DYNAMICS AND TEMPERATURE OF COMBUSTION OF WOOD DUST – AIR MIXTURE IN A QUARTZ TUBE

V. N. Mironov, O. G. Penyazkov, and K. N. Kasparov

A. V. Luikov Heat and Mass Transfer Institute, National Academy of Sciences of Republic of Belarus, 15 P. Brovki Str., Minsk 220072, Republic of Belarus

Abstract: This study is concerned with combustion dynamics of wood dust of fraction from 50 to 100 μm in fuel-rich mixtures in the channel 90 mm in inner diameter and 1.0 m in height. Two types of stretching the combustion front were registered: linear increase in the height of the paraboloid (it simulates the shape of the flame) during combustion propagation; slowing down of paraboloid height growth followed by its reduction, as a rule, in the second half of the tube. For these types of flame stretching dynamics, the dependencies of the velocity of the combustion front vs. parameter dimensionless paraboloid height are obtained as well as the values of pressure and temperature in the channel. The temperature distributions in the combustion region for four values of channel height at various dust concentrations were obtained. The characteristic dimensions of the combustion zone for mixtures with different content of combustible dust were estimated.

Keywords: dust–air mixture; combustion; fire and explosion hazards; industrial explosions

Acknowledgments

This research has been carried out within the scope of the State Research Program "Energy efficiency" (Belarus), task: Energy efficiency 1.5.1.

References

1. Skjold, T., I. B. Kalvatn, G. A. Enstad, and R. K. Eckhoff. 2009. Experimental investigation of the influence of obstacles on flame propagation in propane–air and dust–air suspensions in 3.6 m flame acceleration tube. *22nd ICDERS Proceedings*. Minsk, Belarus. 139–140.
2. Kasparov, K. N., G. D. Ivlev, L. I. Belaziorava, V. N. Mironov, and O. G. Penyazkov. 2012. High temperature measurement in fast phenomena by spectrometry of photoelectrons. *High Temp. High Press.* 41(5):325–340.
3. Mironov, V. N. and O. G. Penyazkov. 2013. O dinamike goreniya drevesnoy pyli v vertikal'nom kanale [On the dynamics of wood dust combustion in a vertical channel]. *Goren. Vzryv (Mosk.) — Combustion and Explosion* 6:179–186.
4. Nikitin, N. I. 1962. Khimiya drevesiny i tsellyulozy [Chemistry of wood and cellulose]. Moscow–Leningrad: AS USSR. 711 p.

5. Benedetto, A. Di, A. Garsia-Agreda, O. Dufaud, I. Khalili, R. Sanchirico, N. Cuervo, L. Perrin, and P. Russo. 2011. Flame propagation of dust and gas–air mixtures in a tube. *7th Mediterranean Combustion Sumposium (MCS7)*. Cagliari, Italy.

Received November 1, 2014

Contributors

Mironov Vitaly N. (b. 1947) — Candidate of Science in technology, senior research scientist, A. V. Luikov Heat and Mass Transfer Institute, National Academy of Sciences of Republic of Belarus, 15 P. Brovki Str., Minsk 220072, Republic of Belarus; mirvit33@gmail.com

Penyazkov Oleg G. (b. 1961) — Academician of National Academy of Sciences of Republic of Belarus, Doctor of Science in physics and mathematics, director, A. V. Luikov Heat and Mass Transfer Institute, National Academy of Sciences of Republic of Belarus, 15 P. Brovki Str., Minsk 220072, Republic of Belarus; Penyaz@dnp.itmo.by

Kasparov Konstantin N. (b. 1933) — Candidate of Science in technology, associate professor, leading research scientist, A. V. Luikov Heat and Mass Transfer Institute, National Academy of Sciences of Republic of Belarus, 15 P. Brovki Str., Minsk 220072, Republic of Belarus; armav33@gmail.com