Improvement and Simplification of Diesel Particulate Filter System Using a Ceria-Based Fuel-Borne Catalyst in Serial Applications

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Highlights

Introduction

Principle and interest of a nanoCeria-based fuel borne catalyst DPF System Approach

Improvements in Vehicle Integration

- FBC activity
- Diesel Particulate Filter
- On-board dosing system

Conclusion and future developments

Key Issues in Designing an Ideal DPF System

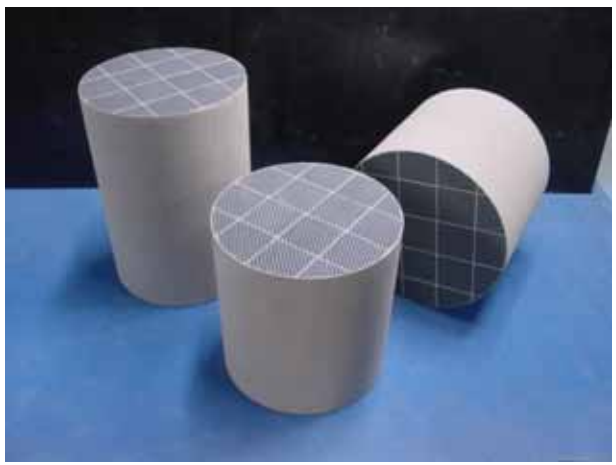
A system approach is needed to meet specifications and requirements in term of:

- technical (efficiency, durability, reliability, compatibility)
- economy (system cost, fuel consumption, maintenance...)
- regulated emissions (NOx, CO, Hydrocarbons, Particulate)
- non-regulated emissions (NO2, O3, dioxin, furan…)
- flexibility (variable diesel fuel quality, sulfur level...)
- customer acceptance (driving pleasure, acoustic performance, maintenance constraints, cost...)

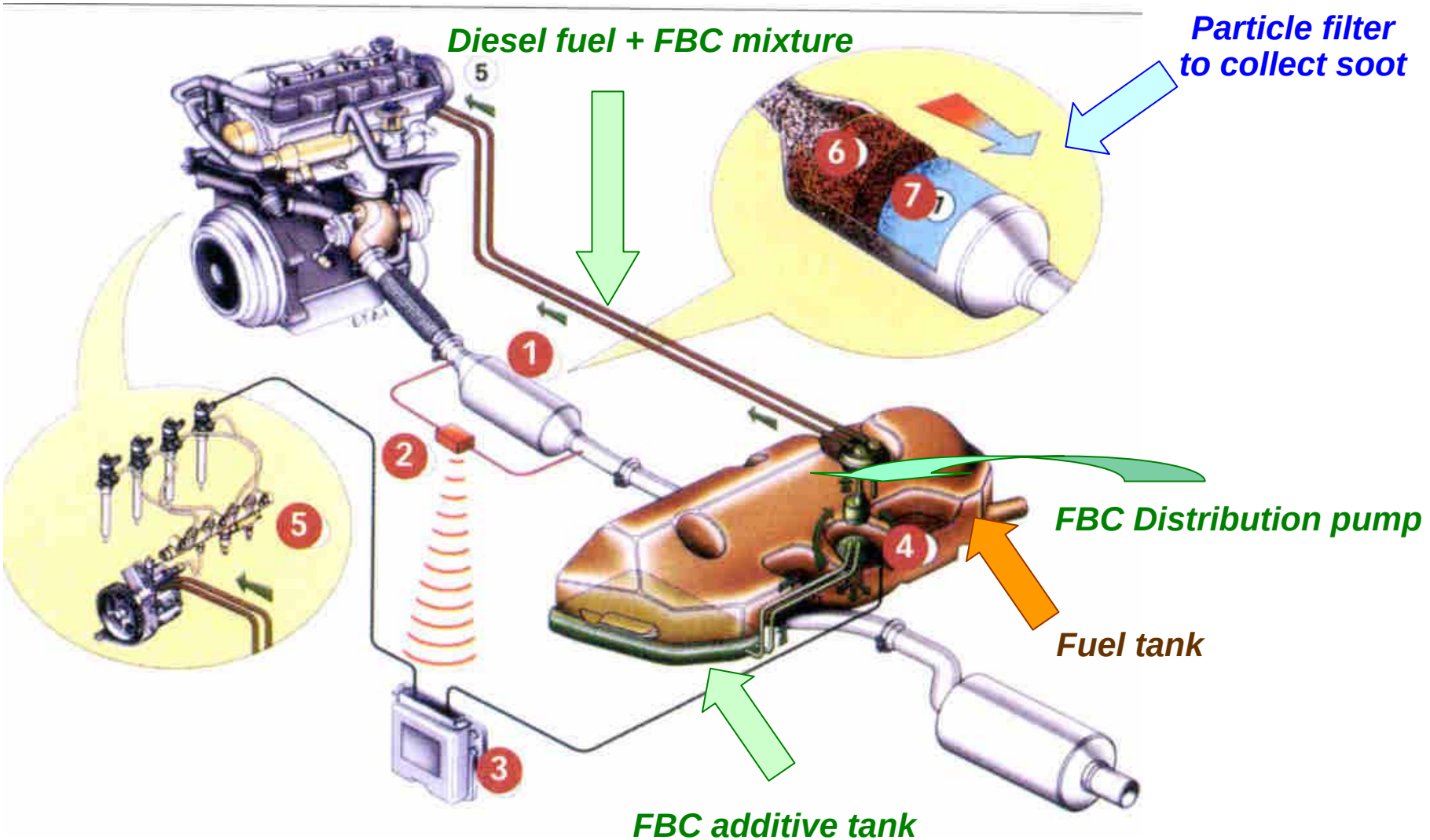
Challenges for a DPF system

In order to use a DPF technology in all types of applications or strategies (first mount, “fit for life”, passive or active retrofit…), two main technical and economical challenges remain:

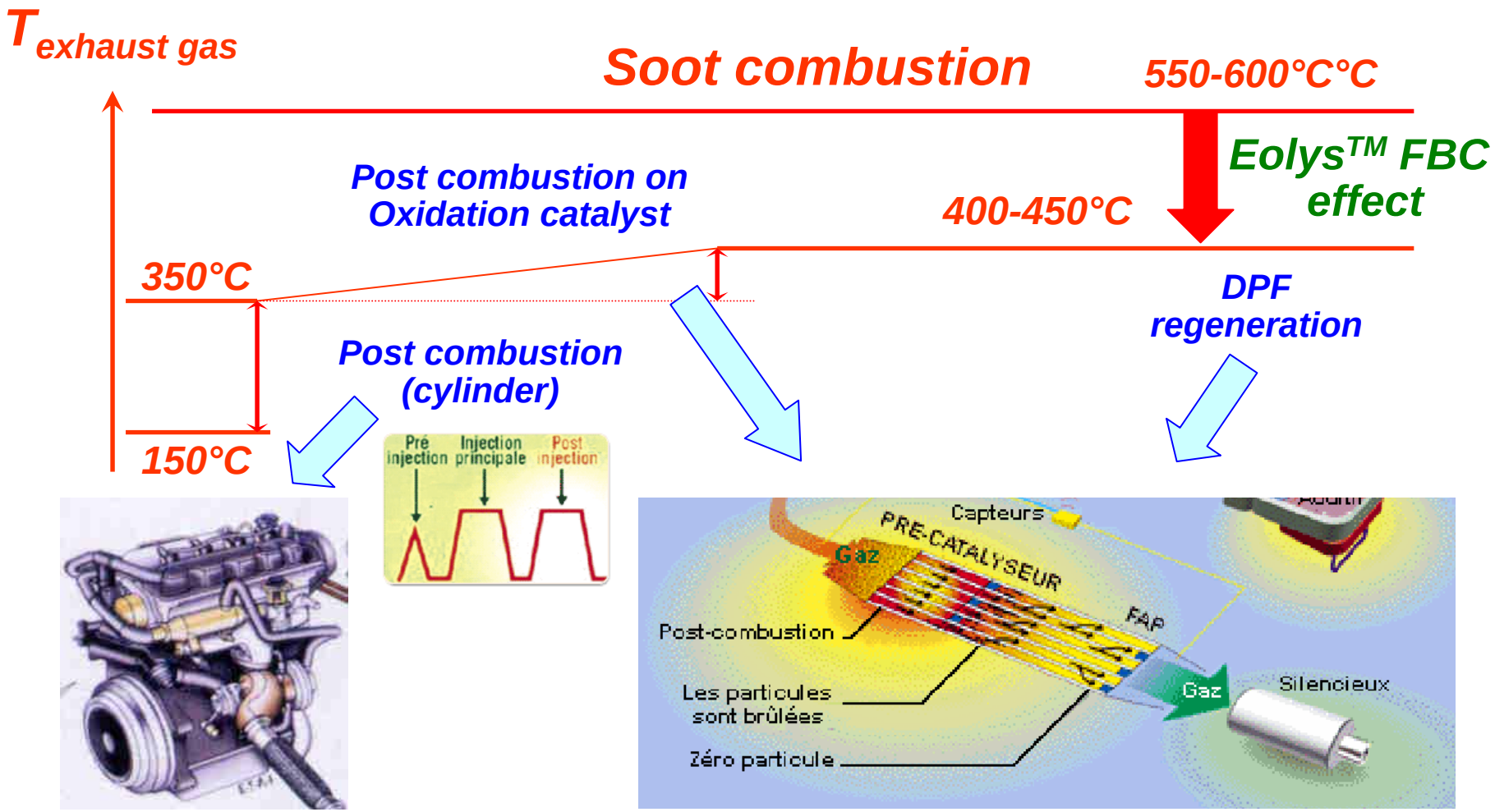
- To provide a high regeneration performance whatever the driving cycle (many different driver’s profiles!) or the DPF location
- To be easily integrated into the vehicle, in order to decrease the overall cost



Principle of Fuel-Borne Catalyst/DPF System



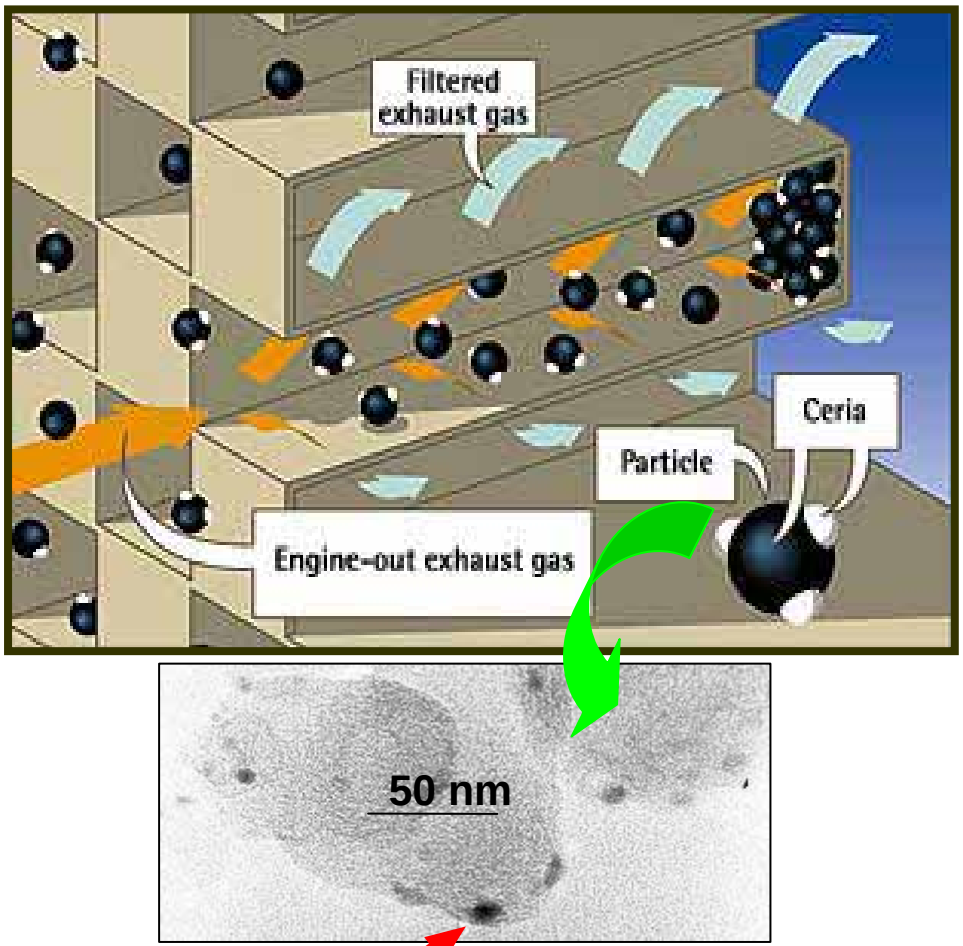
Regeneration Strategy (Engine Management) and FBC Role



‘ Common-Rail ’ system tuning : post injection in cylinder

From PSA Peugeot Citroën

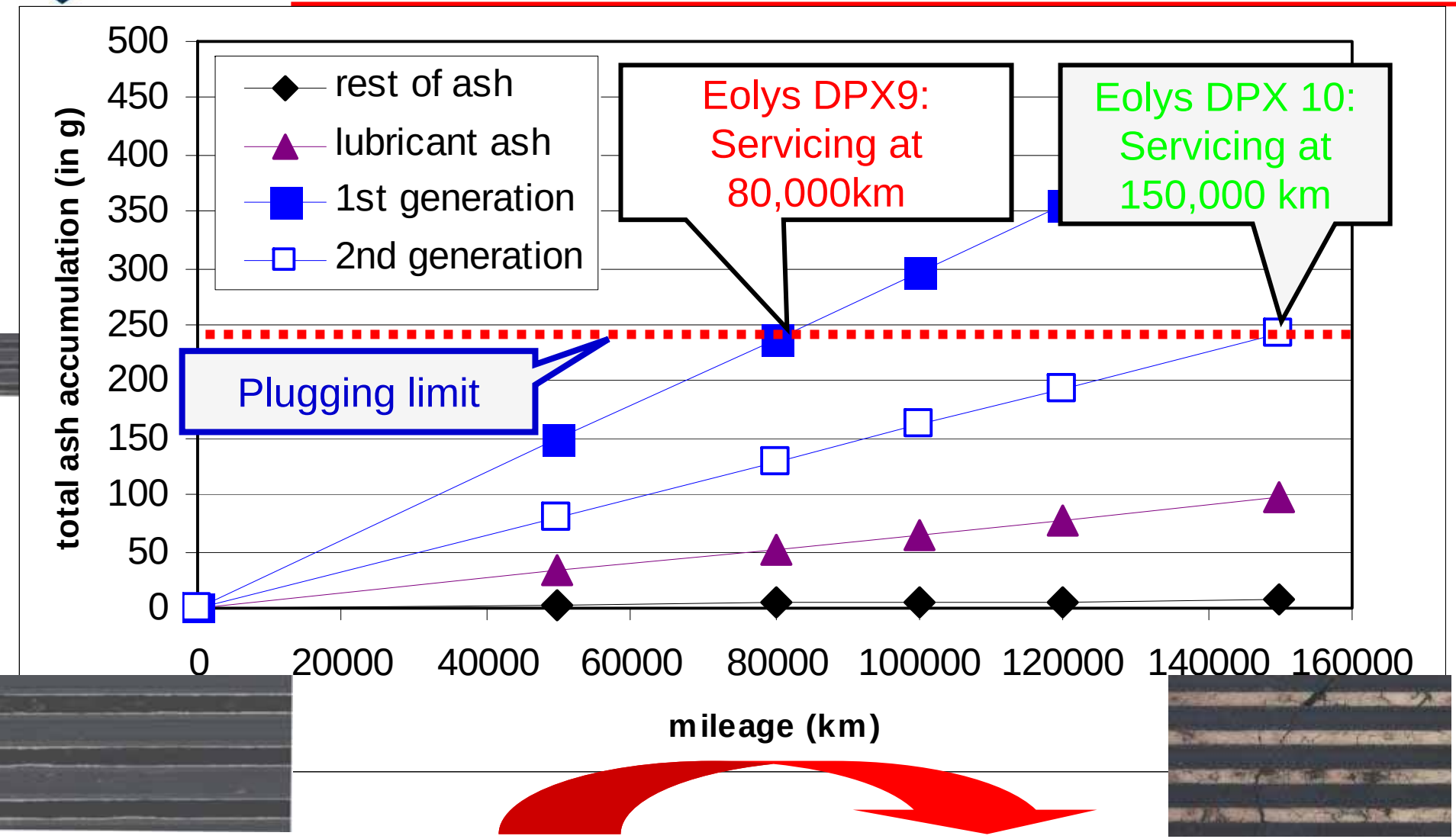
A Fuel-borne Catalyst Is the Best Approach to Facilitate Soot Combustion



FBC

- To lower the temperature of soot ignition, decreasing thus the engine stress (oil dilution…)
- To allow a fast regeneration, whatever the driving cycle
- To favor the diffusion of the combustion process to the entire soot layer, due to a complete regeneration, avoiding thus pyrolytic carbon formation
- To supply in a continuous way a fresh nano-crystal catalyst, insensitive to sulfur poisoning

A More Active FBC Greatly Improved the Filter Autonomy



Dosing rate : 25 ppm

Fuel consumption : 7l/100km

DPF length : 9”

Dosing rate : 10 ppm

Fuel consumption : 7l/100km

DPF length : 9”

How to Further Improve the Fuel-Borne DPF System

Still improve the FBC catalyst activity and Decrease the volume of embarked FBC

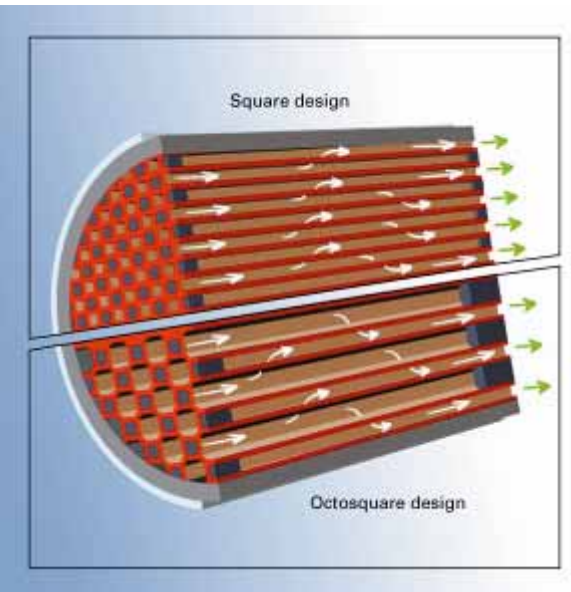
Chemist

Improve the vehicle integration for a **Fit for life** solution

Fuel system specialist

ash (filter)

Simplify the onboard dosing system and decrease cost



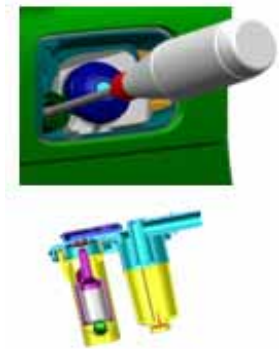
Evolution of Onboard Dosing System: Specification

- An onboard dosing pump with an accuracy level compatible with the increase of FBC concentration and the decrease of dosing rate
- A refilling process as simple as possible
- A flexibility in the autonomy of the FBC tank (different OEM requirements)
- A good reliability and durability of the system
- A global cost reduction

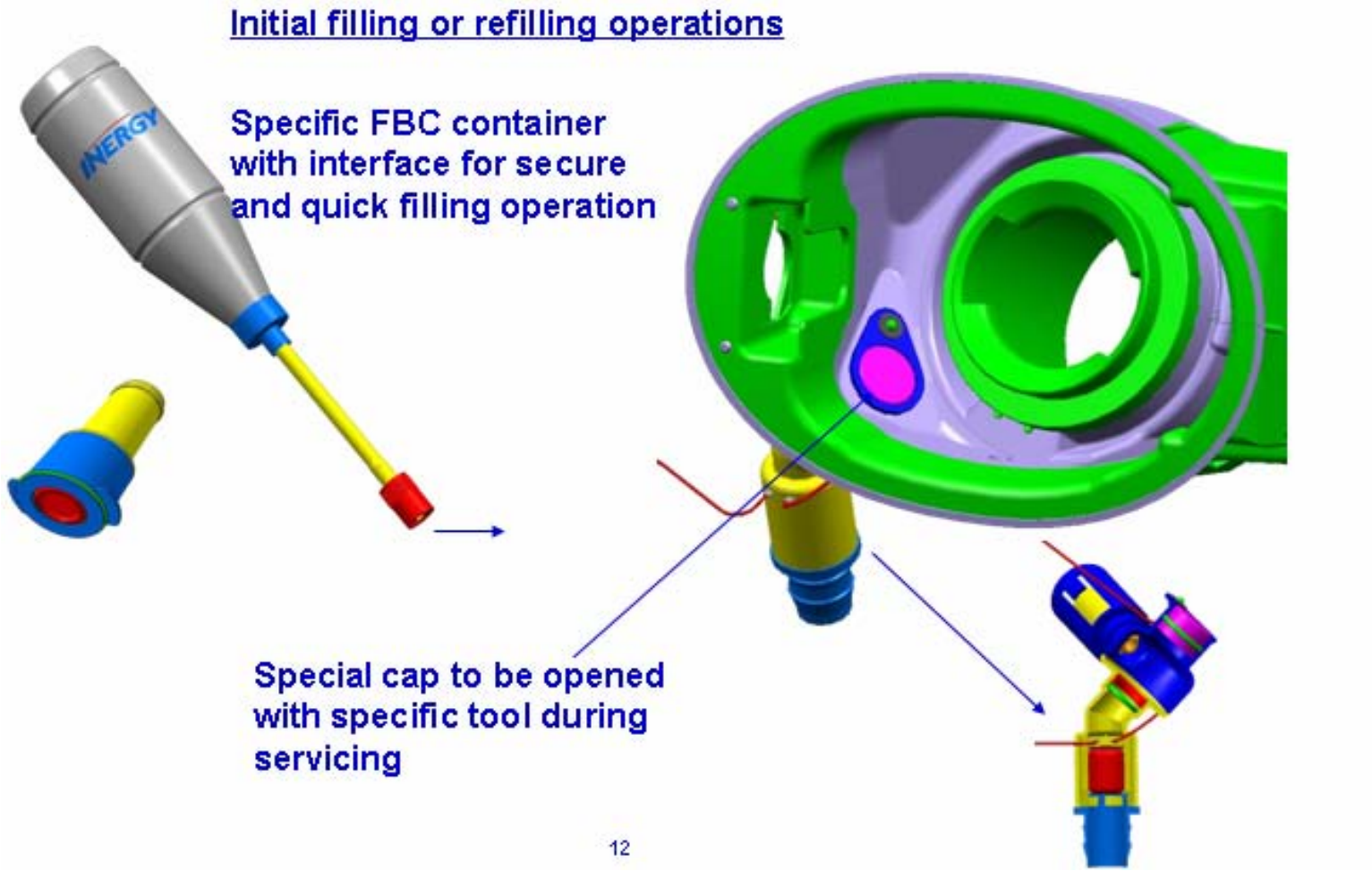
Inergy's Smart Additive System

Four major innovations allow this integration :

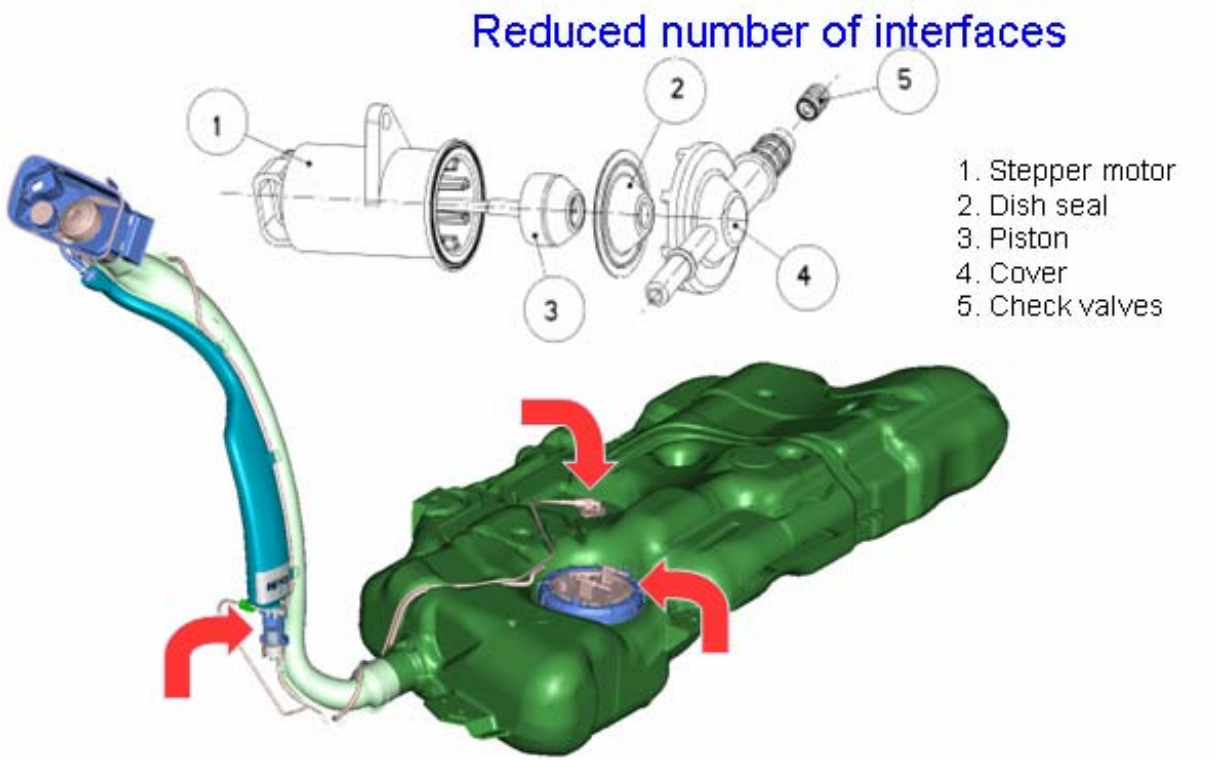
- An additive tank integrated alongside the filler pipe
- A refilling at the filler door
- A specific diesel Fuel Limit Venting Valve (FLVV)
- A high precision pump

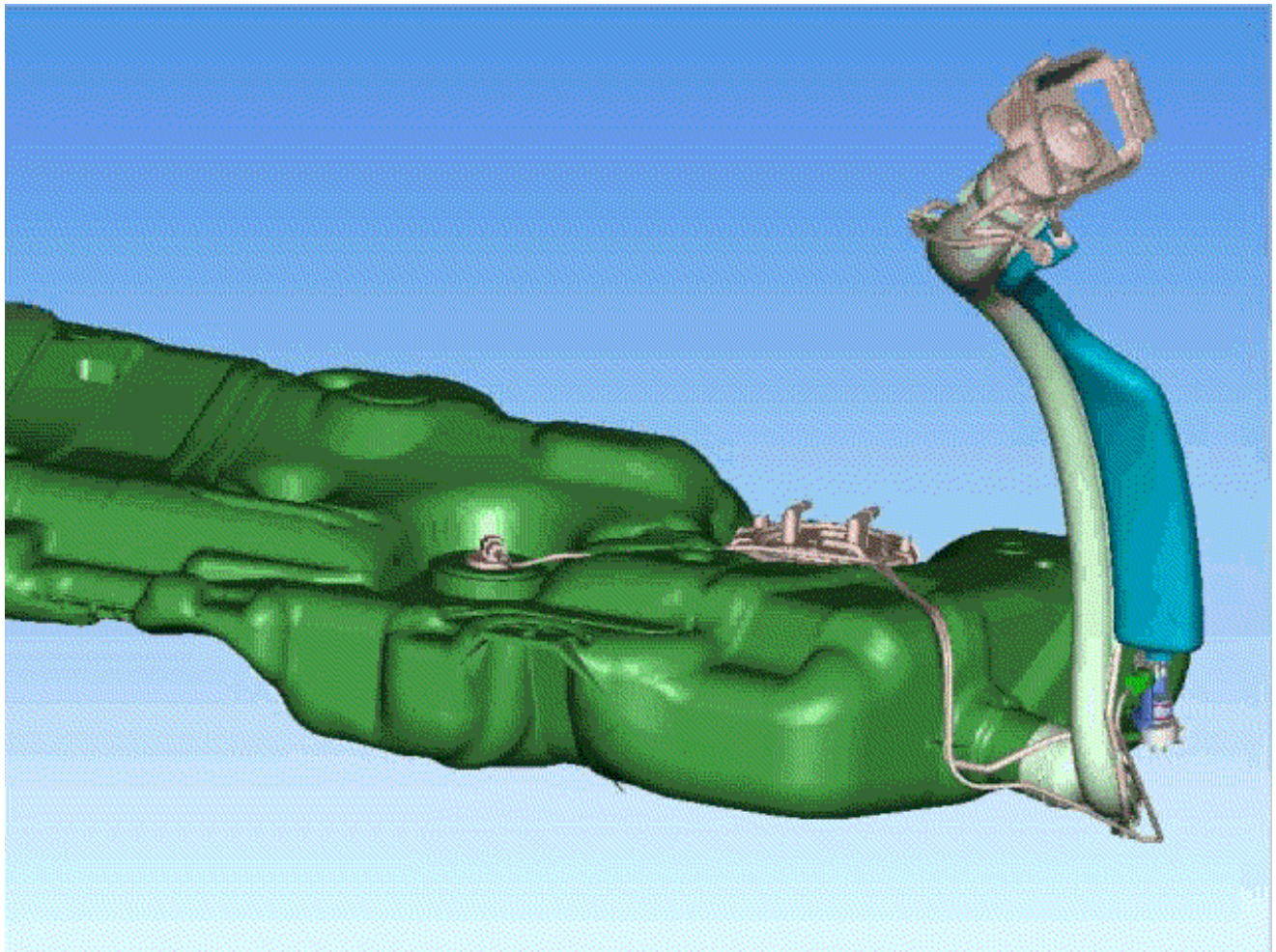


INSAS – Vehicle Integration at Trap



High-Precision Pump with Flexible Location





FBC DPF Optimization

	Current system	INSAS™
Diesel System architecture	😐	☺
Robustness (durability)	☺	☺ ☺
Safety (vibration, crash, fire)	☺	☺ ☺
Vehicle assembly line filling	☹	☺
Refilling during servicing operations	😐	☺
System Costs	😐	☺
Accuracy of FBC dosage	😐	☺
Flexibility (FBC nature)	☹	☺
Adaptability to **Retrofit**	☹	☺ ☺

Eolys™ in serial production since May 2000

More than 800 000 passenger cars already equipped

The **FBC-DPF system** is the **only proven technology** for large serial passenger car applications in Europe:

PEUGEOT


807


307


406


coupé 406


607


C8


C5


C4


407

FIAT e-LANCIA

Ford VOLVO


C-Max

Using EOLYS FBC™

Results of the FBC DPF "Green Diesel"platform approach

The FBC DPF system was improve and allow now a better vehicle integration and different OEMs' strategies through:

- A more active Fuel Borne Catalyst, efficient at 7 ppm or less and highly concentrated, giving an autonomy up to 150,000 km per liter
- A simplified and less expensive on-board dosing system (pump accuracy, simplified architecture and servicing processes…)

Benchmark: a -20% cost decrease compared to actual FBC solutions or alternative technologies [Catalyzed Soot Filters (CSF)]

Ongoing Developments

Due to the flexibility given by the cerium-based additive (EOLYSTM) and the simplified integration in the fuel system (INSASTM), the FBC DPF approach has the capacity to become the leading technology in all market segments:

- Passenger cars
- Heavy-duty vehicules
- Passive retrofit systems
- Active retrofit systems

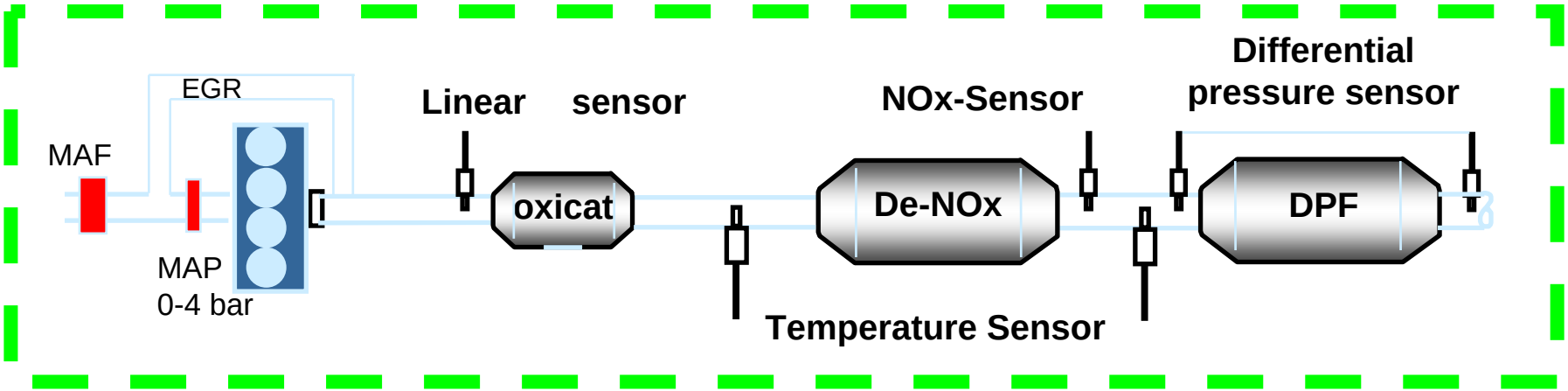
Passenger Car Segment

A strengthening of norms will happen in Europe in 2008-10 (Euro 5/6 with a tighter level either on NOx and Particulate matter) and in 2009-10 in the US (Tier2-Bin5)

This will require the coupling a DPF with a DeNOx system (NOX-TRAP or SCR catalyst)

The DPF regeneration process will become more complex in term of thermal management

Conflicts in Global Exhaust Thermal Management Are Already Identified



- Whatever the technical solution (catalyzed or non catalyzed DPF) or the thermal process used to regenerate the filter, **a FBC** :
  - **will facilitate** (or more probably simply allow) **regeneration** since the filter will be very probably placed in under-floor position
  - will limit the fuel overconsumption
  - will allow a **complete regeneration of the filter**

Active Systems Segment
(First-Mount Or Retrofit for Heavy-Duty or Duty-Cycle Vehicles)

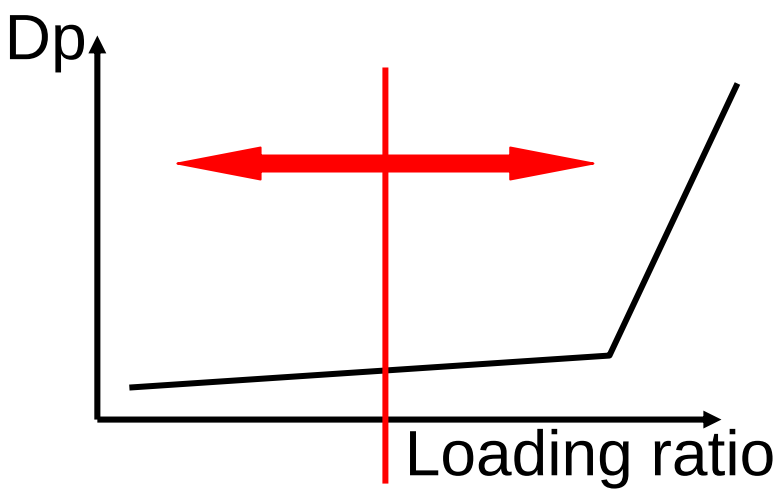
When engine management cannot be used and driving cycle does not allow a passive regeneration, **an active system, independent from the engine**, is required.

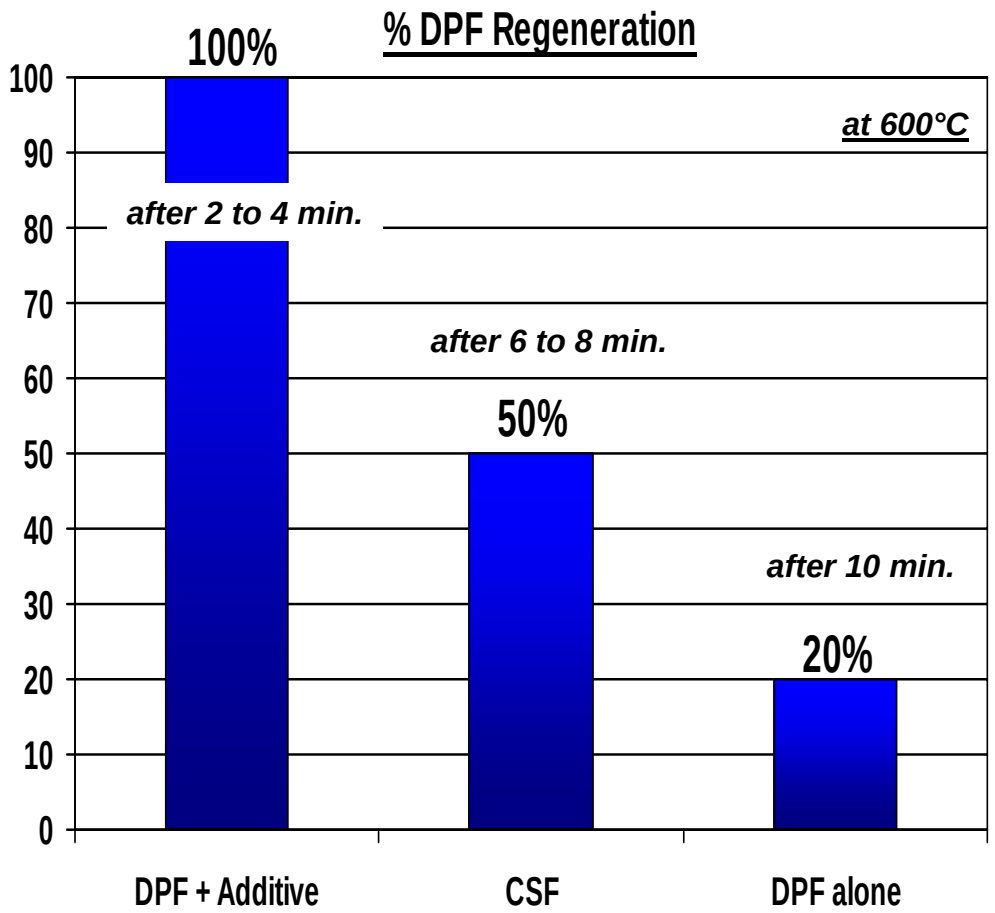
Even with such active systems, the use of a fuel borne catalyst greatly:

- improves the filter durability by **promoting a complete regeneration**
- **decreases the fuel overconsumption** since regeneration starts at a much lower temperature

“Partial” Regenerations

source BOSCH





Potential Detrimental Effect of a Complete Regeneration After Several Uncomplete Regenerations

Melting of a SiC DPF (CSF) in a Paris Urban Cycle

Passive Systems Segment

- Passive retrofit systems for heavy-duty vehicles (cf. next presentation on an urban bus fleet retrofit in La Rochelle)

Thank you for your attention

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