Analysis of Heated Urea-Water Solution Droplets for Selective Catalytic Reduction Systems

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Background

Stringent emission standards are giving rise to a vast variety of research being conducted in the automotive sector to keep them within the acceptable limits. Although the new technologies have helped to reduce the nitrogen oxides (NOx) emissions considerably, further measures are to be taken in order to meet the increasingly restrictive emission standards [1-4]. After treatment solutions like Selective Catalytic Reduction (SCR) have become known to be very promising to match the emerging emission standards.

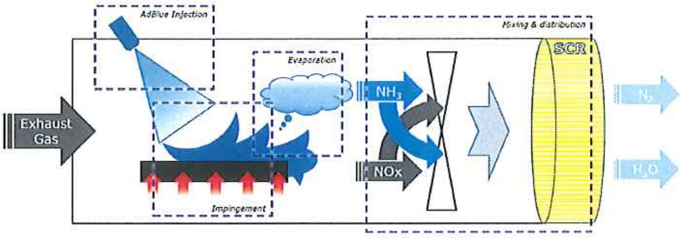

Figure 1. Injection, Evaporation and Mixing in the Chamber [7]

Various factors including wall film, injector tip wetting, exhaust configurations, impingement of droplets on the catalyst and the walls etc. play a vital role in the operational efficiency of SCR [5-6]. Thus, dynamics of spray as well as factors influencing the flow and wall film formation are critically important in effective conversion of NOx.

Objectives

A detailed study of the injection and mixer parameters needs to be conducted. The main objective of the work is to produce some reliable and realistic results (Experimentally, Numerically and correlation between them) to transfer those directly to practical applications.

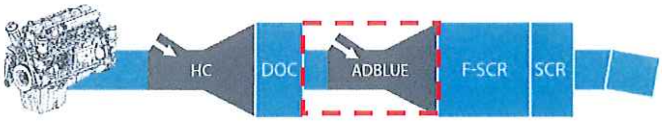

Figure 2. The area to be studied [7]

References

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Methodology/Methods

The experimental work will be conducted in collaboration with Dinex A/S in a specially developed high temperature wind tunnel where the droplet transport paths will be analyzed at different gas temperatures and speeds. The atomization from the nozzles used will be analyzed and characteristic data will also be determined including the droplet size, frame rate, and the spray angle.

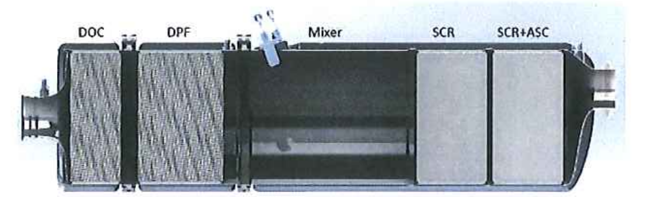

Figure 3. An inline EU-VI ATS with an open void where the Low Thermal Mass Compact Mixer is to be placed [7]

Dinex A/S, in cooperation with SDU, will develop a compact mixer to be included in exhaust systems, with the specific goal of meeting future emission standards. By minimizing the component's thermal mass and optimizing the fluid dynamics behavior the ideal conditions for the reduction of NOx emissions are created.

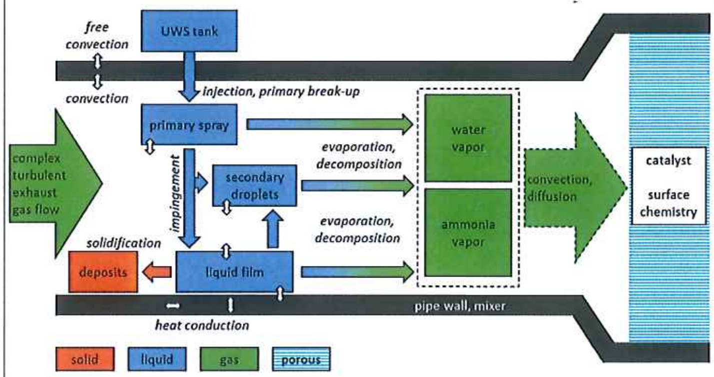

Figure 4. SCR system from a CFD perspective [8]

An in-depth analysis of the injector spray under various states will be considered in this work. Commercial fluid flow analysis tools will be used to potentially understand the design, behavior and conditions of the injector nozzle at various wetting scenarios and the occurrence of droplets.

The study could lead towards developing a strategy to more efficient and reliable de-NOx aftertreatment systems. Moreover, the results obtained from numerical models can show how effective numerical modelling of aftertreatment systems is in front-load calibration in an effort to meet the new Real Driving Emission (RDE) legislation.