

## Carbon-Monoxide (CO): A Poisonous Gas Emitted from Automobiles, Its Effect on Human Health

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### Abstract

The emission of carbon monoxide CO from automobiles has caused hazard to human health. Human beings are faced with health challenges as they breathe air in their living environment. The breathing in of carbon monoxide has caused reduction of oxygen in take by man; because when carbon monoxide is breathed into the lungs, it sticks to the haemoglobin thereby preventing oxygen flow. This affects the transportation of oxygen by the blood which causes suffocation in man. The cluster of automobiles on roads and streets globally has posed health challenge. Hence this research is focused on finding solution to the effect of carbon monoxide CO on human health. To carry out this study the researcher used two automobiles that have different type of exhaust system. The researcher exposed four English rabbits to the two different exhaust systems in different rooms together with white fabrics in each of the rooms for one week to check for level of carbon deposits on the white fabrics after one week of the experiment. Observations were made in respect to body temperature, weight, nasal discharge, vomiting rate and feeding habits of the four rabbits used in the experiment. Findings were discussed based on observations as shown on records and recommendations were made to guide the researcher in making conclusion.

**Keywords:** Carbon monoxide; Automobile and Carbon monoxide emission; Catalytic converter; Environmental pollution

### Introduction

Carbon monoxide (CO) a poisonous gas that is emitted from the exhaust system of a combustible engine of an automobile that uses petrol or diesel as a fuel is odourless, colourless, tasteless and non-irritating. The incomplete combustion process that occurs in an engine; result to the emission of carbon monoxide (CO) as a waste product from the exhaust system of vehicles. Environmental carbon monoxide is produced by incomplete combustion process from any carbon containing fuel. The US department of labour occupation safety and health administration, in 2003 described carbon monoxide as an industrial hazard that result from the incomplete burning of natural gas and any other material that contains carbon, such as gasoline, kerosene, oil, propane, and coal, burning of wood, forges, and blast furnace and coke ovens. States that amount of carbon monoxide present in the human environment naturally is about (40%) and artificially (60%) due to human activities [1].

A great amount of carbon monoxide (CO) are released into the atmosphere by burning fossil, fuels, car exhaust emission and burning of natural gas [2]. Carbon monoxide as a poisonous gas is a major cause of illness and deaths in the USA, most cases result from exposure to the internal combustion engines and to stove burning fossil fuels [3]. Described carbon monoxide as a colourless, odourless, toxic gas that is a product of incomplete combustion from motor vehicles, heater appliances that use carbon-based fuels and household fires [4]. Carbon monoxide (CO) as a gas is a silent killer since it has no colour or smell [5]. The inhalation of exhaust fume has caused a high death rates in USA [6] estimated that more than 10,000 people per year in the USA require medical attention, miss at least one day of work in the early 1970s because of exposure to carbon monoxide. The deadly effect of carbon monoxide has long been known from the time of Greek and Roman Empire when the poisonous gas was used for the execution of human beings. Study carried out by [7]. The group made an observation during continuous monitoring level of carbon monoxide (CO) exposure in homes that nearly one-fifth of lower-income families are exposed to high levels of carbon monoxide which exceeds the World Health Organisation (WHO) guidelines.

### Literature Review

Carbon monoxide (CO) is an intermediate product of the combustion of all carbon species and cause of environmental pollutant [8]. By a way of comparison from the characteristics of carbon monoxide of being colorless, odorless, tasteless and non-irritating, made an assertion that carbon monoxide is slightly lighter when compared to air [9].

Carbon monoxide has a noxious sound effect that is caused by reversible displacement of oxygen from haemoglobin in human lungs to form carboxyl-haemoglobin [10]. Based on this fact in 1926, it became clear and well established that hypoxia was caused by poor tissue in the body and not by the deficiency of oxygen transportation. To support this statement, states that carbon monoxide has 210 times greater affinity for haemoglobin than oxygen [11]. A little concentration of carbon monoxide in an environment can cause toxic levels of carboxyl-haemoglobin. This occurs after carbon monoxide has selectively bound to haemoglobin the oxygen haemoglobin dissociation curve of the remaining oxyhaemoglobin shifts to the left, which reduces the release of oxygen as demonstrated by as shown below [5] (Figure 1).

Carbon monoxide shifts the oxygen-haemoglobin saturation curve to the left and changes it to a more hyperbolic shape, less oxygen is made available for the tissues, showing oxygen diffusion gradient difference at 50% saturation.

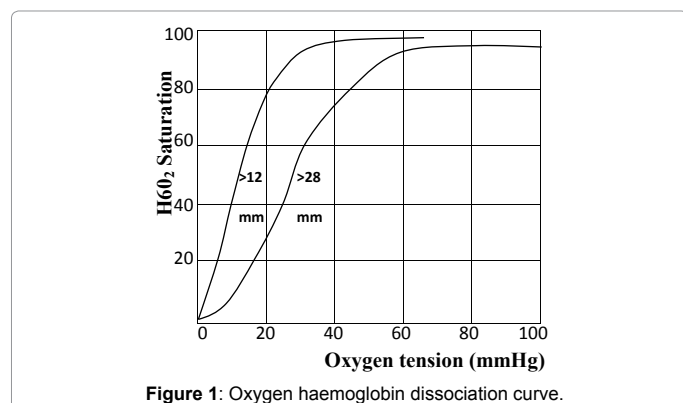
The poisoning effect of carbon monoxide (CO) is mostly common

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**Figure 1:** Oxygen haemoglobin dissociation curve.

in the USA because of industrialization which can be accounted for an estimated number of 50,000 people that are affected by the poisonous gas at the emergency department visit in the United States annually [12]. To support this statement states that children riding on the back of an enclosed pickup truck, seem to be at a very high risk like industrial workers at the pulp mills, steel foundries and a plant producing formaldehyde or coke, due to the exposure to carbon monoxide [13]. Also, fire fighters at a fire scene and individuals working indoors with combustion engines or combustible gas are also exposed to the hazard of carbon monoxide. Despite the negative effect of carbon monoxide on human lives, the poisonous gas has some advantages on the life circle and development of plants. It has been demonstrated through experiment that carbon monoxide (CO) emitted from automobile engines has possible signal molecule during development and adaptive plant response against some abiotic stress on plant life circle. Further research carried out by some group of researchers suggested that carbon monoxide might have some versatile molecule with different functions in plants, which has been proven in animals.

Therefore, it can be assumed that carbon monoxide has a great negative effect on human lives when the gas emitted from the exhaust system of the vehicle is inhaled. Carbon monoxide has claimed so many lives in so many developed nations like USA, UK, Germany etc., because of industrialization and cluster of automobiles on the street. To affirm this, stated that in Britain, most accidents arise through central heating faults that lead to high concentration of carbon monoxide on the street. Recently in this 21st century, most African countries have turned out to be a dumping ground for already used automobiles from the western world [14]. The rate of carbon monoxide emission on most African roads is becoming alarming. Already used vehicles that are popularly known as “Tocumbor” has over clouded the streets of the African continent, compared to brand new automobiles used in the western world. The fairly used imported automobiles have a poor exhaust system that has a bad catalytic converter that is not functional. This has caused a high rate of poor emission of carbon monoxide on highways, streets, that is causing a hazard to human health. This is the problem the study wants to look into and find a possible solution to reduce death rate globally, caused by the emission of carbon monoxide.

### Automobile and carbon monoxide (CO) emission

The history of automobiles is traceable to a number of decades that was based on the prevalent means of propulsion. The manufacture of automobiles that was powered by steam started in 1708 when Nicolas Joseph Cugnot produced the first steam powered engine. The first powered internal combustion engine that was fueled by hydrogen was

designed by a French man called Francois Isaac De Rivaz in 1807. The improvement in technology gave rise to the invention of the first petrol or gasoline powered automobile that was designed by Karl Benz in 1886. The development of the automobile in the recent 21st century gave rise to the manufacture of electrically powered automobiles that brought limitations to the use of petrol or diesel internal combustion engine that emits carbon monoxide (CO) that is hazardous to human health. The exhaust system that emits the burnt gas carbon monoxide is shown below (Figure 2).

The exhaust systems of vehicles are of different types namely:

- a) Single exit pipe
- b) Dual rear exit
- c) Opposite dual exhaust
- d) Dual side exhaust
- e) High-performance exhaust

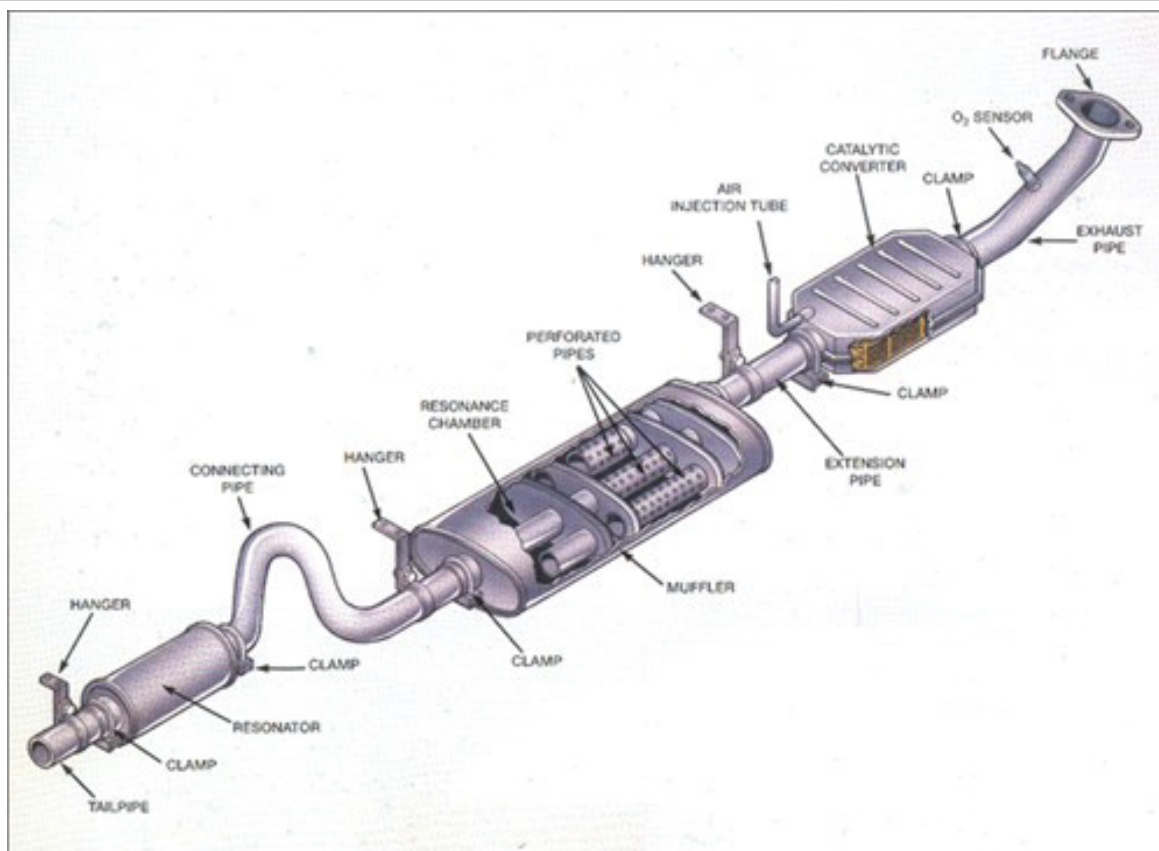
The exhaust system makes use of catalytic converter which helps to convert gas to less toxic pollutants by catalyzing a redox reaction (oxidation or reduction). The catalytic converter is used in internal combustion engines fueled by petrol or diesel used in automobiles to reduce the emission of carbon monoxide into the atmospheric air. The functionality of the catalytic converter is shown below (Figure 3).

The catalytic converter was invented by Eugene Hondry, a French mechanical engineer and expert in catalytic oil refining. The emission of carbon monoxide from the motor vehicle has caused air pollution in the human environment most especially in the African continent where fairly used vehicle are used by 80% of the citizens. The emission of carbon monoxide from the exhaust has created smog in some large cities in the USA that are densely populated. A study carried out by Massachusetts Institute of Technology (MIT) in 2013, observed that about 53,000 people die of carbon monoxide emission in the USA [15]. To support this statement also observed from the study carried out that traffic fumes alone from exhaust system causes the death of about 5,000 people every year in the UK [16]. To control the hazardous effect of carbon monoxide on human health, state that the stringent emission legislation and regulatory body compelled all engine manufacturers to develop technologies that will help to combat exhaust emission. This directive was given to meet emission regulations with competitive fuel economy exhaust gas after treatment and optimize combustion. But however it is still unresolved which concept will succeed when considering production and economic feasibility [17].

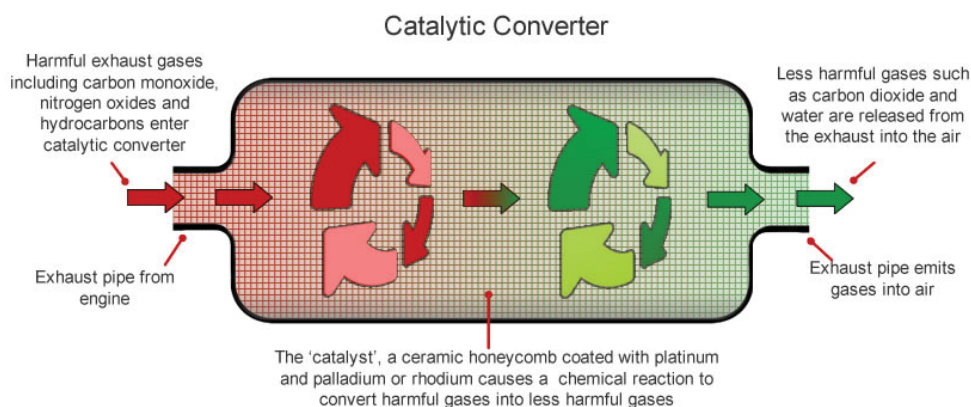
Observed that only a limited number of gasoline powered cars are affected by the carbon monoxide regulatory body that controls the circulation of carbon monoxide within the environment that people lives [18]. The US Environmental Protection Agency (EPA) has required that automotive fuels sold in the USA, mostly contain detergents to help scrub away pollution before it goes out of the vehicles to reduce the effect of carbon monoxide on human health [19].

### Environmental pollution

Environmental pollution has become a real problem, since the beginning of industrial revolution. Pollution generally is the introduction of contaminants into the human environment which has caused harm or discomfort to man and other living organisms. To be more specific environmental pollution can be seen as the contamination of the physical and biological components of the atmospheric system to



**Figure 2:** The exhaust systems.



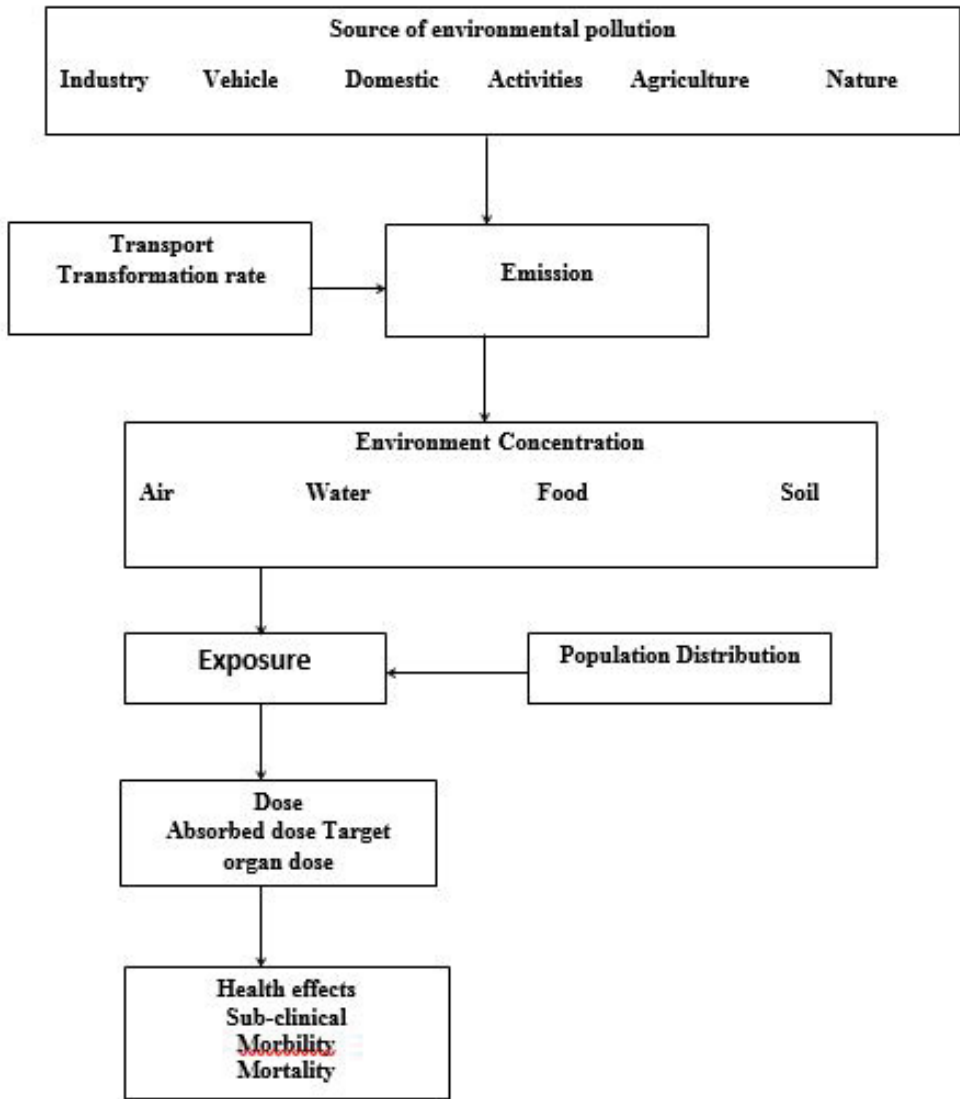
**Figure 3:** The functionality of the catalytic converter.

the extent that normal environmental process is adversely affected. The greatest problem facing the world today most especially in the African continent is the problem of environmental pollution. Environmental pollution has caused irreparable damages to the earth, most especially in the developing nations in Africa.

Environmental pollution consists of five basic types namely; air, water, soil, noise and light. Air pollution is the most harmful form of pollution in the environment. Air pollution is the most harmful form of pollution in the environment. Air pollution is caused by injurious carbon monoxide that is emitted from cars, buses, trucks, trains and factories smoke from burning leaves and cigarettes are harmful to the

environment causing a lot of damage to man. states that soot found on the ceiling of prehistoric caves provides ample evidence of the high levels of pollution that was associated with inadequate ventilation of open fires [20]. observed that despite the major efforts that have been made over recent years to clean up the environment that has been polluted, pollution still remains a major problem that poses a risk to human health [21]. The emission of poisonous gas like carbon monoxide that is harmful and dangerous to human health can be emitted from the following sources as shown in the schematic diagram of [21] (Figure 4).

To ascertain the effect of carbon monoxide on human health, the researcher experimented on four English rabbits for a period of one



**Figure 4:** The emission of poisonous gas like carbon monoxide that is harmful and dangerous to human health can be emitted from the following sources.

week by subjecting the four rabbits to carbon monoxide (CO) that is emitted from two different exhaust systems. One of the exhaust systems made use of the catalytic converter while the other exhaust system did not make use of the catalytic converter. The two exhaust systems are linked to the two different rooms through their tailpipes. The researcher hung two yards of white fabrics in each of the two different rooms used for the experiment to check for the level of carbon deposits on the lungs of the four rabbits as they breathe in carbon monoxide in the two different rooms [22].

**Experimental Method**

The researcher placed the four English rabbits in two different rooms together with two yards of white clean fabrics hung and spread in the two different rooms. The purpose is to check the level of carbon deposits on the white fabric like it will be deposited in the lungs of the four rabbits used for the experiment. The exhaust pipes of the two functional vehicles were connected to the two different rooms and carbon monoxide was emitted at different interval period of time.

The researcher exposed the four rabbits to carbon monoxide that was emitted from the two different exhaust system independently for 30 mins having the two rooms closed for the first day. On the second day, the researcher exposed the four rabbits to carbon monoxide for 60 mins in the two different rooms, having the two rooms closed. The researcher continued the experimental procedure for another four days by increasing the period of exposing the four rabbits to carbon monoxide by 30 mins each day [23]. This made the total time period of exposing the rabbits to carbon monoxide to 210 mins for the seven days that the experiment was carried out.

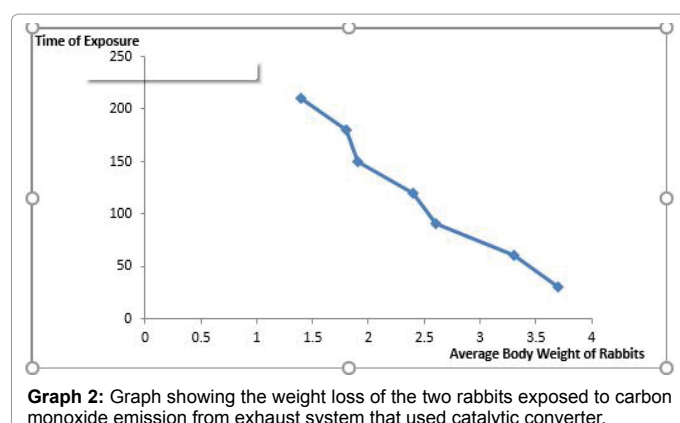
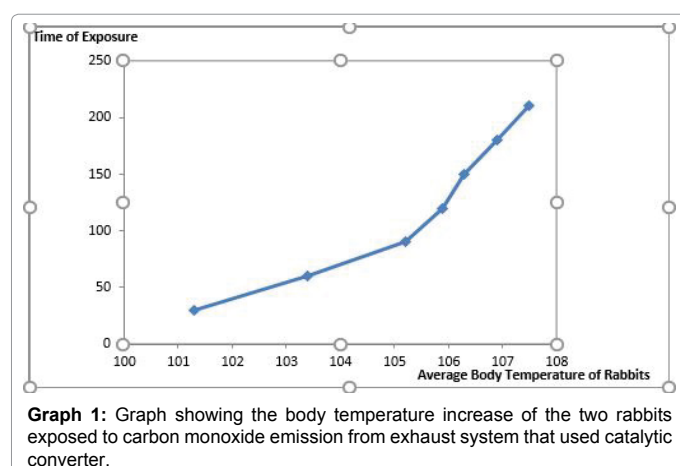
It is very pertinent to note that in each of the days that the four rabbits were exposed to carbon monoxide, the researcher used a clinical thermometer to check the temperature of the four rabbits after the exposure to carbon monoxide. The researcher also used a scale balance to check the weight of the four rabbits after exposure to carbon monoxide every day of the experiment. The researcher checked the color state of the white fabric that was hanged and spread in the two different rooms.



Period of exposure	Colour of carbon monoxide deposited on white fabric	Average body temperature of rabbits after exposure	Average weight of two rabbits after exposure	Nasal discharge	Vomiting rate	Feeding habit	Remark
Day I 30 mins	white	101.3°F	3.7 kg	No discharge	No vomiting	Normal	No effect
Day II 60 mins	Particles of carbon deposit on white fabric	103.4°F	3.3 kg	No	No	Not normal	Change in behaviour
Day III 90 mins	Slight dull	105.2°F	2.6 kg	Slight discharge	Slight vomiting	Dropped	Change in behaviour
Day IV 120 mins	Slight carbon stain	105.9°F	2.4 kg	Slight discharge	Slight vomiting	Dropped	Very restless
Day V 150 mins	Carbon stain	106.3°F	1.9 kg	Increase in discharge	vomiting	Dropped	Running temperature
Day VI 180 mins	High carbon	106.9°F	1.8 kg	High discharge	vomiting	Not eating	Weak
Day VII 210 mins	Slight dark	107.5°F	1.4 kg	Very high discharge	High vomiting	Not eating	Sick

**Note:** The normal body temperature of the two rabbits that was exposed to carbon monoxide of the exhaust system that used catalytic converter before the experiment was 101°F and 103°F. The normal body weight of the two rabbits before the experiment was 3.5 kg and 3.9 kg.

**Table 1:** Showing the records of the two rabbits exposed to exhaust system that used catalytic converter.



## Observation

The researcher made observations based on color of carbon deposit on the white fabric that was used for the experiment, temperature records of the four rabbits that were used for the experiment, the feeding rate and habits of the four rabbits when exposed to carbon monoxide, the weight records of the six rabbits after exposure to carbon monoxide, the nasal discharge from the nose of the rabbit used for the experiment, the rate of vomiting of the rabbits after being exposed to carbon monoxide. The observations made are recorded as follows (Table 1).

But since signal capture was improved we accepted this position. At the 6-month follow-up the signal had drifted and this was confirmed with heart catheterization. Two LA implants suffered signal drift within the first 3 months, but in one the pressure curve was restored shortly after the 6-month follow-up. There were no signs of hemolysis, with a median haptoglobin value of 1.15 g/L (reference <1.9 g/L).

## Analysis 1

From the record shown in Table 1 as demonstrated in the two (Graphs 1 and 2) showing the body temperature increase of the two rabbits used for the experiment that was exposed to carbon monoxide in the exhaust system that used the catalytic converter. From the two graphs, the body temperature of the two rabbits increased in every 30 mins when the rabbit was exposed. As the temperature increases so the weight of the two rabbits also decreases when they were weighed on scale balance, because of the long period of exposure to carbon monoxide (CO). From all the available records as shown in Table 1, the long exposure of the two rabbits to carbon monoxide, has caused nasal discharge. The feeding habit of the two rabbits changed from normal to not eating, which has caused the two rabbits to fall sick. And also, the long period of exposure has caused vomiting of the two rabbits [24].

## Analysis II

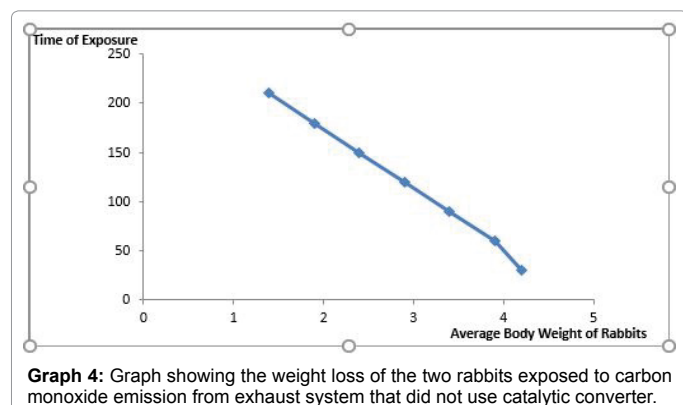
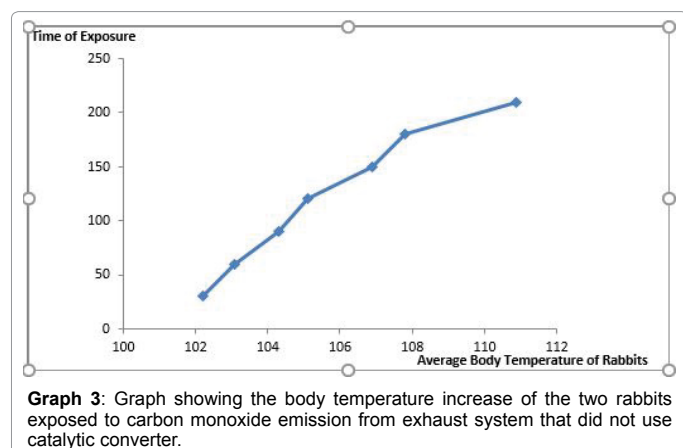
From the record shown in Table 2 as demonstrated in the two (Graphs 3 and 4) showing the body temperature increase of the two rabbits used for the experiment that was exposed to carbon monoxide, in the exhaust system that do not have a catalytic converter from the two graphs, it shows that the temperature of the two rabbits used for the experiment increased when they were exposed to carbon monoxide at an interval of the different period for seven days. Also, the weight of the two rabbits used for the experiment decreased when weighed on a balance scale after each day of the experiment. From all the available records shown in Table 2, the long exposure of the two rabbits to carbon monoxide that was emitted from the exhaust system that did not have a catalytic converter has caused very high nasal discharge, vomiting, poor feeding habit that has led to high body temperature, loss of weight in the two rabbits used for the experiment [25].

## Discussion of Findings

(1) The four rabbits exposed to carbon monoxide (CO) for seven days had a very high body temperature that was above their body normal temperature before the experiment.

Period of exposure	Colour of carbon dioxide deposited on white fabric	Average body temperature of rabbits after exposure	Average weight of two rabbits after exposure	Nasal discharge	Vomiting rate	Feeding habit	Remark
Day I 30 mins	Not too bright	102.2°F	4.2 kg	No discharge	No vomiting	Feeding well	No effect
Day II 60 mins	Dull white	103.1°F	3.9 kg	No discharge	No vomiting	Feeding well	Change in behaviour
Day III 90 mins	Slight carbon	104.3°F	3.4 kg	Slight discharge	Slight vomiting	Not feeding well	Feeling uncomfortable
Day IV 120 mins	carbon stain	105.1°F	2.9 kg	Slight discharge	Slight vomiting	Not feeding well	Feeling very uncomfortable
Day V 150 mins	Very high carbon stain	106.9°F	2.4 kg	Increase in discharge	Increase in vomit	Feeding rate dropped	Shading
Day VI 180 mins	Dark carbon stain	107.8°F	1.9 kg	High discharge	High vomiting	Not feeding	Weak
Day VII 210	Very dark carbon stain	110.9°F	1.4 kg	Very high discharge	Very high vomiting	Not feeding	Death

**Table 2:** The records of the two rabbits exposed to exhaust system that used catalytic converter.



(2) The four rabbit's lost weight when they were exposed to carbon monoxide compared to their actual weight before the experiment was carried out.

(3) There was nasal discharge from the nostril of the four rabbits that was used for the experiment, after exposing them to carbon monoxide as from 90 mins to 210 mins.

(4) The four rabbits used for the experiment vomited after exposing them to carbon monoxide CO as from 90 mins to 210 mins.

(5) The feeding habits of the rabbits used in the experiment dropped after long exposure to carbon monoxide.

(6) The two rabbits used for the experiment that was exposed to

carbon monoxide in the exhaust system that had catalytic converter fell sick. While the other two rabbits exposed to the exhaust system that does not use catalytic converter died at the end of the experiment because of the poor exhaust system [26].

(7) The level of carbon monoxide deposited on the white fabrics hung in the two rooms was high. The carbon deposit on the fabrics where exhaust system that used catalytic converter was not much compared to the fabrics hung in the room that the exhaust system did not make use of the catalytic converter.

(8) The two rabbits used for the experiment in the room where catalytic converter was not used in the exhaust system died while the other rabbits exposed to carbon monoxide in the room where catalytic converter was used in the exhaust system only fell sick because of the reduction of carbon monoxide effect.

## Recommendations

Based on the findings that were discussed from the experiment of the four rabbits exposed to carbon monoxide CO, the following recommendations were made:

(1) All living organisms that breathe in oxygen most especially human beings must not be exposed to carbon monoxide.

(2) An automobile that undergoes combustion process that has poor exhaust system should be eliminated from all highways and streets to reduce the effect of carbon monoxide in man's environment most especially in African countries where fairly used vehicle are used.

(3) Carbon monoxide detectors should be installed in the environment that man lives. This is to help man manage himself in every environment where the automobile is used.

(4) Manufacturers of the automobile should build in the catalytic converter into vehicles to help manage the emission of carbon monoxide from the exhaust system.

(5) The importation of already used automobiles from the western world to some of the developing countries in the African continent should be stopped. This is to help reduce the emission of carbon monoxide on most streets of African countries.

(6) The regulatory body that is responsible for the control of emission of carbon monoxide gas on the road and environment must ensure that automobile users, manufacturers must obey the law of the regulatory body to avert the effect of carbon monoxide CO on human health.

(7) An automobile that lacks catalytic converter in their exhaust system should be banned from plying the highway and street, to help reduce the emission of carbon monoxide in the human environment.

(8) Human beings that live in the cities, whose population is dense should be advised to visit hospitals for a medical checkup on a monthly basis to help check their health status.

## Conclusion

Based on the findings and recommendations made in this research, it can be concluded that carbon monoxide has a serious negative effect on human health like it was assumed. From the experiment carried out using four English rabbits and white fabrics. The color of the fabrics shows the level of carbon deposit that is being deposited in human lungs when carbon monoxide is emitted from the exhaust system. As the rabbits breathe in carbon monoxide when they were exposed to the poisonous gas in an enclosed two different rooms that made use of catalytic converter in one of the exhaust system. And in another exhaust system that did not make use of catalytic converter in the exhaust system.

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