INTERNAL COMBUSTION ENGINES

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Spring 2021

Lecture # 13 (Engine Emissions)

ENGINE EMISSIONS

THE POLLUTANTS

The SI engines have several pollution emitting sources (eg: exhaus pipe, crank shaft, brake system, etc..). The exhaust pipe emission is the most important.

The major polluting materials within the exhaust geases are the following:

#1 Unburned hidrocarbons (CH)

It damages the brain cells and the breathing organs.

It is the result of the lack of oxigen or the uncompleted combustion process.

#2 Carbonmonoxide (CO)

The inhalation of this gas can cause suffocation.

It is the result of the lack of oxigen or the uncompleted combustion process.

#3 Nitric oxides (NOx)

They attack the breathing organs and are responsible for the allergy.

ENGINE EMISSIONS

#4 Carbon dioxide

This is a so called "hot house gas", experts state that this gas is one of those which are responsible for the global warming.

#5 Heavy metals

The lead is responsible for several deseases, damage the brain and lethal in big dose.

Most of the fuels contain lead originated from the crude oil and some fuels containing lead as an additive, which reduces the knock phenomenon.

ENGINE EMISSIONS

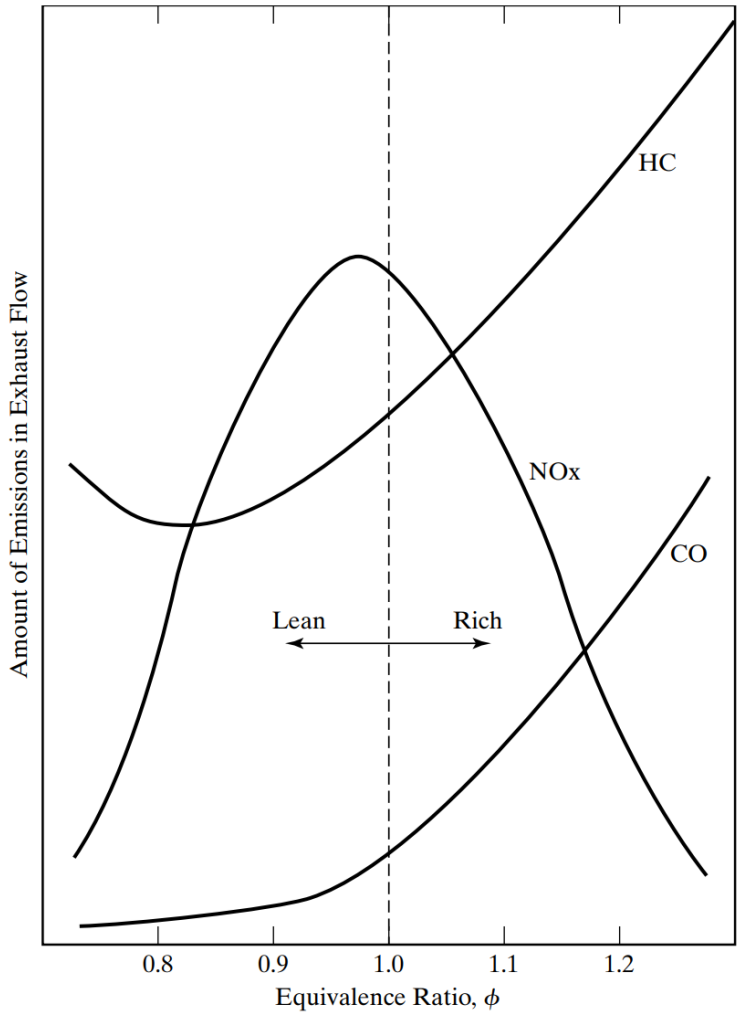


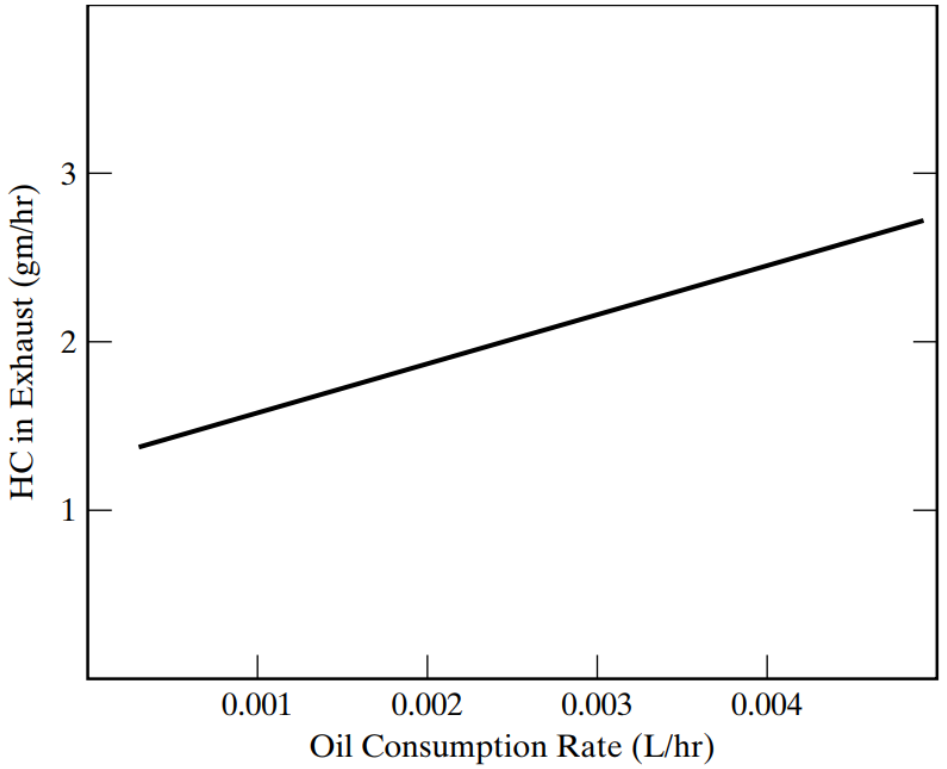
FIGURE 1

Emissions from an SI engine as a function of equivalence ratio. A fuel–rich air–fuel ratio does not have enough oxygen to react with all the carbon and hydrogen, and both HC and CO emissions increase. HC emissions also increase at very lean mixtures due to poor combustion and misfires. The generation of nitrogen oxide emissions is a function of the combustion temperature, being greatest near stoichiometric conditions when temperatures are the highest. Peak NOx emissions occur at slightly lean conditions, where the combustion temperature is high and there is an excess of oxygen to react with the nitrogen. Adapted from [58].

ENGINE EMISSIONS

FIGURE 3

HC exhaust emissions as a function of engine oil consumption. Often, as an engine ages, clearance between the pistons and cylinder walls increases due to wear. This increases oil consumption and contributes to an increase in HC emissions in three ways: There is added crevice volume, there is added absorption–desorption of fuel in the thicker oil film on cylinder walls, and there is more oil burned in the combustion process. Adapted from [138].



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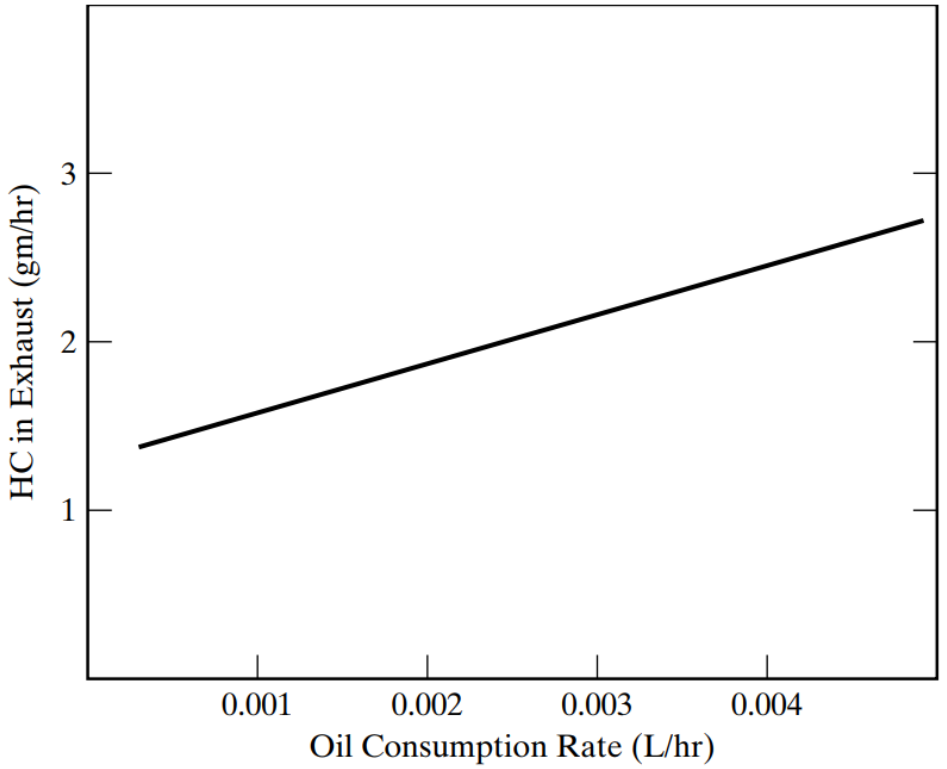

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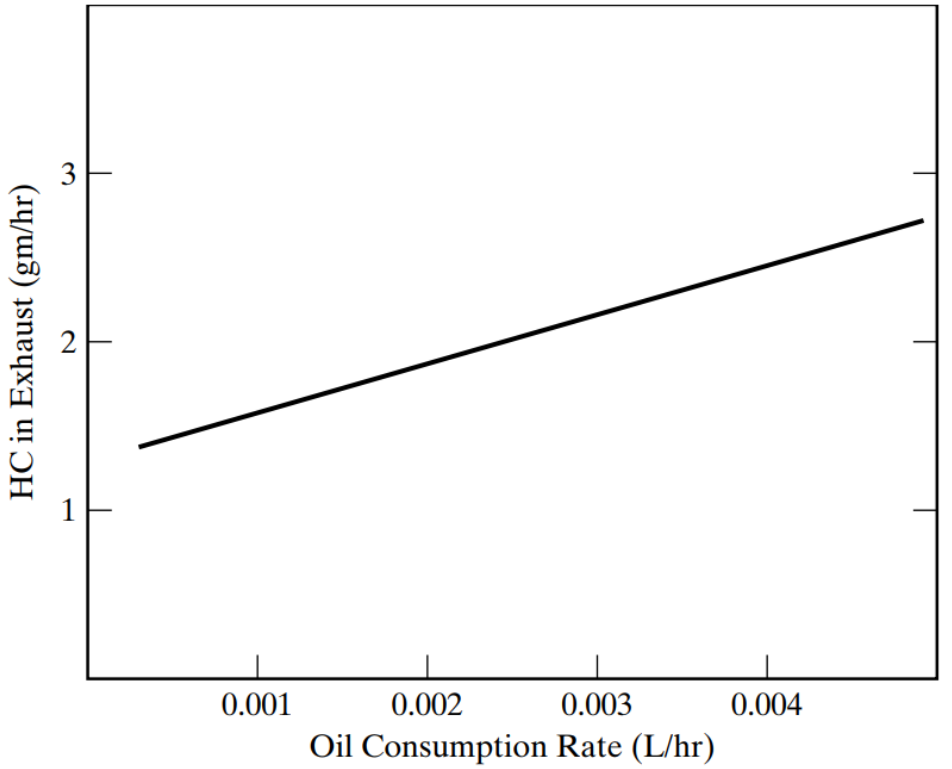

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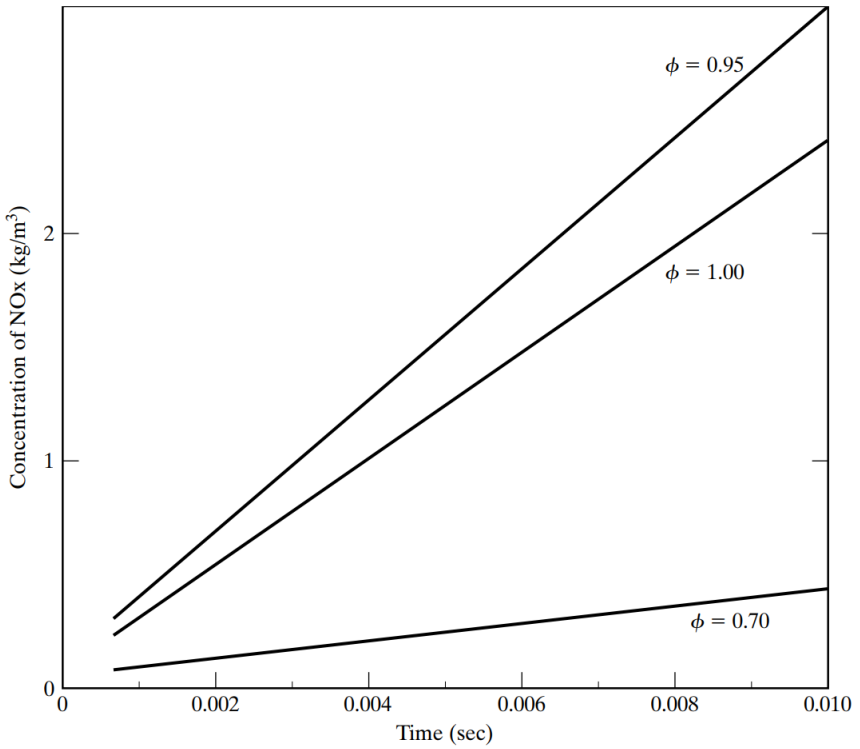

FIGURE 4

Generation of NOx in an engine as a function of combustion time. Many modern engines produce lower NOx emissions due to fast-burn combustion chamber design. Adapted from [92].

ENGINE EMISSIONS

Noise Pollution

Normal conversation has a sound level of about 55 dB, while the ear begins to feel pain at about 120 dB.

Many engine room codes allow noise up to 110 dB. The sensitivity of the human ear is closely related to sound frequency, being less sensitive at low frequency.

In the United States the EPA has an acceptable level of drive-by noise for vehicles of 74 dB (A)

ENGINE EMISSIONS

Control

1. Catalytic Convertor
2. EGR (Exhaust Gas Recirculation)
3. Thermal Reactor

END OF THE LECTURE