

Lecture 21

3rd Semester M Tech. Mechanical Systems Design

Mechanical Engineering Department

Subject: Advanced Engine Design

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Lecture 21 - Pollution Formation And Control From I C Engines

Topic – Nature and Extent of Problem - Autumn Semester – 04-11-2020

NATURE AND EXTENT OF PROBLEM.

- SPARK IGNITION ENGINES.

- OXIDES OF NITROGEN (NO , NO₂-COLLECTIVELY KNOWN AS NO_x)
- CARBON MONOXIDE (CO) AND
- ORGANIC COMPOUNDS – UNBURNED OR PARTIALLY BURNED HYDROCARBONS (HC).

ORDER OF MAGNITUDE OF POLLUTION.

- NO_x

- 500 – 1000 PPM. OR
- 20 g/Kg OF FUEL

- CO

- 1–2% OR
- 200 g/Kg OF FUEL.

- HC

- 3000 PPM OR
- 25 g/Kg OF FUEL.

OTHER SOURCES OF POLLUTION.

- PISTON BLOWBY GASES
- FUEL EVAPORATION AND RELEASE TO THE ATMOSPHERE THROUGH VENTS IN THE FUEL TANK AND CARBURETTOR AFTER ENGINE SHUT-DOWN ARE ALSO SOURCES OF UNBURNED HYDROCARBONS.

POLLUTION FROM DIESEL ENGINES

- NO_x
- DIESEL ENGINE EXHAUST CONCENTRATIONS OF NO_x ARE COMPARABLE TO THOSE FROM S.I. ENGINES.
- HC
- DIESEL HYDROCARBON EMISSIONS ARE SIGNIFICANT THOUGH EXHAUST CONCENTRATIONS ARE LOWER BY ABOUT A FACTOR OF 5 THAN TYPICAL S.I. ENGINE LEVELS.
- SMOKE
- THE HYDROCARBONS IN THE EXHAUST MAY ALSO CONDENSE TO FORM WHITE SMOKE DURING ENGINE STARTING AND WARM UP.
- ODOR
- SPECIFIC HYDROCARBON COMPOUNDS IN THE EXHAUST GASES ARE THE SOURCE OF DIESEL ODOR.
- PARTICULATE EMISSIONS.
- DIESEL ENGINES ARE AN IMPORTANT SOURCE OF PARTICULATE EMISSIONS ; BETWEEN ABOUT 0.2 AND 0.5 PERCENT OF THE FUEL MASS IS EMITTED AS SMALL (0.1 μm diameter) PARTICLES WHICH CONSIST PRIMARILY OF SOOT WITH SOME ADDITIONAL ABSORBED HYDROCARBON MATERIAL.
- CO
- DIESEL ENGINES ARE NOT A SIGNIFICANT SOURCE OF CARBON MONOXIDE.

S.I. AND C.I. ENGINES POLLUTION.

- ALCOHOLS

- USE OF ALCOHOL FUEL IN EITHER S.I. OR C.I. ENGINES SUBSTANTIALLY INCREASES ALDEHYDE EMISSIONS.

- WHILE THESE ARE NOT YET SUBJECT TO REGULATION , ALDEHYDES WOULD BE A SIGNIFICANT POLLUTANT IF THESE FUELS WERE TO BE USED IN QUANTITIES COMPARABLE TO GASOLINE AND DIESEL.

- SULPHUR

- CURRENTLY USED FUELS GASOLINE AND DIESEL CONTAIN SULPHUR.

SULPHUR CONCENTRATION IN GASOLINE AND DIESEL.

- GASOLINE

- SMALL QUANTITIES (≤ 600 PPM BY WEIGHT S)

- DIESEL

- IN DIESEL IN LARGER AMOUNTS (≤ 0.5 PERCENT)

- SULPHUR EFFECTS

- THE SULPHUR IS OXIDIZED TO PRODUCE SULPHUR DIOXIDE SO_2 , OF WHICH A FRACTION CAN BE OXIDIZED TO SULPHUR TRIOXIDE , SO_3 , WHICH COMBINES WITH WATER TO FORM A SULPHURIC ACID AEROSOL.

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Text Book:

Internal Combustion Engine Fundamentals
Author: John B Heywood
Published By: McGraw-Hill Book Company