

# INVESTIGATION OF COMBUSTION AND POLLUTANT FORMATION PROCESSES IN CYLINDER OF A HIGH-SPEED DIESEL ENGINE BASED ON A THREE-DIMENSIONAL MODEL OF THE WORKING PROCESS

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**Abstract:** In spite of active development of the aftertreatment systems, in-cylinder minimization of soot and NO<sub>x</sub> formations is a compulsory condition by diesel engines development which satisfies modern emission legislations. Based on a three-dimensional computational fluid dynamics (CFD) combustion model, soot and NO<sub>x</sub> formation processes in cylinder of a high-speed passenger car diesel engine by different piston bowl shapes are under investigation. It can be concluded that the higher piston bowl diameter, the higher spray cone angle is necessary to reduce a fuel mass going to the piston bowl and to increase a fuel mass coming into the volume above the piston top face.

**Keywords:** soot; NO<sub>x</sub>; diesel; CFD

## References

1. Kavtaradze, R. Z. 2008. *Teoriya porshnevnykh dvigateley. Special'nye glavy*. Moscow: Izd-vo MGTU named after N. E. Bauman. 720 p.
2. Basshuesen, R., and F. Schäfer. 2007. *Handbuch. Verbrennungsmotor. 4. Aufgabe*. Wiesbaden: Vieweg & Sohn Verlag. 1032 p.
3. Robert Bosch GmbH. 2011. *Kraftfahrtechnisches Taschenbuch. 27. Auflage*. Wiesbaden: Vieweg + Teubner Verlag. 1267 p.
4. Merker, G., and C. Schwarz (Hrsg). 2012. *Grundlagen Verbrennungsmotoren. Simulation der Gemischbildung, Verbrennung, Schadstoffbildung und Aufladung. Praxis. 6. Auflage*. Wiesbaden: Vieweg+Teubner Verlag. 795 p.
5. Kavtaradze, R. Z., and S. S. Sergeev. 2014. Novyy al'ternativnyy (chastichno-gomogenny) protsess sgoraniya kak sposob snizheniya kontsentratsiy oksidov azota i sazhi v produktakh sgoraniya dizelya. *Teplofizika Vysokikh Temperatur* 52(2):294–309.
6. Kavtaradze, R. Z., D. O. Onishhenko, and S. S. Sergeev. 2011. Vliyanie vpusknoy sistemy na obrazovanie vrednykh komponentov v kamere sgoraniya dizelya. *Teplovye processy v tekhnike* 5:210.
7. Kavtaradze, R. Z., D. O. Onishchenko, A. A. Zelentsov, and S. S. Sergeev. 2009. The influence of rotational charge motion intensity on nitric oxide formation in gas-engine cylinder. *Int. J. Heat Mass Transfer* 52:4308–4316.

8. Frolov, S. M., V. Y. Basevich, and A. A. Skripnik. 2007. Modeling of soot formation in internal combustion engines. *Mat-ly Mezhdun. Konf. "Dvigatel' 2007"*. Moscow. 28.
9. Basevich, V. Ya., P. A. Vlasov, A. A. Skripnik, and S. M. Frolov. 2008. Modelirovanie sazheobrazovaniya v dvigatelyakh vnutrennego sgoraniya. *Goren. Vzryv (Mosk.) — Combustion and Explosion* 1:40–43.
10. Luckhchoura, V., F. X. Robert, and S. Pischinger. 2010. Investigation of spray-bowl interaction using two-part analysis in a direct-injection diesel engine. SAE Paper No. 2010-01-0182.

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