How Egr Effects Tailpipe Emissions and The Environment

The effect of EGR rate on NOx reduction at various engine loads at a mid-speed condition is illustrated in Figure 1. Under all loads, the amount of NOx decreases as the EGR rate increases. The graph also shows that the NOx reduction effect at a given EGR rate increases as the engine load becomes higher. The temperature of the EGR can impact the intake mixture temperature and therefore NOx emissions. Cooling EGR would increase the temperature differential term in the heat absorption equation for EGR. Now I will be talking about bad or failing EGR symptoms.

The exhaust gas recirculation valve is a component commonly found on many roadgoing vehicles. It is a part of the vehicle's exhaust gas recirculation (EGR) system, an emissions system that is designed to recirculate exhaust gasses back into the vehicle's intake in order to reduce cylinder temperatures and NOx emissions. The EGR valve is one of the main components that control the flow and recirculation of these exhaust gasses. When the valve is opened, exhaust gasses are allowed through the vehicle's EGR system to help control vehicle emissions. When the EGR valve has an issue, it can cause problems with the flow and operation of the EGR system, which can lead to increased emissions and performance issues. Usually, a bad or failing EGR valve will produce a few symptoms that can alert the driver of a potential issue. I will tell one thing about engine performance issues and one issue to do with rough idling.

Engine performance issues – One of the first symptoms of a problem with the EGR valve is engine performance issues. A clogged or malfunctioning EGR valve can disrupt the vehicle's air-fuel ratio, which can cause engine performance issues such as a reduction in power, acceleration, and even fuel efficiency. Rough idle – One of the most common symptoms of a problem with the vehicle's EGR valve is a rough idle. It is not uncommon for EGR valves to malfunction and become stuck in the open position. This can lead to exhaust gas recirculation to occur causing a rough idle even when the conditions are not desirable.

Next 02 sensors and ways that they may affect or don't affect automotive emissions. First I'm gonna explain exactly what a 02 sensor is and what it does and who created it. An oxygen sensor (or lambda sensor) is an electronic device that measures the proportion of oxygen (O2) in the gas or liquid being analyzed. It was developed by the Robert Bosch GmbH company during the late 1960s under the supervision of Dr. G?nter Bauman. Hydrocarbon emissions result when fuel molecules in the engine do not burn or burn only partially. Hydrocarbons react in the presence of

nitrogen oxides and sunlight to form ground-level ozone, a major component of smog. Ozone irritates the eyes, damages the lungs, and aggravates respiratory problems. It is our most widespread and intractable urban air pollution problem. A number of exhaust hydrocarbons are also toxic, with the potential to cause cancer.

- Nitrogen Oxides (NOx) Under the high pressure and temperature conditions in an engine, nitrogen and oxygen atoms in the air react to form various nitrogen oxides, collectively known as NOx. Nitrogen oxides, like hydrocarbons, are precursors to the formation of ozone. They also contribute to the formation of acid rain.

- Carbon monoxide (CO) is a product of incomplete combustion and occurs when carbon in the fuel is partially oxidized rather than fully oxidized to carbon dioxide (CO). Carbon monoxide reduces the flow of oxygen in the bloodstream and is particularly dangerous to persons with heart disease.

- Carbon Dioxide, in recent years, the U.S. Environmental Protection Agency (EPA) has started to view carbon dioxide, a product of "perfect" combustion, as a pollution concern. Carbon dioxide does not directly impair human health, but it is a "greenhouse gas" that traps the earth's heat and contributes to the potential for global warming

Evaporative Emissions Hydrocarbon pollutants also escape into the air through fuel evaporation. With today's efficient exhaust emission controls and today's gasoline formulations, evaporative losses can account for a majority of the total hydrocarbon pollution from current model cars on hot days when ozone levels are highest. Evaporative emissions occur in several ways:

DIURNAL: Gasoline evaporation increases as the temperature rises during the day, heating the fuel tank and venting gasoline vapors.

RUNNING LOSSES: The hot engine and exhaust system can vaporize gasoline when the car is running.

HOT SOAK: The engine remains hot for a period of time after the car is turned off, and gasoline evaporation continues when the car is parked.

REFUELING: Gasoline vapors are always present in fuel tanks. These vapors are forced out when the tank is filled with liquid fuel. Si engine emissions S.I. engine emissions are divided into three categories as exhaust emission, evaporative emission, and crankcase emission. The major

constituents which contribute to air pollution are CO, NOx, and HC coming from S.I. engine exhaust. The relative amounts depend on engine design and operating conditions but are of order, NOx -> 500-1000 ppm (20 gm/kg of fuel), CO -> 122% (200 gm/kg of fuel) and HC -> 43000 ppm (25 gm/kg of fuel). Fuel evaporation from the fuel tank and carburetor exist even after engine shut down and these are unburned hydrocarbons. However, in most modern engines, these non- exhaust unburned HCR effectively controlled by returning the blow-by gases from the crankcase to the engine.

Intake system by venting the fuel tank and a vapor absorbing carbon canister which is purged as some of the engine intake air during normal engine operation. The order constituent includes SO2 and lead compounds. The petrol rarely contains sulphur, therefore; SO2 is not a pollutant from s.i. engine exhaust. Petrol contains lead in small percentages but its effect is more serious on human health. Therefore Delhi govt has restricted the use of petrol without lead. One of the most important variables in determining S.I. emission is the fuel-air equivalence ratio. The SI engine is always operated at the stoichiometric or slightly rich mixture. At the starting of the engine, the very rich mixture is supplied as vaporization is very slow. Thus, until the engine warms up and this enrichment is stopped, CO and HC emissions are high. At part load conditions, the lean mixture can be used which will reduce HC and CO emissions and moderate NOx emissions. Use of recycled exhaust to dilute the engine intake mixture lowers the NOx level but deteriorates combustion quality. Exhaust gas recirculation (EGR). The method is used with stoichiometric mixtures in many engines to reduce emissions. The sources of pollution are mainly three as mentioned earlier, the engine exhaust, (CO, NOx, HC), the crankcase breather (HC) and direct evaporation of petrol from carburetor and fuel tank particularly in hot weather(HC). CI engine emissions Diesel combustion is heterogeneous in nature, unlike spark-ignited engines where the combustible mixture is predominantly homogeneous. In diesel engines, fuel is injected into a cylinder filled with high temperature compressed air. Emissions formed as a result of burning this heterogeneous air/fuel mixture depending on the prevailing conditions not only during combustion but also during the expansion and especially prior to the exhaust valve opening. Mixture preparation during the ignition delay, fuel ignition quality, residence time at different combustion temperatures, expansion duration, and general engine design features play a very important role in emission formation. In essence, the concentration of the different emission species in the exhaust is the result of their formation and their reduction in the exhaust system.

Incomplete combustion products formed in the early stages of combustion may be oxidized later during the expansion stroke.

Mixing of unburned hydrocarbons with oxidizing gases, high combustion chamber temperature, and adequate residence time for the oxidation process permit more complete combustion. In most cases, once nitric oxide (NO) is formed it is not decomposed but may increase in concentration during the rest of the combustion process if the temperature remains high. IV. Euro norms The exhaust gases from IC engines mainly contain unburned hydrocarbons(HC), carbon monoxide(CO), and nitrogen oxides(NOx), which are mainly responsible for air pollution which causes health hazards and bad effects on the crops also.

Therefore, the govt. has imposed on emission standards which limit the amount of each pollution emitted by the engine into the atmosphere. Collection efficiencies of these filters range from 50 percent to over 90 percent. Excellent filter efficiency has rarely been a problem with the various filter materials listed above, but work has continued with the materials, for example, to (1) optimize high filter efficiency with accompanying low back pressure, (2) improve the radial flow of oxidation through the filter during regeneration, and (3) improve the mechanical strength of the filter designs.

Particulate-gladdened diesel exhaust enters the filter but because the cell of the filter is capped at the opposite end, the exhaust cannot exit out the cell. Instead, the exhaust gases pass through the porous walls of the cell. The particle is trapped on the cell wall. The exhaust gases exit the filter through the adjacent cell. XX. Use of Catalyst and Particulate Filter Control in Conjunction with other Control Strategies Retarding injection timing slightly or incorporating exhaust gas recirculation (EGR) will reduce NOx emissions of diesel engines by more than 40 percent. However, both techniques are accompanied by secondary effects. Injection timing retards, while decreasing NOx emissions substantially, increases the emissions of CO, NMHC, and PM and reduces fuel economy. The increase in the other exhaust emissions, however, can be offset with either oxidation catalyst or diesel particulate filter technology. Ceramic engine coatings have been found to offset the fuel economy penalty as well. Employing EGR to diesel engines introduces abrasive diesel particulate into the air intake which could result in increased engine wear and fouling. Using EGR after a diesel particulate filter would supply clean EGR and effectively eliminate this concern. A variety of emission control technologies exist for controlling NOx, CO, NMHC, and PM Oxidation catalysts provide significant reductions in CO (90%) and

NMHC (90%) from lean burn engines at a cost of $9-10/bhp. In the case of diesel engines, PM emissions are also reduced by greater than 25 percent at no additional cost.

NSCR can be used to eliminate greater than 90 percent of NOx emissions from rich burn engines for $10-15/bhp. NSCR, or three-way catalysts, eliminate over 90 percent of NOx, CO, and NMHC for engines operated stoichiometrically at a cost of $10-15/bhp.

SCR can be used to reduce greater than 90 percent of NOx emissions from lean burn engines at a cost of $50-125/bhp. More recently, lean NOx catalysts have been applied to stationary lean-burn IC engines to provide significant reductions in NOx (80%), CO (60%), and NMHC (60%) at a cost of $10-20/bhp.

Although not currently in widespread use on stationary engines, diesel particulate filter or trap oxidizers provide the considerable potential to eliminate more than 90 percent of the PM emissions from stationary diesel engines at a cost of $30-50/bhp depending on engine size. Catalytic coatings on such DPFs add the advantage of also reducing CO and HC. Ceramic coatings used on the internal combustion surfaces of IC engines can improve performance, reduce emissions or allow a tradeoff in performance and emission levels not possible using catalyst technology itself. Used in conjunction with catalyst, ceramic coatings have allowed significant reductions in PM and NOx for heavy-duty diesel while providing significant performance increases in power and torque. Costs are in the range of $5-15/bhp.

Sound pollution and its Control Sound is another source of pollution which creates comfort feelings in human beings. The sound level of automobiles is always higher than the desired and therefore legislative measures are also imposed to control the sound level below a particular level to build a peaceful environment. The noise is measured by decibel (dB) which is given by N =10 log10(I/Or) Where N is in decibels, I am the intensity of sounds and Ir is the reference intensity whose unit is W/m2. The intensity of sound is doubled when the number of decibel goes up by about 3 as it is a logarithmic function. Engine Noise: The engine is the main source of the noise. In most cases, at present control levels, exhaust and intake noise is dominant. Many individual vibrations contribute, excited by the rapid rise of cylinder pressure at the onset of combustion and by the impact of the piston on the cylinder wall as it changes the direction at TDC. At rated speed and load, the differences between engine types are within about 5dB. But at comparable operating points near half speed, S.I. engine averages about 20 dB lower than the large diesel.

Catalytic converters are a primary emission control device. They perform a final cleanup of the tailpipe emission on a properly running engine equipped with functioning emission control system. Catalytic converters can use a base structure. Causes a chemical reaction without itself being consumed or changed in the reaction. The reduction catalyst contains a platinum and rhodium coating, which can help get rid of the nitrogen into the base compound.