

Emission control challenges associated with increasingly lower exhaust temperatures from advanced combustion engines

Dr Phil Blakeman philip.blakeman@jmusa.com



Advanced Combustion Challenges



- Expected changes to catalyst operating conditions
 - Lower catalyst temperatures due to more efficient powertrains and heat sinks upstream of critical components
 - Less aggressive catalyst heating strategies for CO₂ reduction
- Optimized cold start calibration is crucial
 - SI must balance drivability/fuel economy with spark advance, high RPM, and lean calibrations on cold start
 - CI must minimise amount of heating
- Changes in exhaust composition
 - Higher levels of HC and CO, but lower NOx?
 - HC speciation and alt. fuels
 - O₂ levels / Stoichiometry
 - Lean NOx control

Catalyst challenges



- Catalyst development requirements
 - Improved low temperature & cold start conversions (including storage)
 - Improved durability (thermal and poisoning)
 - Maintain good selectivity against N₂O formation
 - Lower PGM content
- System design
 - Package as much volume / functionality as possible closer to engine
 - Minimize peak temperatures
 - Maintain temperatures during real-world driving
 - Advanced substrates (e.g. high cpsi) for improved heat/mass transfer





CO T50

135

Impact of DOC HC storage and PGM loading on system HC emissions

FUL aged



Improving HC emissions:

- Include HC storage for cold start
- Increase PGM loading
- Higher PGM may not always be worth while



Low T storage for NOx is under investigation Cold Start Concept (CSCTM) technology





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Historic trend of diesel SCR performance





Cu SCR performance evolution

Extruded V SCR performance
evolution

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SCRF[®] system can warm up faster than an uf SCR system Enables earlier urea dosing and increased NOx performance



Historical comparison of TWC technologies



- When comparing JM TWC technologies
 - Improved light-off
 - Improved durability



 Improved formulations / systems have led simultaneously to reduction in the amount of PGM required



HC trap can help gasoline cold-start emissions



Design should match HC desorption with TWC light-off

Benefits at hills 1 and 19 on FTP



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Outlook



- Catalyst technology will continue to improve
 - Better light-off & durability
- System & calibration design will continue to be refined to optimize emissions
 - Lower peak temperatures
 - Warmer catalyst location in exhaust
- Catalyst solutions for improved cold-start emission control under development
 - Based on low T storage and higher T release of critical gas components
 - Diesel and gasoline efforts on these approaches