SNS COLLEGE OF TECHNOLOGY

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COIMBATORE-35.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

23AUT202 – AUTOMOTIVE ENGINES AND EMISSION CONTROL

II YEAR / III SEMESTER

Topic –**Emission Formation in SI & CI Engines**

- Emission formation in Spark Ignition (SI) and Compression Ignition (CI) engines involves complex chemical reactions and processes influenced by engine design, operating conditions, and fuel characteristics.

Emission Formation in SI Engines

Hydrocarbons (HC)

- Incomplete combustion of the air-fuel mixture. This can occur due to flame quenching at the cylinder walls, crevice volumes (e.g., piston ring crevices), or during the cold start of the engine.
- **Influencing Factors:** Air-fuel ratio, ignition timing, engine temperature, and combustion chamber design.

Carbon Monoxide (CO):

- Occurs when there is not enough oxygen to convert all carbon in the fuel to carbon dioxide (CO_2). This typically happens under rich mixture conditions.
- **Influencing Factors:** Air-fuel ratio, engine load, and incomplete combustion.

Nitrogen Oxides (NOx):

- High-temperature combustion leads to the oxidation of nitrogen in the air. NOx formation is strongly temperature-dependent and occurs more readily at higher combustion temperatures.
- **Influencing Factors:** Combustion temperature, pressure, air-fuel ratio, and ignition timing.

Particulate Matter (PM):

- SI engines generally produce fewer particulates compared to CI engines, but particulates can still form under certain conditions, such as during high-load operation or with direct injection systems.
- **Influencing Factors:** Fuel type, combustion efficiency, and engine load.

Emission Formation in CI Engines

Hydrocarbons (HC)

- Incomplete combustion, particularly during cold starts or in over-fueled conditions. Fuel injection timing and quality also play significant roles.
- **Influencing Factors:** Injection timing, air-fuel mixture quality, engine temperature, and combustion chamber design.

Carbon Monoxide (CO)

- Result of incomplete combustion, more prominent during engine start-up and under load conditions where air-fuel mixture is rich.
- **Influencing Factors:** Air-fuel ratio, injection timing, and combustion efficiency.

Nitrogen Oxides (NOx)

- Formed due to high peak temperatures during combustion, similar to SI engines. The formation process is strongly influenced by the combustion temperature and oxygen availability.
- **Influencing Factors:** Combustion temperature, pressure, air-fuel ratio, and injection timing.

Particulate Matter (PM)

- CI engines, particularly diesel engines, produce soot (a major component of PM) due to heterogeneous combustion of fuel droplets. PM formation is significant during high-load conditions and with rich air-fuel mixtures.
- **Influencing Factors:** Fuel type, injection timing, air-fuel ratio, and combustion efficiency.

Sulfur Oxides (SOx)

- Sulfur in the fuel combines with oxygen during combustion to form sulfur oxides. These emissions depend directly on the sulfur content of the fuel.
- **Influencing Factors:** Fuel sulfur content and combustion conditions.

Key Differences Between SI and CI Engines in Emission Formation

- **Combustion Process:**
- SI engines rely on a spark to initiate combustion, typically running on homogeneous mixtures. CI engines use compression to ignite fuel, often with heterogeneous mixtures.
- **Operating Conditions:** CI engines generally operate at higher pressures and temperatures, which can lead to higher NOx but also greater efficiency.
- **Fuel Characteristics:** SI engines typically use gasoline, which is more volatile, while CI engines use diesel, which has a higher energy density and leads to different emission profiles.
- **Emission Control:** SI engines often use catalytic converters to reduce HC, CO, and NOx emissions. CI engines use technologies like diesel particulate filters (DPF) and selective catalytic reduction (SCR) to manage PM and NOx emissions.

Thank You !