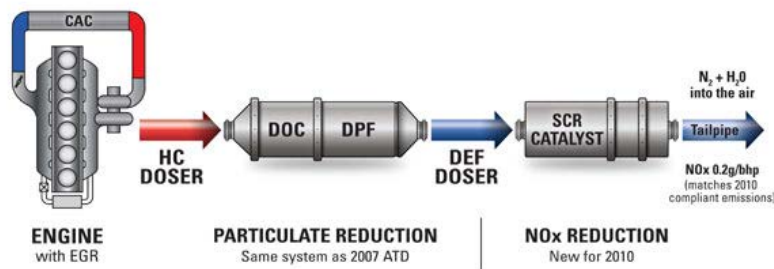


課題 2: Explain typical methods of reducing diesel exhaust emissions, focusing on combustion and/or after-treatment technologies.

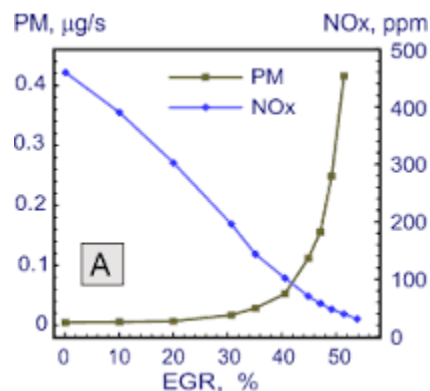
Vehicle emission pollution became more and more obvious, with the rapid increase in the number of cars. As an important category of internal combustion engine, diesel exhaust emissions accounts for a large proportion of vehicle emissions. Diesel exhaust is a Group 1 carcinogen, which causes lung cancer and has a positive association with bladder cancer. It contains several substances that are also listed individually as human carcinogens by the IARC. The diesel exhaust systems main to reduce nitrogen oxides (NO_x) and particulate matter (PM) in the exhaust.



[Fig 1 Diesel Exhaust System]

1.Reducing emission in combustion process

Generally speaking, nitrogen oxides (NO_x) was generated caused of high temperatures, oxygen enrichment and long reaction time. While Particulate matter (PM) is caused of high temperatures and insufficient oxygen. So NO_x -PM is a relationship of trade-off as [Fig 2]

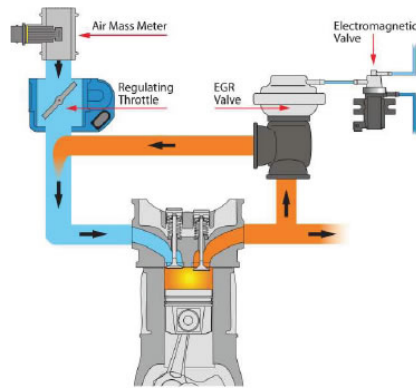


[Fig 2 NO_x-PM trade-off]

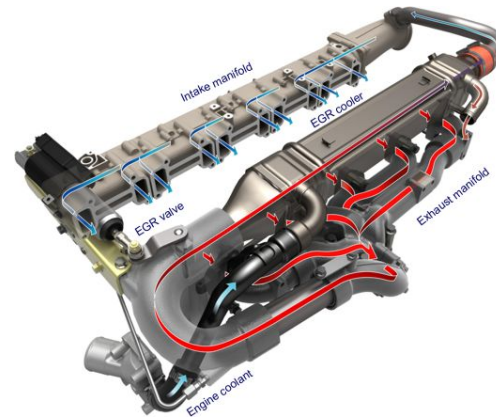
NO_x:

Exhaust gas recirculation (EGR) can be used to achieve a richer fuel to air mixture and a lower peak combustion temperature. EGR works by recirculating a portion of an engine's exhaust gas back to the engine cylinders. This dilutes the O₂ in the incoming air stream and provides gases inert to combustion to act as absorbents of combustion heat to reduce peak in-cylinder temperatures. NO_x is produced in a narrow band of high cylinder temperatures and pressures.

Injecting fuel later and lower the fuel injection pressure can also reduce peak in-cylinder temperatures.



[Fig 3 EGR procession]



[Fig 4 EGR structure]

PM:

Common rail and Unit Pump can higher the fuel injection pressure.

Injecting fuel earlier can increase the time of air fuel mixing to richer fuel to air mixture.

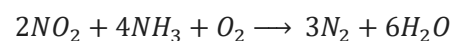
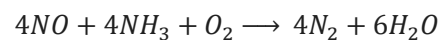
Dividing every fuel injection fuel into multi-times.

There is also other method such as infect methanol into air-intake and inject a little fuel (1/3 as former volume) into cylinder to burn ignite methanol, which can reduce both NOx and PM.

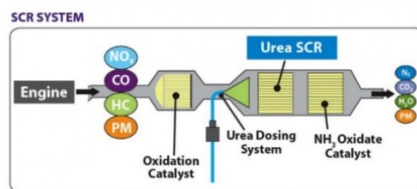
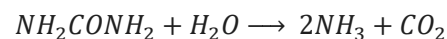
2.Reducing emission after treatment

NOx:

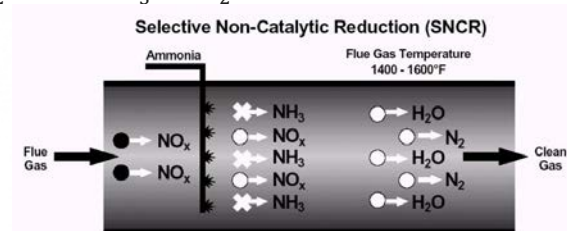
Selective catalytic reduction (SCR): The NOx reduction reaction takes place as the gases pass through the catalyst chamber. Before entering the catalyst chamber the ammonia, or other reductant (such as urea), is injected and mixed with the gases. The chemical equation for a stoichiometric reaction using either anhydrous or aqueous ammonia for a selective catalytic reduction process is:



Urea (NH_2CONH_2) is easier to handle and store than the more dangerous ammonia (NH_3). So Selective non-catalytic reduction (SNCR) was been applied.



[Fig 4 SCR procession]



[Fig 5 SNCR procession]

PM:

A diesel particulate filter (DPF) is a device designed to remove diesel particulate matter or soot from the exhaust gas of a diesel engine. Fuel burner, Microwave energy and heat effect of electric current can realize the DPF regeneration.

HC & CO:

Diesel oxidation catalyst(DOC) can oxidize *HC* and *CO* to *H₂O* and *CO₂*

Overall, Modern on-road diesel engines typically use methods during combusting and after treatment to meet emissions laws, as single methods cannot adequately reduce emission to meet the newer standards applicable in many jurisdictions.

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