Investigation of Alternate Valvetrain Strategies for Implementation of Diesel Engine Cylinder Deactivation

Nishad G. Damle, Dheeraj B. Gosala and Gregory M. Shaver
Department of Mechanical Engineering, Purdue University

ABSTRACT

Cylinder deactivation is a technique in multi-cylinder engines where the airflow and fuel injection are deactivated to a few of the total number of the cylinders such that the power demand is met by increasing fuel consumption in the remaining active cylinders. Diesel engine cylinder deactivation has been demonstrated to have fuel savings of 3.4% over heavy duty federal test procedure and approximately 4 – 35% fuel benefit is predicted over the port drayage cycle, while maintaining higher aftertreatment temperatures. Deactivation of cylinders can result in a decay in in-cylinder pressure via heat loss and blowby to the crankcase, which can lead to oil transport from the crankcase to the cylinder. Oil accumulation in the cylinders can deplete the lubricating oil faster and lead to misfiring or poor combustion when these cylinders are reactivated. This study involves the evaluation of different valvetrain strategies to address the issue of oil accumulation in the deactivated cylinders, while maintaining the benefits provided by cylinder deactivation. A commercial engine simulation software GT-Power, experimentally validated with experimental data, will be used in this study for simulation of the novel valvetrain strategies. The study will determine the effects and benefits of various intake and exhaust valve opening by varying the valve lifts, valve closing and opening timings for each of the two intake and two exhaust valves. The simulation results have shown that the valve strategies implemented have helped to maintain the in-cylinder pressures at around the atmospheric pressure in addition to maintaining the benefits of cylinder deactivation.

KEYWORDS

Aftertreatment thermal management, Cylinder deactivation, Diesel engine, Fuel Economy, Oil accumulation, Variable valve actuation