Numerical Simulation for Improving Radiator Efficiency by Air Flow Optimization.

S. Chacko
Computer Aided Engineering - EAG, Tata Technologies Ltd, India

ABSTRACT

The Efficiency of the vehicle cooling system is widely dependent on the air flow profile through the radiator .The Flow through the Radiator would also depend on the other panels in the vicinity of the radiator and these include grille, front inner panel, cowl, floor. A clear understanding of the flow happening through the radiator would help us optimize the flow, quality and improve efficiency of the radiator.

The objective of the Project was to Optimize Airflow Distribution inside the Radiator with the use of CFD as a tool. Detailed experimental measurements were also needed to validate the results provided from CFD. For achieving this test rig had been developed and experiments performed on static rig consisting of the grille, radiator, front inner panel, floor panels etc at room temperature. The data obtained from the experiments on special test-rig was compared with the numerical simulations of the similar Front-End configuration and results validated.

The CFD Analysis was done using FLUENT, while Surface Mesh & Grid generated using ANSA/TGRID Respectively. Use of ANSA helped us to reduce the total cycle time by reducing the surface meshing time for total iterations done to reach the final optimized shape of the panels in the vicinity.

The CFD Simulation Model validated were based on the following conditions

- Vehicle at Rest
- Ambient Pressure & Temperature Corresponding to Test Condition
- Pressure = 101325 Pa (Atmospheric)
- Temperature = 34 °C (Room Temperature During Testing)
- Radiator Heat Generation Neglected
- Rated Fan Flow rate considered

This paper would take one through the various phases of the project, from interpreting the basic physics behind the problem, to setting it up numerically, finding out the accuracy of the solution by validating the same with experimental data, Running the simulation, Interpreting its results, taking a note of all the possible causes, suggesting design changes, implementing those changes and predicting % improvement from the base case