This course can be adapted to virtual classroom mode

New Combustion Developments in Diesel Engines

3 days **COMBD-EN-A**

Overview

LEVEL

Expert

PURPOSE

To understand, in Diesel engines:
the role of the injection system and of aerodynamics in the cylinder on the air-fuel mixture
the mechanisms of the mixture inflammation, of combustion and of pollutants formation
the influence of the engine tuning parameters on performances, efficiency and emissions
the turbocharger behavior.

LEARNING OBJECTIVES

To be able to organize a series of tests and to analyze the results in order to optimize:
the combustion system (injection system, internal aerodynamics, combustion chamber geometry)
the engine tuning parameters (advance, injection pressure, multi-injections, exhaust gas recirculation).

WAYS AND MEANS

One of our best-sellers.
Practical aspects come with dimensioning and matching simulation exercises.

Agenda

FUEL JET INFLAMMATION — 0.5 d

Diesel engine history.
Diesel combustion stages. Self-inflammation delay, basic knowledge on cold flames, influence of the different temperature, pressure, air-fuel ratio, residual gas parameters. Pre-mixture flame and diffusion flame combustions. Soot formation and oxidation mechanisms, nitrogen oxides and carbon monoxide formations.
Jet structure during combustion.

DIESEL COMBUSTION — 1.5 d

Optimization situation of diesel combustion system during the design process.
Pollutants formation in heterogeneous combustion: particles, nitrogen oxides, unburnt hydrocarbons, carbon monoxide.
The three phases of combustion. Noise. Pre-injection and post-injection.
Injectors jets behavior: introduction rate, jets penetration and atomization, cavitation, injection jets overlap; optimization of the injector jets set, bowl shape and dimensions, swirl.
Exhaust gas recirculation (EGR): effect on combustion, EGR cooling, interest of low pressure EGR.
Full load performances: limiting parameters, cylinder head thermodynamic resistance; supercharging, interest of a variable geometry turbocharger.
Start and cold start. Glow plug and post-glow plugs.
Combustion optimization at dyno bench: injector jets positions, influence of injection advance and of low-load and high-load EGR, injection pressure, supercharging pressure. Combustion system evolutions.
Practical exercises on dyno bench test results interpretation.

AERODYNAMICS - SWIRL GENERATION AND MEASUREMENT

0.25 d

Interference between the swirl and the squish.
Influence on the air-fuel mixture and on combustion.
Defining the swirl number and the cylinder head permeability. Bowl shape in the piston.

INJECTION SYSTEMS

0.25 d

Injectors nozzles, injector holes flow rate coefficient, hydraulic flow rate.
Exercise: determining a hydraulic flow rate.
Common-rail injection systems technologies: solenoid control (balanced or unbalanced electrovalve), piezo-electric control, 2-way and 3-way valves, direct piezo control, pressure amplification systems.

HOMOGENEOUS CHARGE COMPRESSION IGNITION (HCCI)

0.5 d

Operating principle, interest, examples of developments.
Critical points: operating area without NOx formation, HC and CO emissions, high load operating, combustion control.
Technologies to be implemented to optimize the concept as a whole: combustion system, exhaust gas after-treatment, engine control (acting on the exhaust gas recirculation, the turbocharger, the inlet temperature, the variable timing).