Car emissions

Introduction

Exhaust gas or flue gas is emitted as a result of the combustion of fuels such as natural gas, gasoline, petrol, biodiesel blends, diesel fuel, fuel oil, or coal. According to the type of engine, it is discharged into the atmosphere through an exhaust pipe, flue gas stack, or propelling nozzle. It often disperses downwind in a pattern called an exhaust plume.

It is a major component of motor vehicle emissions (and from stationary internal combustion engines), which can also include:

- Crankcase blow-by
- Evaporation of unused gasoline

Motor vehicle emissions contribute to air pollution and are a major ingredient in the creation of smog in some large cities. A 2013 study by MIT indicates that 53,000 early deaths occur per year in the United States alone because of vehicle emissions. According to another study from the same university, traffic fumes alone cause the death of 5,000 people every year just in the United Kingdom.

Main harmful car emissions

- Carbon dioxide gas

- Carbon monoxide gas

- Unburned hydrocarbons (CxHy)

- Nitrogen oxides (NOx)

In the following report, we will discuss harmful effect of these emissions on humans and the surrounding environment in order to understand emission control necessity.

First Carbon dioxide gas (CO_2)

- Carbon dioxide is one of the natural products of the fuel/air mix combustion process.

- Carbon dioxide is a **greenhouse gas***. Motor vehicle CO_2 emissions are part of the anthropogenic contribution to the growth of CO_2 concentrations in the atmosphere which according to the vast majority of the scientific community is causing climate change. Motor vehicles are calculated to generate about 20% of the European Union's man-made CO_2 emissions, with passenger cars contributing about 12%.

  ***A** **greenhouse gas** is a gas in an atmosphere that absorbs and emits radiation within the thermal infrared range. This process is the fundamental cause of the greenhouse effect. The greenhouse effect is the process by which radiation from a planet's atmosphere warms the planet's surface to a temperature above what it would be without its atmosphere. The negative results of the planet's surface heating are the melting of the ice at the Earth's poles causing drastic climate changes and floods.

- Moreover, very large CO_2 concentrations (20% and more) produce adverse effects in humans and pure CO_2 is a toxic gas. "**Hypercapnia**", also known as hypercarbia and CO_2 retention, is a condition of abnormally elevated carbon dioxide (CO_2) levels in the blood. Carbon dioxide is a gaseous product of the body's metabolism and is normally expelled through the lungs. **Hypercapnia** normally triggers a reflex which increases breathing and access to oxygen (O_2), such as arousal and turning the head during sleep. A failure of this reflex can be fatal, for example as a contributory factor in sudden infant death syndrome.

- Finally, at elevated temperatures, CO_2 can dissociate into carbon monoxide and oxygen gases. Carbon monoxide is toxic and poisonous gas as we will soon learn.

Second Carbon monoxide gas (CO)

- Carbon monoxide release in car emissions can be attributed to multiple reasons: incomplete combustion of fuel due to insufficient air for stoichiometric combustion or due non-homogenous air- fuel mixture in the cylinder or dissociation of carbon dioxide at high temperatures.

- Carbon monoxide poisoning is the most common type of fatal air poisoning in many countries. Carbon monoxide is colorless, odorless and tasteless, but highly toxic. It

combines with hemoglobin to produce carboxyhemoglobin, which is ineffective for delivering oxygen to bodily tissues. In 2011, 52% of carbon monoxide emissions were created by mobile vehicles in the U.S.

- Symptoms are often described as "flu-like" and commonly include headache, dizziness, weakness, vomiting, chest pain, and confusion. Large exposures can result in loss of consciousness, arrhythmias, seizures, or death.

Third nitrogen oxides (NOx)

- Nitrogen oxides are formed due to high temperatures in the car engine and the presence of oxygen and nitrogen.

- Mono-nitrogen oxides NO and NO_2 (whether produced this way or naturally by lightning) react with ammonia, moisture, and other compounds to form nitric acid vapor and related particles. Small particles can penetrate deeply into sensitive lung tissue and damage it, causing premature death in extreme cases. Inhalation of such particles may cause or worsen respiratory diseases such as emphysemaand bronchitis. It may also aggravate existing heart disease. A large scale 22 year study shows that NOx increases the changes of colorectal cancer death.

  In a 2005 U.S. EPA study the largest emissions of NOx came from on road motor vehicles, with the second largest contributor being non-road equipment which is mostly gasoline and diesel stations.

- When oxides of nitrogen (NOx) and volatile organic compounds (VOCs) react in the presence of sunlight, ground level ozone is formed, a primary ingredient in smog.

  A 2005 U.S. EPA report gives road vehicles as the second largest source of VOCs in the U.S. at 26% and 19% are from non road equipment which is mostly gasoline and diesel stations. 27% of VOC emissions are from solvents which are used in the manufacturer of paints and paint thinners and other uses.

- Ozone is beneficial in the upper atmosphere, but at ground level ozone irritates the respiratory system, causing coughing, choking, and reduced lung capacity. It also has many bad effects throughout the ecosystem.

Fourth Hydrocarbons (HC)

- Hydrocarbons carried away by exhaust gases are due to incomplete combustions or non homogenous mixtures

- The hydrocarbons, in gaseous form (or those that are volatile), are involved in air pollution under ordinary conditions.

- Hydrocarbons in air by themselves alone cause no harmful effects. However, they undergo chemical reactions in the presence of sunlight and nitrogen oxides. They form photochemical oxidants leading to photochemical smog. This causes irritation in the eyes and lungs leading to respiratory diseases.

- A number of other pollutants may enter into the atmosphere from many sources. For example, lead comes from automobile exhaust, though this has reduced considerably after the compulsory change over to the use of unleaded fuel by many countries.

References

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