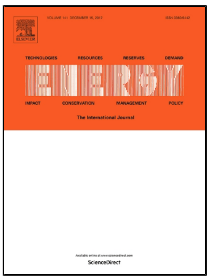
Accepted Manuscript



Effects of Altitude on Combustion and Ignition Characteristics of Speed-up Period during Cold Start in a Diesel Engine

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PII:	S0360-5442(17)32146-1
DOI:	10.1016/j.energy.2017.12.103
Reference:	EGY 12052
To appear in:	*Energy*
Received Date:	31 December 2016
Revised Date:	21 June 2017
Accepted Date:	19 December 2017

Please cite this article as: Zechao Kan, Zhiyuan Hu, Di Ming Lou, Piqiang Tan, Zhiyi Cao, Zhenhuan Yang, Effects of Altitude on Combustion and Ignition Characteristics of Speed-up Period during Cold Start in a Diesel Engine, *Energy* (2017), doi: 10.1016/j.energy.2017.12.103

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Abstract

Altitude has a significant effect on the combustion of diesel engines during cold start, especially during speed-up. In this study, combustion characteristics of speed-up period were investigated using an experimental test on a heavy-duty diesel engine with an intake and exhaust pressure controlled by the plateau simulation test system to simulate altitude conditions including 0 m, 3,000 m and 4,500 m. Further effects of altitude on ignition characteristics of diesel engine were accomplished through a zero-dimensional thermodynamic model coupled with a detailed kinetic model. Results indicated that as the altitude rose from 0 m to 3,000 m, the pressure in the cylinder was reduced，the number of diesel engine speed-up cycles increased, and the rising speed ratio decreased during speed-up. There was a misfire after the fifth cycle at an altitude of 4500 m, and the rising speed ratio was significantly reduced. Through analysis of fuel injection, air intake and ignition phase, we confirmed that the misfire at the high 4,500 m altitude was caused by the ignition delay, which was mainly controlled by chemical reaction during cold start. In the detailed kinetic study, the hot-flame and blue-flame reactions slowed down in the chemical reaction of the mixture as the altitude rose. The higher altitude enhanced the H-atom abstraction, but weakened the second O_2 addition and the peroxyalkylhydroperoxide isomerization. The decomposition