PROJECT

SYLOC-DEXA

System Level Optimisation and Control Tools for Diesel Exhaust After treatment

Funding: European (5th RTD Framework Programme)
Duration: Feb 2000 - Jan 2003
Status: Complete with results

Background & policy context:

The Diesel engine is the most efficient power plant among all known types of internal combustion engines. Passenger cars, heavy trucks, urban buses and industrial equipment are powered by Diesel engines all over the world. The Diesel engine is a major candidate to be the power plant of the future. However, there is a barrier to a wide-spread diffusion of Diesel engines: the contemporary reduction of NOx and particulate emissions up to the level required by the next stages of European legislation Euro 4 and beyond. Diesel particulates and nitrogen oxides, the two most troublesome components of Diesel exhaust emissions, have a dramatic, damaging impact on the environment and health.

In order to achieve proposed emission levels, considerable progress concerning the control of the combustion process using “second generation” common rail systems, characterised by higher fuel injection pressures and better electronic control of the injection process, has been made. Nevertheless, for vehicle classes of inertia test weight higher than 1.600 kg at present future emission levels can only be met by parallel application of catalysts and Diesel particulate filter systems.

Considerable attention therefore is currently directed towards improving the performance of these components. However, engine development work so far has proven that it is not possible to optimise the behaviour of the individual components of a Diesel engine exhaust system in isolation: the optimisation comes out from a fruitful interaction of individual elements of the exhaust system and the engine. The identification of successful combinations by building and testing entire aftertreatment systems or vehicles requires even more effort and money. Therefore it was the prime objective of the SYLOC-DEXA project to develop an alternative for the layout of optimal Diesel engine exhaust systems to meet future emission standards.

Objectives:

The prime objective of the SYLOC-DEXA project to develop an alternative for the layout of optimal Diesel engine exhaust systems to meet future emission standards. This alternative was seen to be the development of predictive computer models for the optimisation of complete Diesel engine exhaust systems and to use these models in such a way that various design options can be assessed rapidly to determine the most suitable design for a particular engine-prototype or vehicle.

In particular the project objectives have been:

- Development of an advanced, efficient and user-friendly simulation tool (sub-modules) for the computer-aided design and engineering of integrated Diesel exhaust aftertreatment systems
- Validation of the simulation tool extensively during laboratory and engine bench tests
- Performing system level optimisation and control for the design of selected demonstrator cases
- Validation of the complete optimised simulation system and control approach against the demonstrators

Methodology:

In the first half of the project, research work focused on laboratory experiments and steady-state engine tests for creating measurement data as input to the simulation software. The consortium partners have investigated practically all kinds of commercial particulate filter types and conversion
systems. Filter sub-models, which account for pressure drop, filter regeneration characteristics and thermal behaviour, have been created and the models to represent the complete exhaust gas aftertreatment system have been developed. A database containing information on filter materials has been established and this was continuously updated/extended during the run-time of the project.

Research activities in the second half of the project concentrated on transient engine testing and model validation. In particular the layout of the exhaust system for a Demonstrator (Alfa Romeo 156 1.9 JTD) was performed using the SYLOC-DEXA software toolkit to demonstrate its potential concerning filter loading and regeneration simulations. Additionally design variants of a virtual demonstrator have been assessed to show the wide range of applicability of the SYLOC-DEXA modules.

Furthermore two versions of the simulator toolkit have been created and made available to the project partners. The finally released software version V2.0 contains an efficient and user-friendly Graphical User Interface – GUI and sub-models to deal with all aspects of Diesel engine exhaust system design including oxidation catalysts and filter loading and regeneration modules.

Close co-operation between the consortium partners and intensive (and open) data exchange between the development engineers ensured a short reaction time with respect to the integration of new features in the modelling work, such as for example a reaction mechanism for the continuous soot regeneration provided by NO2.

Parent Programmes:  
**FP5-GROWTH KA3 - Land transport and marine technologies**

**Institute type:** Public institution  
**Institute name:** European Commission, Directorate-General for Research (DG Research)  
**Funding type:** Public (EU)

**Partners:**

Austria:
Christian-Doppler-Laboratory for Applied Computational Thermofluidodynamics

Germany:
Zeuna-Staerker GmbH. & Co. KG; Clausthaler-Umwelttechnik-Institut GmbH.

Greece:
Centre for Research and Technology Hellas/Chemical Process Engineering Research Institute

Italy:
C.R.F. Società Consortile per Azioni; Politecnico di Torino

United Kingdom:
Johnson Matthey PLC

**Organisation:** AVL List GmbH  
**Address:** 1 Hans-List-Platz 1  
**Zipcode:** 8020  
**City:** GRAZ  
**Contact country:** Austria

**Key Results:**

The results achieved reveal that, due to the highly sophisticated interaction of different components of the Diesel engine exhaust system in combination with the engine operating conditions, future optimisation and application of new exhaust aftertreatment strategies in passenger cars is impossible to perform without simulation models as developed within the SYLOC-DEXA project.

Open interfaces of the SYLOC-DEXA software insure that programs developed by other software vendors can be easily linked to the Diesel exhaust gas simulator toolkit. This approach will widen the market opportunities for the software developed within this project.

In summary the results of this project are considered to be an important contribution to the fast
commercialisation of particulate control technology and increases the competitiveness of European automotive industry.

**Technical Implications**

See key results

**Policy implications**

See key results

Documents:
- Final Report (Final report)

**STRIA Roadmaps:** Vehicle design and manufacturing

**Transport mode:** Road transport

**Transport sectors:** Passenger transport, Freight transport

**Transport policies:** Environmental/Emissions aspects

**Geo-spatial type:** Other