Combination of Diesel fuel system architectures and Ceria-based fuel-borne catalysts for improvement and simplification of the Diesel Particulate Filter System in serial applications

Mike CIVIELLO
RHODIA Electronics & Catalysis Inc.

Paul WOUTERS
INERGY Automotive Systems

Content of presentation

- Introduction
- Global DPF System Approach
- Ceria-Based Fuel Borne Catalysts
- Improvements in Vehicle Integrations
  - Diesel Particulate Filter
  - On-Board Eolys™ tank
- Conclusions
- Acknowledgement

Content of presentation

Introduction

Global DPF System Approach

Ceria-Based Fuel Borne Catalysts

Improvements in Vehicle Integrations

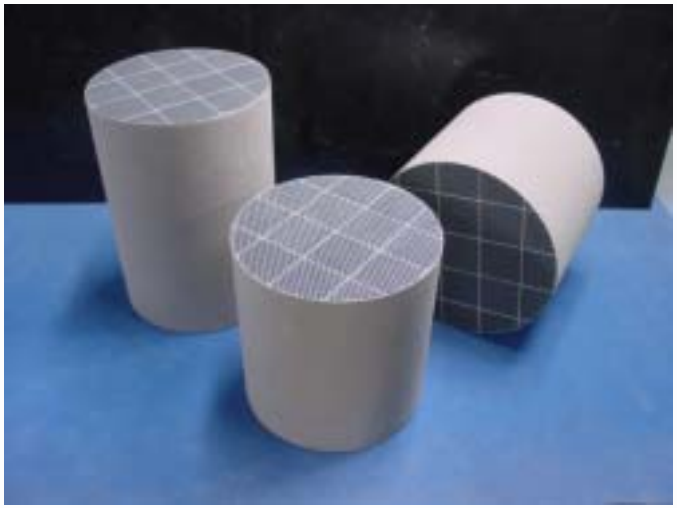
- Diesel Particulate Filter
- On-Board Eolys™ tank

Conclusions

Acknowledgement

Durability of DPF performance:
the key issue for series applications

Efficiency of Diesel Particulate Filter is not really the key issue any more



On the other hand, **durability in Diesel Particulate Filter performance** (to meet emission standard limits) is the real technical and economical challenge

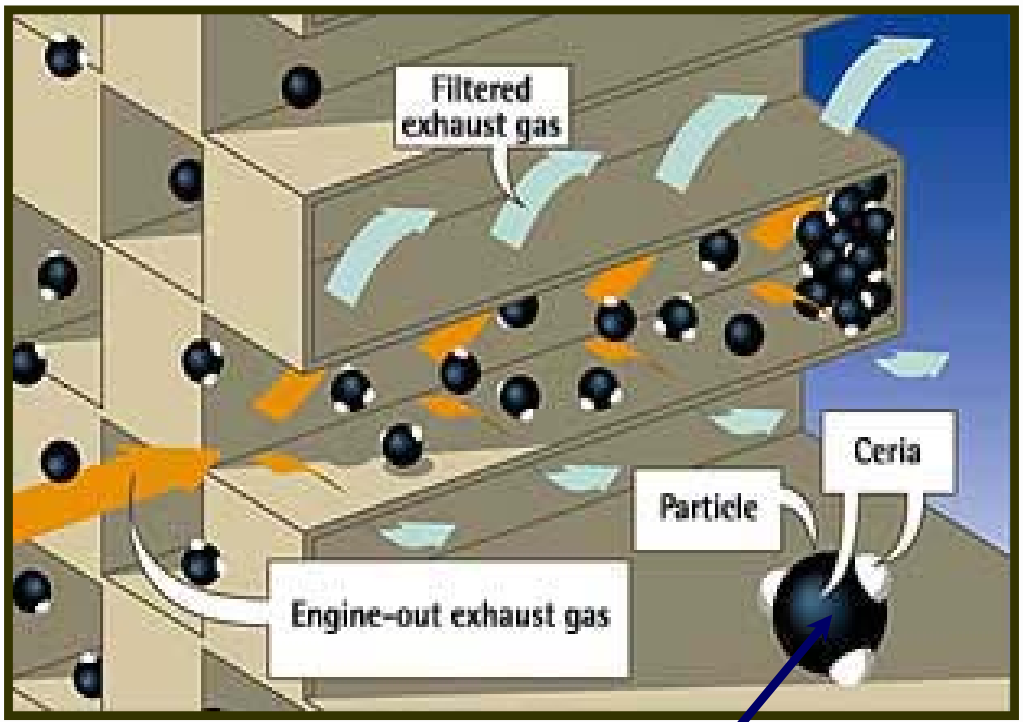
Particularly for automotive series applications where driver profile is diverse and unknown (series productions)

Complex challenge to design the ideal DPF system

Active system approach is needed to meet specifications and requirements :

- ***technical*** (efficiency, durability, reliability, compatibility)
- ***economic*** (system cost, fuel consumption, maintenance…)
- ***regulated emissions*** (NOx, CO, Hydrocarbons, Particulate)
- ***non-regulated emissions*** (NO_2, O_3, dioxin, furan, particle)
- ***geographical*** (variable diesel fuel quality, sulfur level…)
- ***customer acceptance*** (driving pleasure, acoustic performance, maintenance constraints, cost…)

The use of Eolys™ Fuel-borne Catalyst:
the best approach for solid-solid catalysis



Ceria catalyst and soot aggregate

- to lower the temperature of soot combustion process
- continuous and fresh nano-crystal catalyst supplying
- homogeneous Catalyst dispersion (highest contact point numbers)
- to favor diffusion of soot combustion process to the entire soot layer
- fast & complete DPF regeneration
- no Sulfur sensitivity

Content of presentation

Introduction

Global DPF System Approach

Ceria-Based Fuel Borne Catalysts

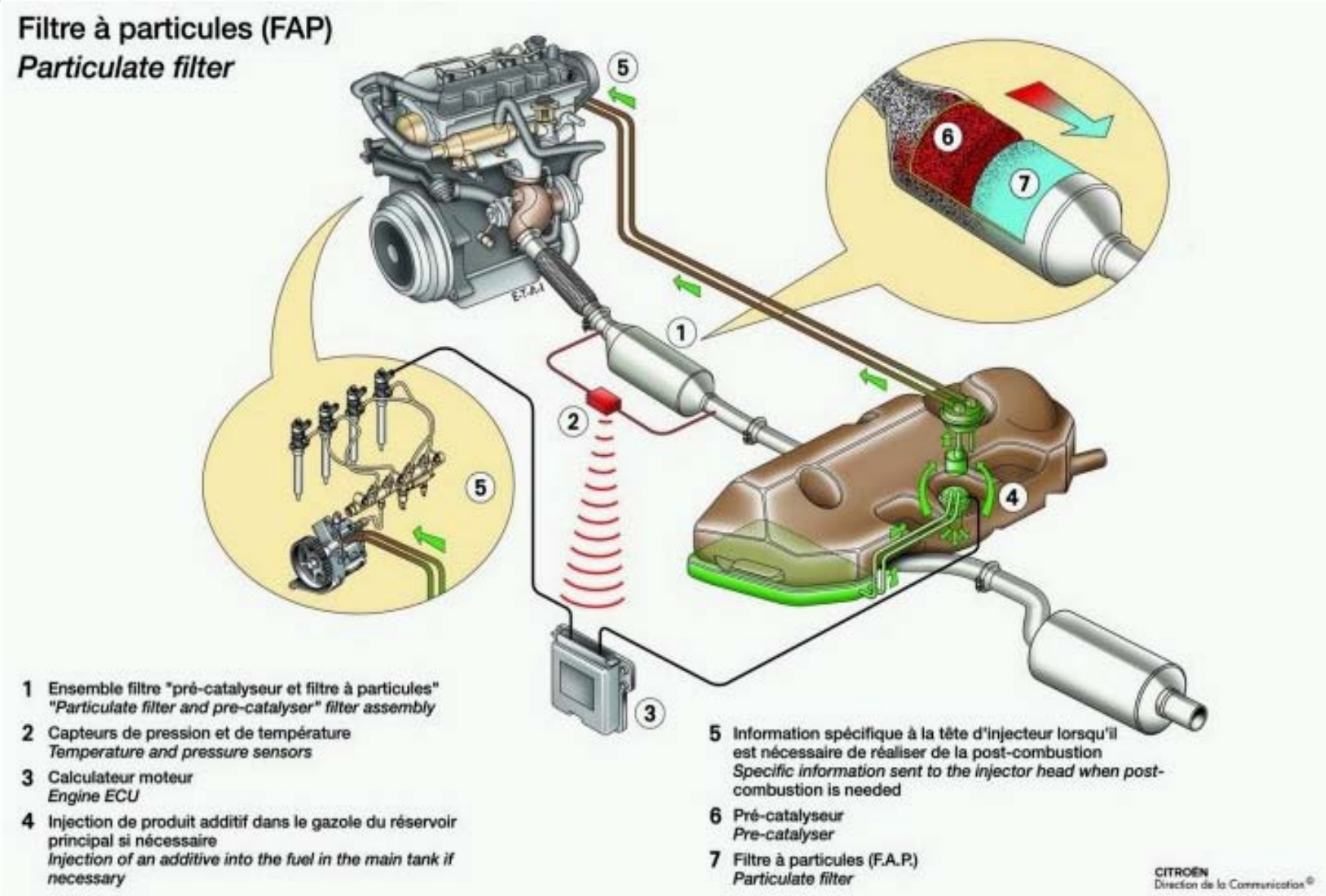
Improvements in Vehicle Integrations

- Diesel Particulate Filter
- On-Board Eolys™ tank

Conclusions

Acknowledgement

PSA Peugeot Citroën DPF System



Eolys™ in Series Production since May 2000

More than 500,000 vehicles equipped to date

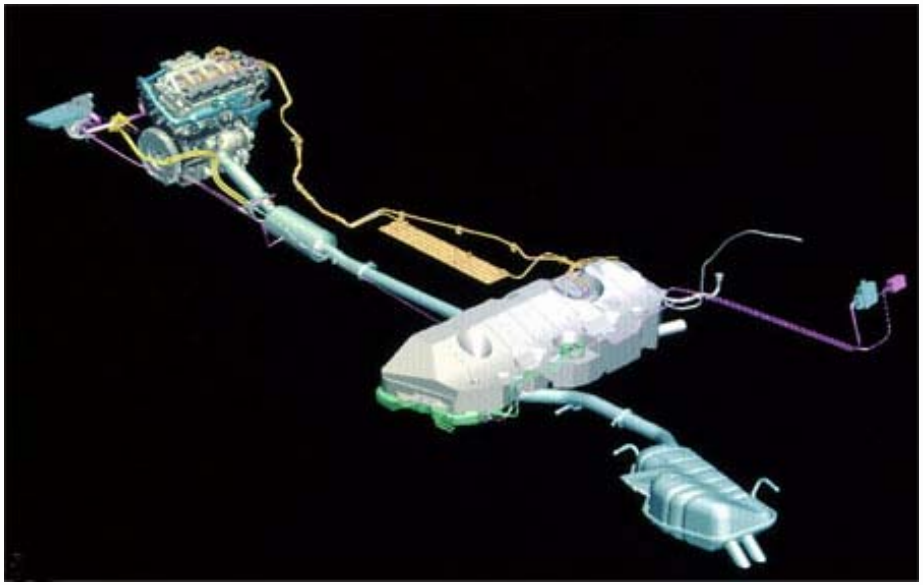
(750,000 vehicles by the end of 2003)

PEUGEOT

FIAT

e-LANCIA

DPF System still under improvements



Advantage

- validated in Series Productions
  (1/2 millions+ of DPF production)
- no recall, no field failure
- more than 3 years experience

Drawback

- New after-treatment system
- Global cost
- Global DPF System maintenance
- Global Vehicle integration

Global DPF System Improvements

- **Better vehicle integration:**

  space, weight, materials, dosing system and strategy, and SiC-based DPF design

- **Limited and easier Eolys™ vehicle integration and maintenance**

- **Global Cost Reduction of the DPF System**

Content of presentation

Introduction

Global DPF System Approach

Ceria-Based Fuel Borne Catalysts

Improvements in Vehicle Integrations

- Diesel Particulate Filter
- On-Board Eolys™ tank

Conclusions

Acknowledgement

Ceria-based fuel-borne catalysts Comparison

Fuel-Borne Catalysts	Ce-FBC reference	Fe/Ce-FBC
Active Ceria	Ceria	Iron-doped Ceria
Dosing rate (ppm)	25 *	10 *
Soot burn-off (°C)	460	410
Regeneration time (second) (at 500°C - 1600rpm/42Nm)	1600	400
Max. temperature peak (°C) (with 8g/l soot loading)	700	750
Thermal stress (°C/cm) (with 8g/l soot loading	55 **	55 **

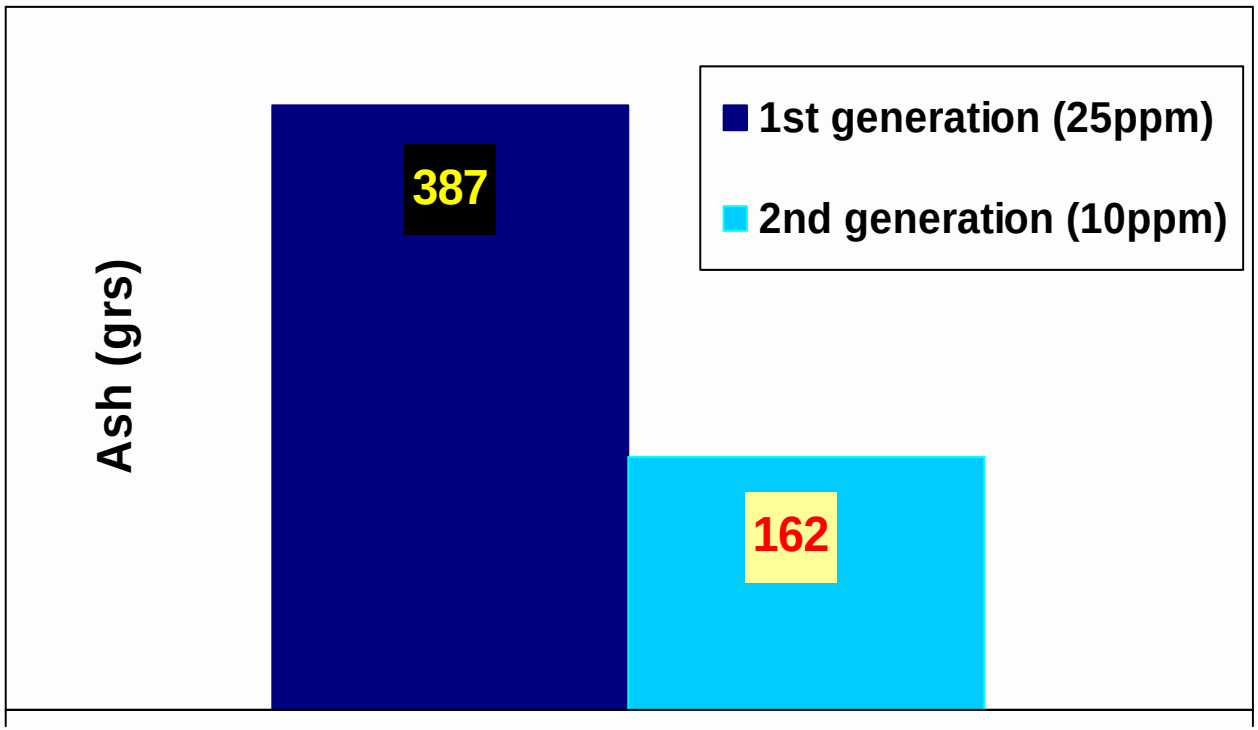
** according to EURO 3 diesel engine*

*** Ibiden Co. recommendation : 40 to 70°C/cm*

Source: SAE 2002-01-2781

Impact on ash production

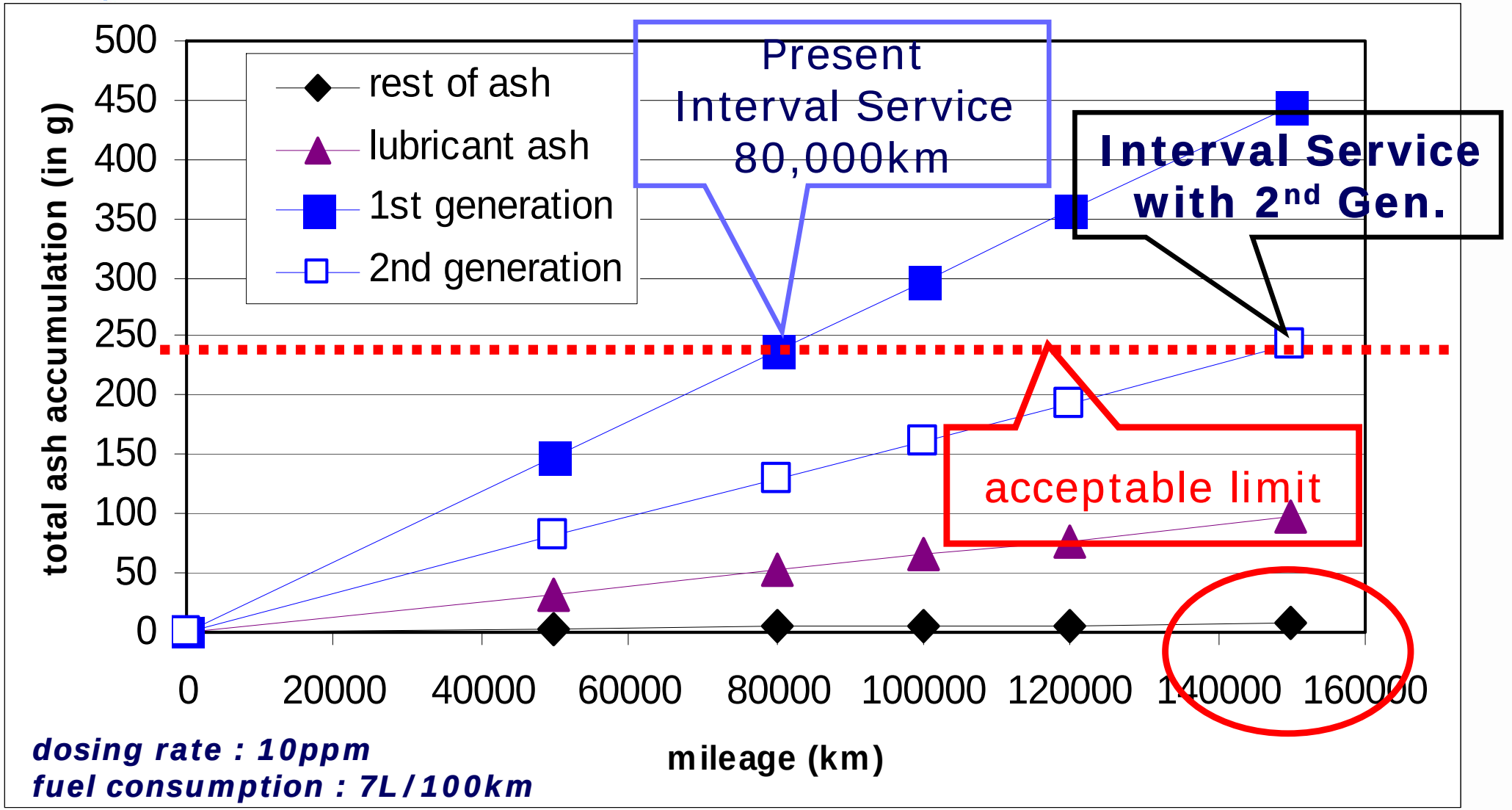
calculation over 150,000km
average fuel consumption of 10 L/100km
Diesel fuel density : 0,84 kg/L
dosing rate 1st (25ppm) and 2nd (10ppm) generation



↘ ~ 60% w/w decrease of ash

Source: SAE 2002-01-2781

DPF Interval Service (length of 9”)



Source: SAE 2003-01-0378

Content of presentation

Introduction

Global DPF System Approach

Ceria-Based Fuel Borne Catalysts

Improvements in Vehicle Integrations

- **Diesel Particulate Filter**
- **On-Board Eolys™ tank**

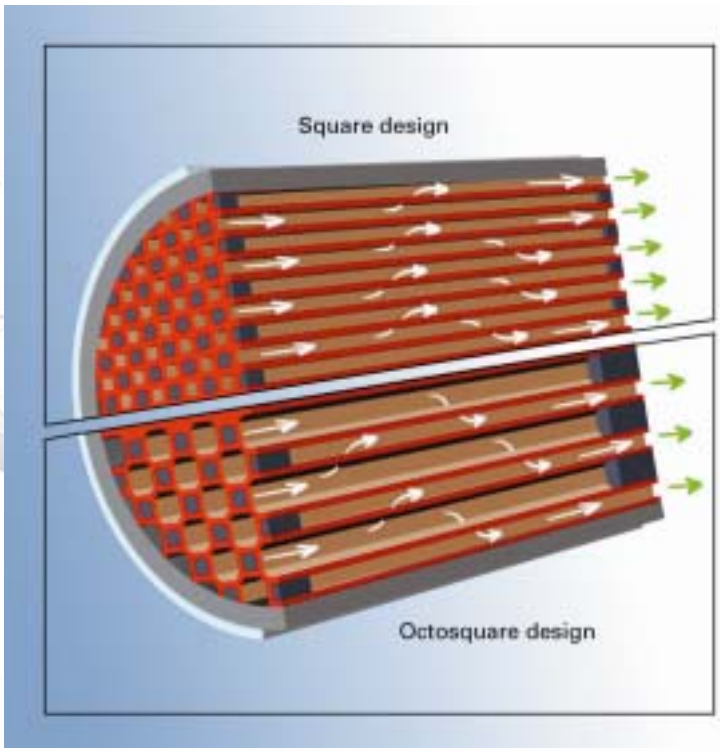
Conclusions

Acknowledgement

Limited DPF maintenance constraint

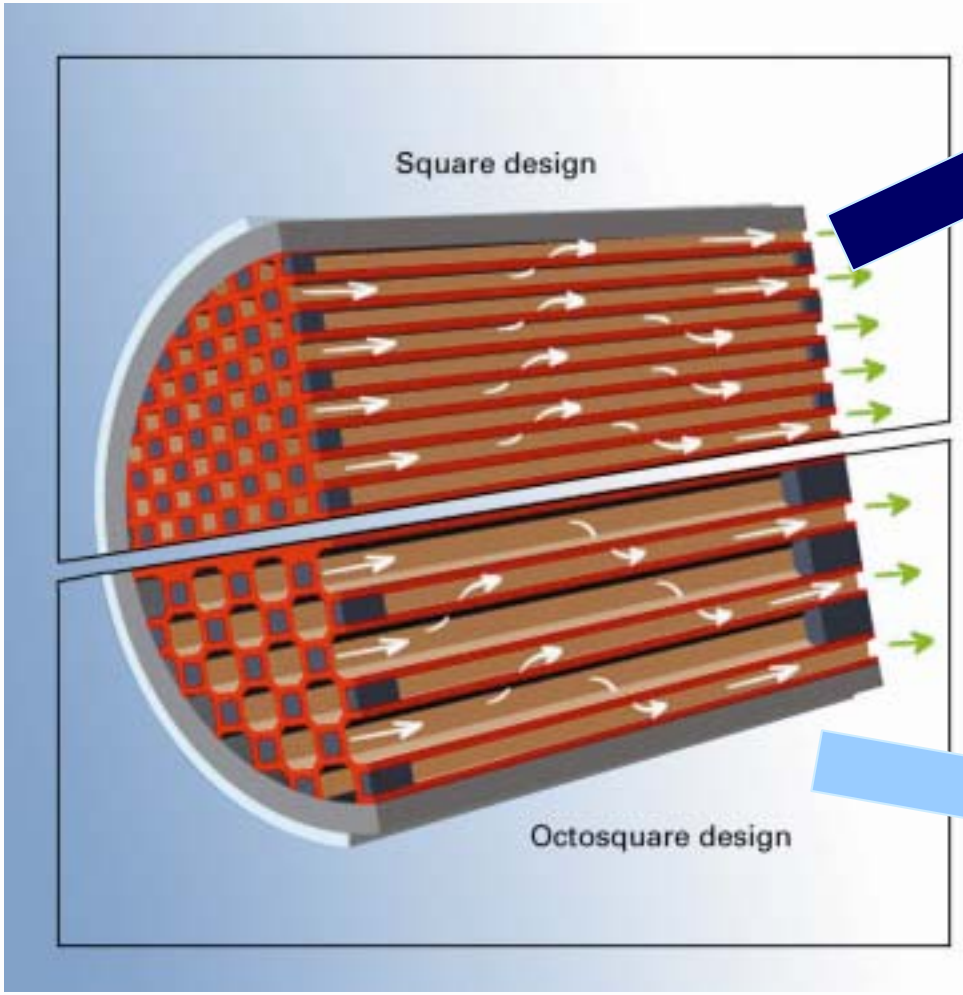
1st Step : 120,000 to 150,000km **(Nov. 2002)**
with existing parts and ***the 2nd Eolys™ generation***

2nd Step : DPF w/o servicing **(mid of 2004)**
with **the *2nd Ibiden Co.'s SiC-DPF generation***



Source: PSA Peugeot-Citroën

Better DPF vehicle integration



Typical Square design

250,000 km DPF Operation

with a Ø 5.66" x 13.8" filter

New Octosquare design

250,000 km DPF Operation

with a Ø 5.66" x 11" filter

Source: Tenneco-Gillet

Evolution of On-board Dosing Systems

Year	Tank Volume	Tank design	Tank Autonomy (km)
2000	**5 liters**		**80,000**
2003	**3 liters**		**120,000**
2004	**< 1,5 liters**	**New design**	**150,000**

Content of presentation

Introduction

Global DPF System Approach

Ceria-Based Fuel Borne Catalysts

Improvements in Vehicle Integrations

- Diesel Particulate Filter
- On-Board Eolys™ tank

Conclusions

Acknowledgement

Conclusions

A Global DPF System Approach for Innovation, Simplification, Better Vehicle Integration and Global Cost Reduction:

- New Ceria-based fuel-borne catalyst generation with enhanced catalytic activity, while keeping the DPF functionality (exothermic & thermal stress)

- New SiC-based DPF design for better global ash management (lubricant & fuel-borne catalyst)

- New Eolys™ Dosing System architecture for better vehicle integration

Conclusions (ctd)

Constant Innovations and Simplification of the Global DPF System lead to:

- better vehicle integration (DPF size, Eolys™ tank)

- limited and easier DPF System maintenance

- reduction of DPF System cost (OEM and after-sales/maintenance)

New innovations are going on to fit with the future NOx/PM EURO 5 standard limits (introduction of NOx-traps)

Content of presentation

Introduction

Global DPF System Approach

Ceria-Based Fuel Borne Catalysts

Improvements in Vehicle Integrations

- Diesel Particulate Filter
- On-Board Eolys™ tank

Conclusions

Acknowledgement

Acknowledgement

The authors would like to thank :

Aaqius & Aaqius

HTW Dresden

PSA Peugeot Citroën

and our colleagues

for making available the detailed results, graphs and pictures.

Thank you for your attention