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# Numerical Modeling of Flashing Sprays Using a Hybrid Breakup Model

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Fuel droplets may undergo flash-boiling conditions when they are injected into a cylinder at higher than saturation temperature for the corresponding chamber pressure, resulting in a rapid evaporation. Such conditions lead to wider spray angles, finer droplets and shorter penetration. Based on current experimental investigations, such conditions may promote a more homogeneous fuel-air mixture and a faster evaporation compared to traditional methods.

This investigation presents a numerical study in OpenFOAM focusing on the modeling of gasoline direct injection sprays under flash and non-flash boiling conditions. The model was implemented in a scenario where already superheated and compressed fuel at 100 bar was injected into a chamber at a pressure lower than its saturation pressure at the corresponding temperature. A new hybrid breakup method has been implemented along with a momentum flux post-processing tool for the characterization of the initials conditions.

It was found that better prediction accuracy in evaporation rate was obtained. Spray penetration was also better modeled for flash boiling conditions compared with traditional breakup models.

## Anahtar Kelimeler

spray, momentum flux, cfd

## KaynakÃƒÂ§a


- [1] Xu, M., Zhang, Y., Zeng, W., Zhang, G., & Zhang, M. (2013). Flash boiling: easy and better way to generate ideal sprays than the high injection pressure. SAE International Journal of Fuels and Lubricants, 6(2013-01-1614), 137-148.
- [2] Ashgriz, N. (Ed.). (2011). Handbook of atomization and sprays: theory and applications. Springer Science & Business Media.
- [3] Huang, C., & Lipatnikov, A. (2011). Modelling of gasoline and ethanol hollow-cone sprays using OpenFOAM (No. 2011-01-1896). SAE Technical Paper.
- [4] Kim, D., & Kim, K. (2014). Comparison of Spray Structures of Diesel and Gasoline Using Modified Evaporation Model in Openfoam CFD Package (No. 2014-01-1417). SAE Technical Paper.
- [5] Yu, S., Yin, B., Jia, H., & Yu, J. (2017). Numerical research on micro diesel spray characteristics under ultra-high injection pressure by Large Eddy Simulation (LES). International Journal of Heat and Fluid Flow, 64, 129-136.
- [6] KÃƒÂ¶sters, A., & Karlsson, A. (2011). A comprehensive numerical study of diesel fuel spray formation with openfoam (No. 2011-01-0842). SAE Technical Paper.
- [7] Rotondi, R., HÃƒÂ©lie, J., Leger, C., Mojtabi, M., & Wigley, G. (2010, September). Multihole gasoline direct injection spray plumes. In 23rd Annual Conference on Liquid Atomization and Spray Systems, Brno, Czech Republic.
- [8] Li, Z. H., He, B. Q., & Zhao, H. (2014). Application of a hybrid breakup model for the spray simulation of a multi-hole injector used for a DISI gasoline engine. Applied Thermal Engineering, 65(1-2), 282-292.
- [9] Zuo, B., Gomes, A. M., & Rutland, C. J. (2000). Modelling superheated fuel sprays and vaproization. International Journal of Engine Research, 1(4), 321-336.

- [10] Price, C., Hamzehloo, A., Aleiferis, P., & Richardson, D. (2015). Aspects of Numerical Modelling of Flash-Boiling Fuel Sprays (No. 2015-24-2463). SAE Technical Paper.
- [11] Chryssakis, C., & Assanis, D. N. (2008). A unified fuel spray breakup model for internal combustion engine applications. Atomization and Sprays, 18(5).
- [12] Huh, K. Y., Lee, E., & Koo, J. (1998). Diesel spray atomization model considering nozzle exit turbulence conditions. Atomization and Sprays, 8(4).
- [13] Som, S., & Aggarwal, S. K. (2010). Effects of primary breakup modeling on spray and combustion characteristics of compression ignition engines. Combustion and Flame, 157(6), 1179-1193.
- [14] Cavicchi, A., Postrioti, L., Giovannoni, N., Fontanesi, S., Bonandrini, G., & Di Gioia, R. (2017). Numerical and experimental analysis of the spray momentum flux measuring on a GDI injector. Fuel, 206, 614-627.
- [15] O'Rourke, P. J., & Amsden, A. A. (1987). The TAB method for numerical calculation of spray droplet breakup (No. 872089). SAE Technical Paper.
- [16] Reitz, R. D., & Diwakar, R. (1986). Effect of drop breakup on fuel sprays (No. 860469). SAE Technical Paper.
- [17] Rotondi, R., & Bella, G. (2006). Gasoline direct injection spray simulation. International Journal of Thermal Sciences, 45(2), 168-179.
- [18] Rotondi, R. (2006). Modeling mixture formation in a gasoline direct injection engine. Journal of applied mechanics, 73(6), 931-939.
- [19] Reitz, R. D. (1990). A photographic study of flash-boiling atomization. Aerosol Science and Technology, 12(3), 561-569.
- [20] Postrioti, L., Bosi, M., Cavicchi, A., AbuZahra, F., Di Gioia, R., & Bonandrini, G. (2015). Momentum Flux Measurement on Single-Hole GDI Injector under Flash-Boiling Condition (No. 2015-24-2480). SAE Technical Paper.
- [21] Pilch, M., & Erdman, C. A. (1987). Use of breakup time data and velocity history data to predict the maximum size of stable fragments for acceleration-induced breakup of a liquid drop. International journal of multiphase flow, 13(6), 741-757.
- [22] Bell, I. H., Wronski, J., Quoilin, S., & Lemort, V. (2014). Pure and

pseudo-pure fluid thermophysical property evaluation and the open-source thermophysical property library CoolProp. Industrial & engineering chemistry research, 53(6), 2498-2508.

## AyrÃ„Â±ntÃ„Â±lar

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