ON MODELING OF GASEOUS DETONATION IN POROUS MEDIA BY THE ONE-DIMENSIONAL REACTIVE EULER EQUATIONS

A. R. Kasimov[1] and R. E. Semenko[2]

[1]Applied Mathematics and Computational Science, King Abdullah University of Science and Technology (KAUST), Thuwal, Saudi Arabia
[2]Department of Mechanics and Mathematics, Novosibirsk State University, 2 Pirogova Str., Novosibirsk 630090, Russian Federation

Abstract: The problem of propagation of gaseous detonation in a packed bed of inert motionless solid particles is investigated. The modeling is based on the one-dimensional (1D) system of reactive Euler equations that includes the losses of momentum and heat. The heat release in gaseous reactions is assumed to be given by an overall one-step reaction governed by the standard or generalized Arrhenius law. The authors have attempted to make quantitative predictions of the observed experimental data by varying the thermokinetic parameters of the mixture. The role of these parameters in the observed discrepancies between theory and experiment is discussed.

Keywords: detonation theory; detonation with losses

References

1. Zel'dovich, Y. B. 1940. K teorii rasprostraneniya detonatsii v gazoobraznykh sistemakh [On the theory of propagation of detonation in gaseous systems]. ZhETF 10(5):542−568.
2. Pinaev, A. V., and G. A. Lyamin. 1989. Fundamental laws governing subsonic and detonating gas combustion in inert porous media. *Combust. Explo. Shock Waves* 25(4):448−458.
3. Zel'dovich, Y. B., B. E. Gel'fand, Y. M. Kazhdan, and S. M. Frolov. 1987. Detonation propagation in a rough tube taking account of deceleration and heat transfer. *Combust. Explo. Shock Waves* 23(3):342−349.
4. Zel'dovich, Y. B., A. A. Borisov, B. E. Gel'fand, S. M. Frolov, and A. E. Mailkov. 1988. Nonideal detonation waves in rough tubes. *Dynamics of explosions*. Progress in astronautics and aeronautics ser. New York, NY: AIAA. 114:211−231.
5. Semenko, R., L. M. Faria, A. R. Kasimov, and B. S. Ermolaev. 2016. Set-valued solutions for non-ideal detonation. *Shock Waves* 26(2):141−160.
6. Goldshtik, M. A. 1984. *Protsessy perenosa v zernistom sloe* [Transfer processes in granular layer]. Novosibirsk: Institute of Thermophysics of the Siberian Branch of the USSR Academy of Sciences. 164 p.
7. Kaneshige, M., and J. E. Shepherd. 1997. Detonation database. GALCIT. Technical report.
8. Borisov, A. A., O. I. Mel'nichuk, A. R. Kasimov, B. A. Khasainov, K. Ya. Troshin, and V. Kosenkov. 1995. On the energy evolution in gaseous detonation waves. *J. Phys. IV* 5(C4):129−141.

9. Radulescu, M. I., G. J. Sharpe, C. K. Law, and J. H. S. Lee. 2007. The hydrodynamic structure of unstable cellular detonations. *J. Fluid Mech.* 580:31−81.

Contributors

Kasimov Aslan R. (b. 1969) — Ph.D., Professor, Applied Mathematics and Computational Science, King Abdullah University of Science and Technology (KAUST), Thuwal, Saudi Arabia, aslankasimov@gmail.com

Semenko Roman E. (b. 1986) — Candidate of Science in physics and mathematics, Lecturer, Department of Mechanics and Mathematics, Novosibirsk State University, 2 Pirogova Str., Novosibirsk 630090, Russia, rsem86@mail.ru