This course can be adapted to virtual classroom mode

Exhaust Gas After-Treatment

3 days **PTGE-EN-A**

Overview

LEVEL

Expert

PURPOSE

This course provides a deeper knowledge on relations between Diesel and SI engines and air quality.

LEARNING OBJECTIVES

Upon completion of the course, participants will be able to:
understand the contribution of alternative engines to atmospheric pollution phenomena,
know the emissions regulations,
know the nature of the emitted pollutants,
use emission reduction levers at source,
understand Diesel and SI engines depollution systems' operations, in relation with the combustion mode,
choose depollution strategies and select after-treatment systems.

WAYS AND MEANS

Industry experts manage computerized Matlab Simulink simulations on real life data.

Agenda

OXIDATION AND TRI-FUNCTIONAL CATALYSIS — 1 d

Automotive exhaust catalysis: catalytic reactions, mechanisms, catalysts, noble metals, performance criteria, functional definitions (conversion rate, after-treatment related constraints, gasoline and diesel).
Catalysts structure: catalytic converter industry, initiation, conversion rate, case of methane, active substances.
Oxidation catalysis: efficiency, field, initiation, conversion rate, case of methane, sulfur and particles oxidation.
Tri-functional catalysis: stoichiometric conditions, air/fuel ratio control, cold conditions (HC, exhaust thermal management), high power loop opening.
Catalysts ageing: ageing nature, thermal (temperature and sintering), chemical (poisoning), by the accumulation of deposits coming from the lubricants, the fuels or the additives. Functional limit of catalysts ageing.
On Board Diagnostics (OBD), prospects and conclusions.

NITROGEN OXIDES TREATMENT — 0.5 d

NOx traps: operating principle (storage mechanisms, range of temperatures to use, rich mixture reduction phase), trap desulfurization.
Selective reduction catalytic (SCR): by ammonia, urea injection strategy, use restrictions. "Clean-up" catalysts.

DIESEL PARTICULATES FILTER - DPF — 0.5 d

Filtration element structure and composition regeneration strategy either by fuel additive, Fuel Born Catalyst, or by Catalytic Diesel Particulates Filter (CdPF). Use of the 5th or the 7th injector.

Installation on the vehicle:
Evolution towards the 4-way catalysis: in the same converter, combining the particulates filter of a nitrogen oxides treatment system (SCr or non-trap) with an oxidation catalyst.

OPTIMIZATION BY SIMULATING A DIESEL EXHAUST LINE (PRACTICAL ON MATLAB SIMULINK) 1 d

An example of diesel exhaust line including a Diesel Oxidation Catalyst (DOC) as well as a Diesel Particulate Filter (DPF) will serve as the basis for introducing after-treatment systems modeling/simulation. Participants will be taught how calculations can replace a long series of tests and focus the validation tests to the strict necessary. Different digital tools will be analyzed then implemented to optimize the line. The input data being know (temperature and gas flow at DOC intake, at source engine emissions), several scenario will be simulated to optimize:
The catalyst volume and precious metals load.
The hydrocarbons quantity to be post-injected to the exhaust line to make sure the DPF will be regenerated.
The practical will make it possible for participants to understand the physics found in the model: thermal balance, pollutants mass balance, chemical reactions kinetics on load and speed transients.