Laboratory of Renewable Energy Science and Engineering

Heat storage for enhancing the use and performance of automotive catalytic converters

Prof. Sophia Haussener

Institute of Mechanical Engineering, EPFL, Switzerland
LRESE

• Project d’ingénierie simultanée

• Heat storage for enhancing the use and performance of automotive catalytic converters

• Project description:
  “The catalytic converter in a car must be preheated in order to minimize the emissions of the engine after a cold start. The charging and discharging behavior of a high-temperature heat storage reservoir comprising a phase-change material delivering the required heat shall be experimentally tested and optimized by a numeric heat transfer model.”
Background:

- Catalytic converters work only in "hot" operation.
- After cold starts or longer intermediate stops, several minutes are needed until full operation of catalytic converters.
- Modern engines (downsizing) with lower exhaust gas temperatures cause a longer heat up phase of catalytic converters.
- Recent exhaust gas regulations tighten the allowed emissions.

→ Methods for reduction of emissions after cold start required.
Recent methods:
• Use of rich air fuel ratio in order to reduce heat up phase of catalytic converter
• Electric preheating of catalytic converter before cold start

New principle:
• Heat reservoir as heat storage
• Phase changing material (PCM) as heat storage medium
  – Example: Al-12.6%Si, 578°C
• Charging/discharging cycles

Charging cycle:
Hot exhaust gas (>600°C)

Discharging cycle:
No exhaust gas (before engine started)
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Tasks:
• Literature review
• Experimental campaign:
  – Getting familiar with experimental setup
  – Measurement of charging/discharging behavior for various driving cycles
  – Data evaluation and post-processing
• Implementation of numeric heat transfer model:
  – Adjustments of existing basic model to current problem
  – Model validation with experimental data
  – Optimization of configuration in terms of PCM type and thickness
  – Sensitivity analysis
• Further investigation as cost analysis, comparison to alternative preheating systems, etc.
• Report + Poster + Presentation

Organization:
• Teams: 2 teams of 3 students