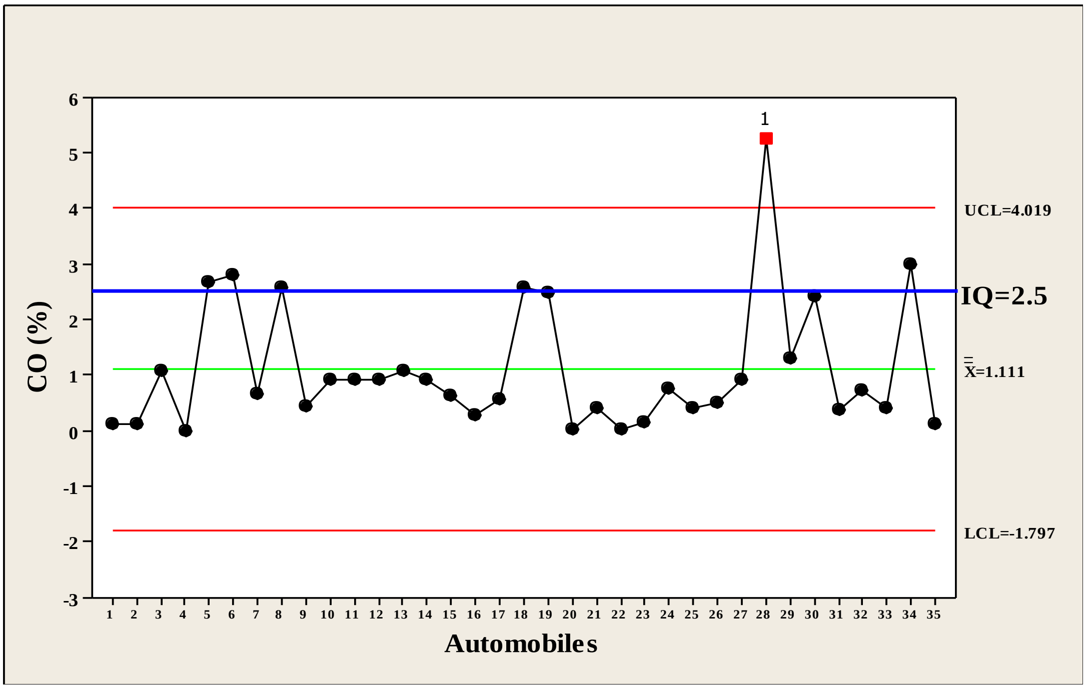

Figure (2): $\bar{X}$ chart of CO emissions of Iraqi automobiles

As for HC gas emissions, the emissions were represented in **Figure (3),** maximum emissions limits for Iraqi standard specifications of (HC = 600 PPM). While, the maximum emissions limits for

European standard specifications (0.10 g/km for Euro 2014). Whereas the, automobiles which have a numbers (3, 5, 10, 13, 28) exceed the maximum limit of Iraqi standard specifications.

That means 14% of the overall automobiles emissions were exceeded the upper emissions limits, which are acceptable by the Iraqi emissions standard specifications. The emissions of automobiles number (3, 5) are outside the upper quality control limits.

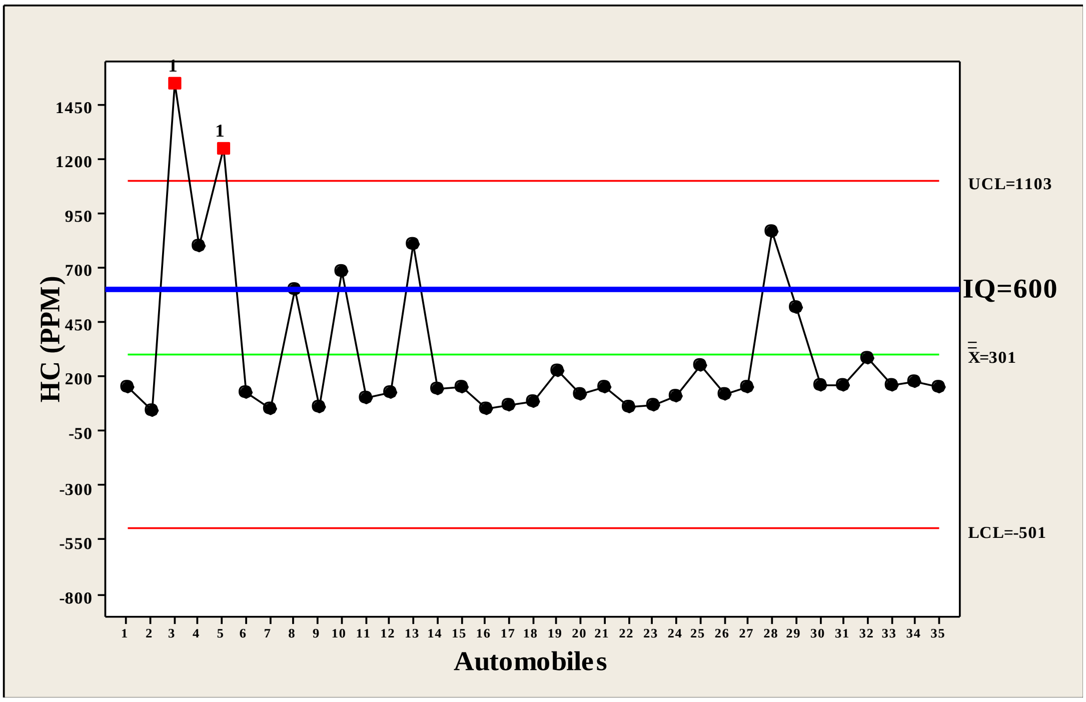

Figure (3): $\bar{X}$ chart of HC emissions of Iraqi automobiles

Figure (4) represents the emissions of automobile which is carried number (26) fallen outside the upper control limits of $\bar{X}$ chart for NOx gas, the value of UCL equal to (2630).

As clarified from **Figure (4)** the automobiles emissions NOx is vary from one automobile to another. The maximum emissions limits of NOx gas are not available in the Iraqi standard specifications. While, the European standard specification was sets the maximum value of gas emission by (0.06 g / km).

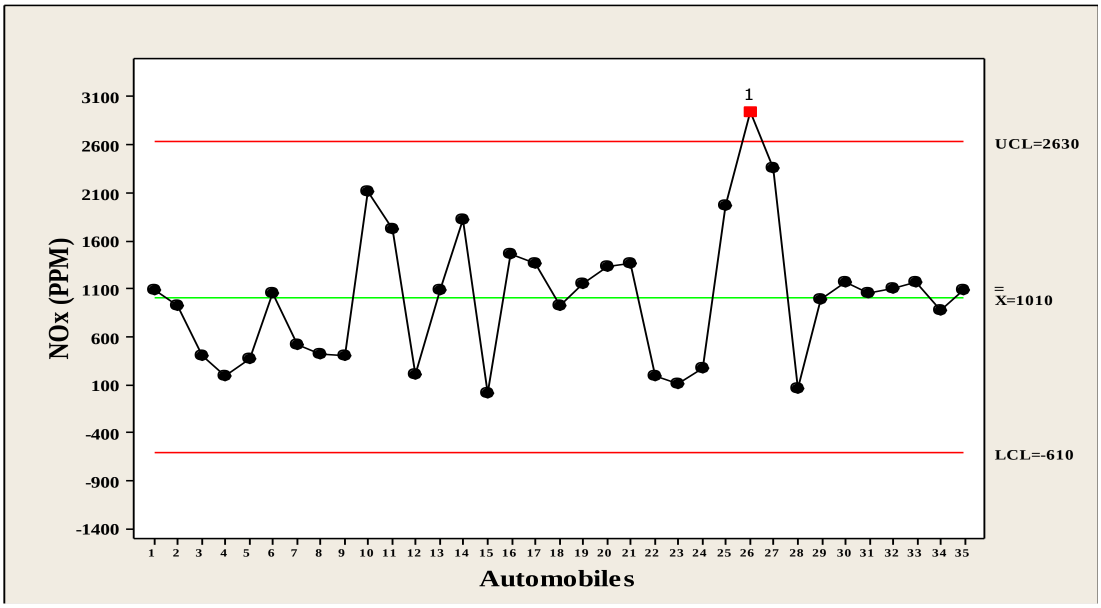

Figure (4): $\bar{X}$ chart of NOx emissions in Iraqi automobiles

Process capability was used to summarize significant percentages and metrics, comprehensive observations and results of the process capability for the emissions specifications of testing automobiles are shown below in **Figures (5, 6 and 7).** It is knowing that the within (red) and overall (black) curves that are superimposed on the histogram. The within and overall curves are normal density functions using the process mean and different variances. The within curve uses the within-subgroup variance, while the overall curve uses the overall sample variance.

Assess the normality of the data by comparing the curve to the bars. A normal distribution is symmetric and bell-shaped. The study was examined the curves to see how closely they follow each other. A substantial difference between the within and overall curves may indicate that the process is out of control, or there are sources of variation are not estimated by the within component. For the piston data, the within and overall curves are closely aligned.

Target, and lower and upper specification limits represented by green and red vertical dashed lines on the histogram.

Capacity index Part per million (PPM) can be measured depend on practical data or with the cumulative distribution function of the theoretical distribution. When process capability greater than 1.33 is required to produce less than 64 non-confirming PPM, this case is contained within 4 standard deviations of the process specifications.

At a barely capable which mean process capability between 1 and 1.33 the process will produce greater than 64 PPM but less than 2700 non-confirming PPM, which is contained within 3 to 4 standard deviations of the process specifications.

Cp < 1 the process is incapable and will produce more than 2700 non-confirming PPM, It is impossible for the current process to meet specifications even when it is in statistical control.

This study fall in the third case, as clarify in **Figures (5, 6 and 7).** The process is not capable which mean the specifications are realistic; real efforts have to be made on the way to improve the process (decrease dissimilarity) to the point where it is capable of producing consistently within specifications.

Figure (5) shown the data was taken for CO emissions of tested Iraqi automobiles, the lower specification limit was (0.003), the upper specification limit (5.27) and the target identified as allowable emission limit for Iraqi standard specification must not exceed (2.5 %).

The summery of the process capability for CO emissions clarified that the process is not capable to meeting specifications depending on Cp < 1; in addition to the emissions are not meet the allowable limits of Iraqi standard specification.

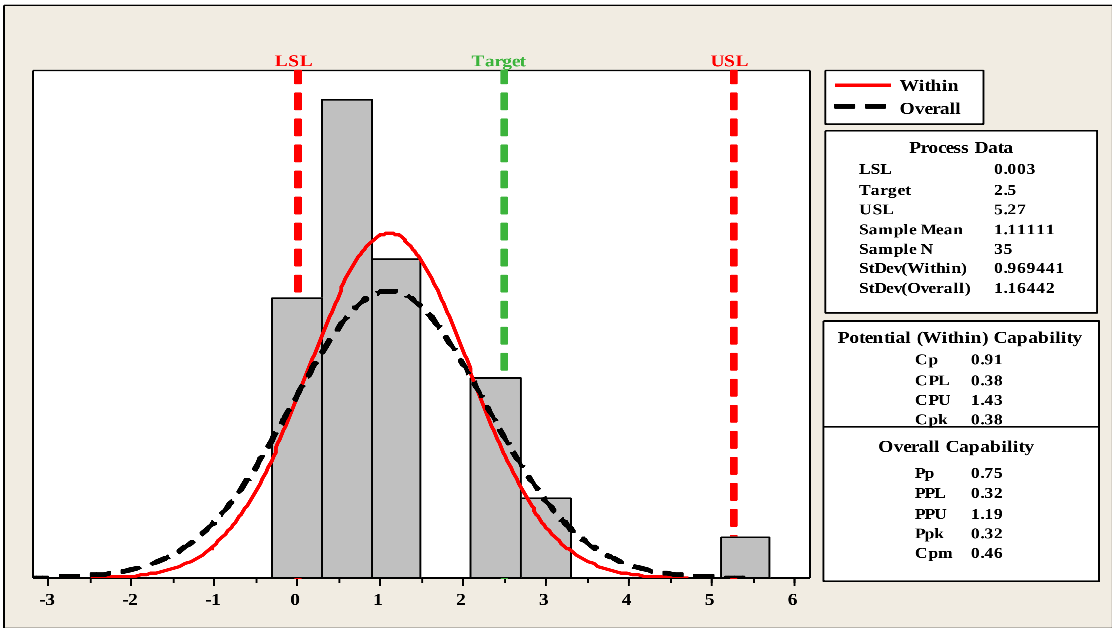

Figure (5): Summary of process capability for CO emissions

Process capability for HC gas emissions as shown in **Figure (6)** represented that the process capability is less than 1 which mean the emissions are exceed the Iraqi standard specification; where the maximum limit or the target should not exceed 600. The lower and upper specifications limits identified from HC gas emissions as (41, 1546 respectively). Therefore, the summary results show that the process capability index and process capability measures < 1.

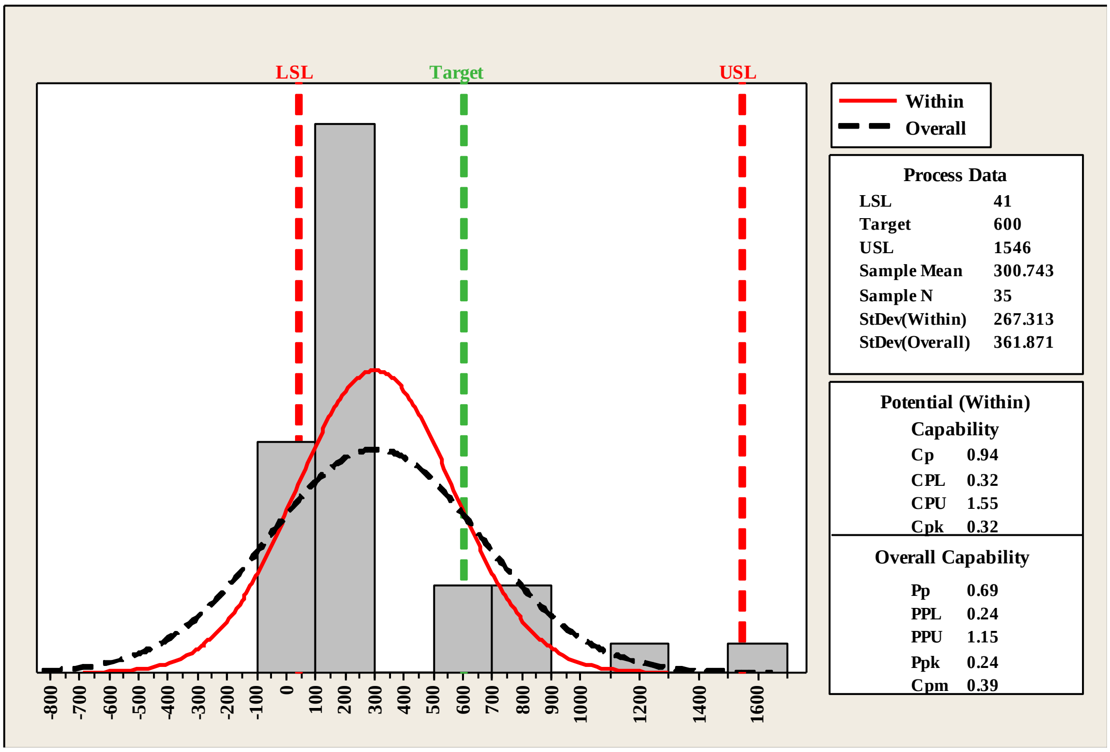

Figure (6): Summary of process capability for HC emissions

The target for process capability of Nox emissions was not specified according to Iraqi standard specifications. The LSL and USL specified as 10 for lower specification limit, 2945 for upper specification limit depending on measured automobiles emissions. The process capability and process capability index of NOx emissions does not different from CO and HC, which were less than 1. The process capability measure does not appear; because it has depended on the target of the specifications as clarify in **Figure (7).**

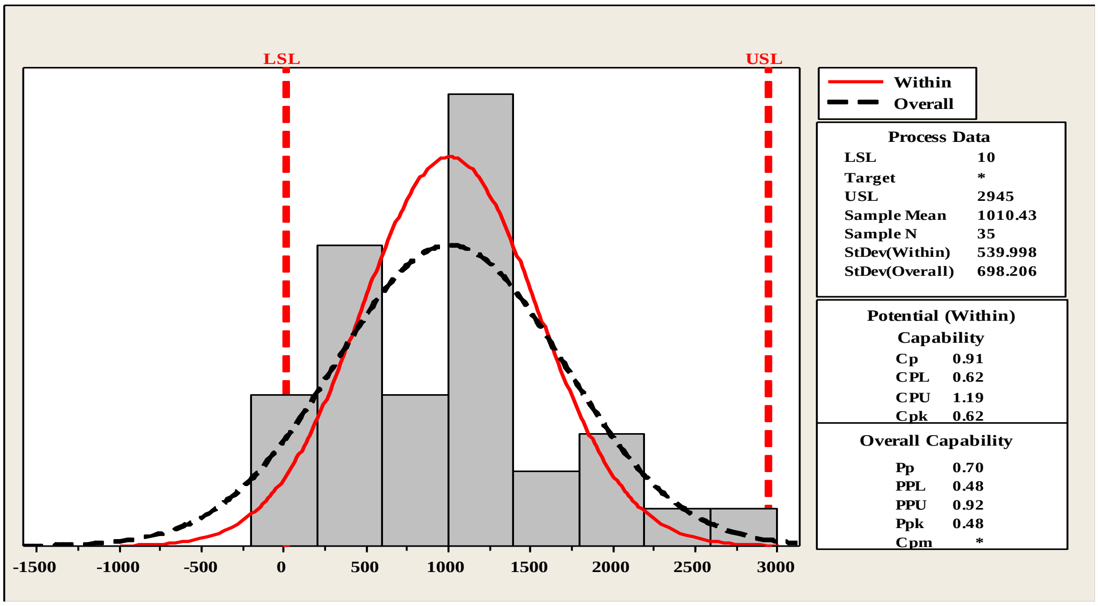

Figure (7): Summary of process capability for NOx emissions

5- Conclusions

Automobiles emissions are affecting on the environment and human health, this study highlighted the following conclusions are deduced:-

- Emissions of (CO, HC) gases for the automobiles are about 30% exceed allowable limits of the Iraqi standard specifications.
- Process capability index of emissions from tested automobiles demonstrate that the process Cp < 1.
- The process is not capable which mean the specifications are realistic; real efforts have to be made on the way to improve the process (decrease dissimilarity) of the emissions.
- Iraqi specifications are limited because only two emissions of (CO, HC) gases were identified in the Iraqi standard specifications.
- The Iraqi specification must be updated as appropriate with the Iraqi environment conditions like as a European standard specification which is continuously updated.
- Quality assurance requires continuous monitoring and periodic inspections of automobiles to minimize and reduce harmful emissions from fuel combustion.
- The Iraqi government should make greater efforts to protect the environment and human health from the risks of pollution caused by transport, which is considered the main cause of air pollution.
- Increasing in harmful emissions is directly proportional to the increase in the number of private vehicles; it is therefore necessary to review existing policies and laws and develop new policies to control this phenomenon, which adversely affect the environment and public health of the population.

CONFLICT OF INTERESTS.

- There are no conflicts of interest.

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دراسة وتحليل مواصفات الانبعاثات للسيارات العراقية

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الخلاصة

في هذا البحث تم التركيز على التلوث البيئي الناتج من احتراق وقود السيارات اذ قارنت الدراسة المواصفات القياسية العراقية مع المواصفات القياسية الاوربية للحدود العليا المسموحة لانبعاثات غازات العادم. حيث ظهرت الكثير من الاختلافات بين المواصفة العراقية والمواصفة الاوربية كون المواصفة العراقية محدودة ولا تشمل جميع الغازات المنبعثة من العادم على العكس من الاوربية، بالاضافة الى ان المواصفة العراقية تعتمد على الانبعاثات الناتجة من المركبات في ظروف التشغيل المثالية في حين المواصفة الاوربية يكون في ظروف تشغيلية مختلفة. هذه الدراسة اجريت على 35 مركبة اذ تم التحقق من الانبعاثات الناتجة من المركبات باستخدام جهاز تحليل العادم ومناقشة التباين في المواصفة العراقية حيث تم دراسة النتائج باستخدام مخططات السيطرة النوعية (X- bar) وتمثيلها بيانياً باستخدام برنامج (Minitab 2016).

وكذلك استخدم مؤشر مقدرة العملية لقياس الانبعاثات الناتجة من المركبات ومدى مطابقتها للمواصفات القياسية. حيث أظهرت النتائجبواسطة مخططات السيطرة النوعية أن حوالي 30٪ من انبعاثات السيارات خارج حدود المواصفات القياسية العراقية، وهذا بدوره يؤثر سلبا على البيئة العراقية لأن الانبعاثات تؤثر بشكل مباشر وغير مباشر على البيئة وصحة الإنسان. ان ضمان الجودة يتطلب الرصد المستمر والتفتيش الدوري للمركبات للحد من الانبعاثات الضارة الناتجة احتراق الوقود وبالتالي يجب تحديث المواصفات القياسية العراقية بما يتلائم مع البيئة العراقية.

الكلمات الدالة: - الانبعاثات، عادم المركبات، المواصفة القياسية العراقية، السيطرة النوعية، المواصفة القياسية الاوربية، مؤشر مقدرة العملية، ضمان الجودة.