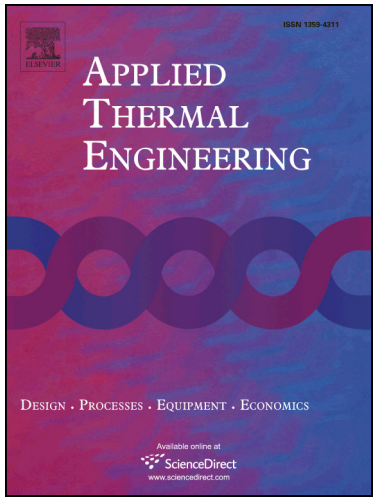

Effects of application of variable valve timing on the exhaust gas temperature improvement in a low-loaded diesel engine

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Abstract

Engine manufacturers generally use aftertreatment systems to meet the strict emission criteria on automotive diesel engines. However, those systems operate inefficiently particularly at low-loaded cases of diesel engines since exhaust gas temperatures at aftertreatment inlet remain below 250ºC. For those cases, variable valve timing (VVT) method can be applied to elevate exhaust temperatures and improve aftertreatment emission conversion efficiency. Therefore, in this study, intake valve closing (IVC) timing is advanced and retarded sufficiently from the base condition on a low-loaded diesel engine to increase aftertreatment inlet exhaust temperature above 250ºC.. A specially designed computer program, Lotus Engine Simulation (LES), is utilized to model the diesel engine. Experimental data of a similar study is used for the validation of the simulation. Engine loading (taken as brake mean effective pressure (BMEP)) is kept constant at 2.5 bar by adjusting the fuel injection rate. The results show that there is a considerable exhaust temperature rise (up to 65ºC) at aftertreatment inlet with the method and it is adequate for effective aftertreatment performance ($T_{exhaust}$ > 250ºC). It is also seen that the increase on exhaust temperature is due to the sudden reduction on volumetric efficiency (from 94 % to 65 %). Therefore, there is lower air induction into the cylinders and hence lower pumping losses which result in fuel-efficiency in the system. However, air flow reduction also causes a sharp decrease on the exhaust flow rate which affects the heat capacity of exhaust gases negatively in the system.

Keywords: Diesel exhaust temperature, aftertreatment management, variable valve timing.

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