“ANSYS Fluent helps us to optimize catalyst structures (pipe, cone and mixer), and significantly shorten the product development life cycle. SCR simulations using DPM modeling can correctly simulate AdBlue dosing and wall deposition phenomena.”

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Multiphase Fluids and Structures Simulations for Bharat Stage VI Emission After-Treatment Systems with ANSYS

Introduction
The catalytic converter converts the toxic gases and pollutants in exhaust gases into harmless compounds like CO2 and H2O. In India, due to increasing air pollution, the introduction of BS-VI emission norms has led to the development of selective catalytic reduction (SCR) technology, as well as diesel particulate filters (DPF) and gasoline particulate filters (GPF) for the trapping of particulate matter. The BS-VI emission limits are shown in Fig. 2 & 3.

The catalytic converter consists mainly of a diesel oxidation catalyst (DOC), DPF and SCR for a diesel vehicle, as well as a three-way catalytic converter (TWC) for gasoline and compressed natural gas (CNG) applications. The main purpose of the DOC is to oxidize the CO and HC into CO2 and H2O, as well convert NOx into NO2 (this helps in passive regeneration). SCR tends to reduce NOx with AdBlue dosing, an aqueous solution of Urea (NH2)2CO (aq.) that undergoes thermolysis and hydrolysis reactions for ammonia NH3 formation, which reduces the NOx into N2. DPFs are filters that physically captures particulates (carbonaceous soot) and prevents their release in the atmosphere.

Business Challenges
We simulated SCR to optimize the injector configuration, ascertain the AdBlue dosing required per the exhaust gas flow rate and temperature, determine the injection angle, optimize the mixer design with respect to the back pressure limitation, calculate the mixing length required and optimize the heat shield to maintain the desire temperature to prevent wall film thickness formation and achieve a higher ammonia uniformity index at the substrate wall. We were also challenged to optimize the pipe/cone/diffusor for minimum backpressure and maximum flow distribution.

Technology Used
ANSYS® Fluent®

Methodology Adopted

Figure 2. Emission limit for gasoline (current and future)
Figure 3. Emission limit for diesel (current and future)
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Company Description
Ecocat India is a joint venture of the Vikas Group and Ecocat Finland. It produces substrates, coatings, canings and supplies products to OEMs, canners and system integrators. Our mission is to develop technologies for a clean environment, with values that include responsibility, networking, market intimacy and success.

Conclusion
• ANSYS Fluent helped us to optimize catalyst structures (pipe, cone and diffusor) and significantly reduce our product development life cycle.
• SCR simulations using DPM modeling can correctly simulate AdBlue dosing and wall deposition phenomena.

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