

# EXPERIMENTAL STUDY OF FINE PARTICLES IMPACT ON FLAME PROPAGATION BEHAVIOR IN HYDROGEN-CONTAINING COMPOSITIONS

*M. E. Ignatyuk, E. S. Morozov, P. V. Promyslov, Yu. A. Piskunov, A. A. Tyaktev,  
N. B. Anikin, I. L. Bugaenko*

FSUE «RFNC – VNIITF named after Academ. E. I. Zababakhin», Snezhinsk, Russia

Severe accident can lead to situations when the understanding of how fine water mist affects combustion of hydrogen-containing compositions is vital for the NPP safety predictions. This challenging issue has been already studied, but without using shadowgraphy [1] and for other concentrations and compositions [2].

The paper experimentally studies the process of combustion of hydrogen-containing mixtures with  $H_2$  concentration ranging from 6 to 73 vol.% when distilled water mist is present. The gas mixture used was specially prepared for each series of experiments. This approach allows for direct comparison of experiments in each series, including comparison of experiments in the presence of fine particles with those in a dry gas mixture.

The images taken during the experiments were used to analyze flame propagation under the action of water mist for different gas mixture compositions. Figure 1 shows the shadow images in the presence of water mist (Fig. 1, *a*) and in a respective dry mixture (Fig. 1, *b*).

The paper proves that water mist has a significant impact on the flame propagation behavior. This impact demonstrates nonmonotonic dependence on hydrogen concentration in the mixture. The results obtained can be used to validate the computer codes for the NPP hydrogen safety analysis.

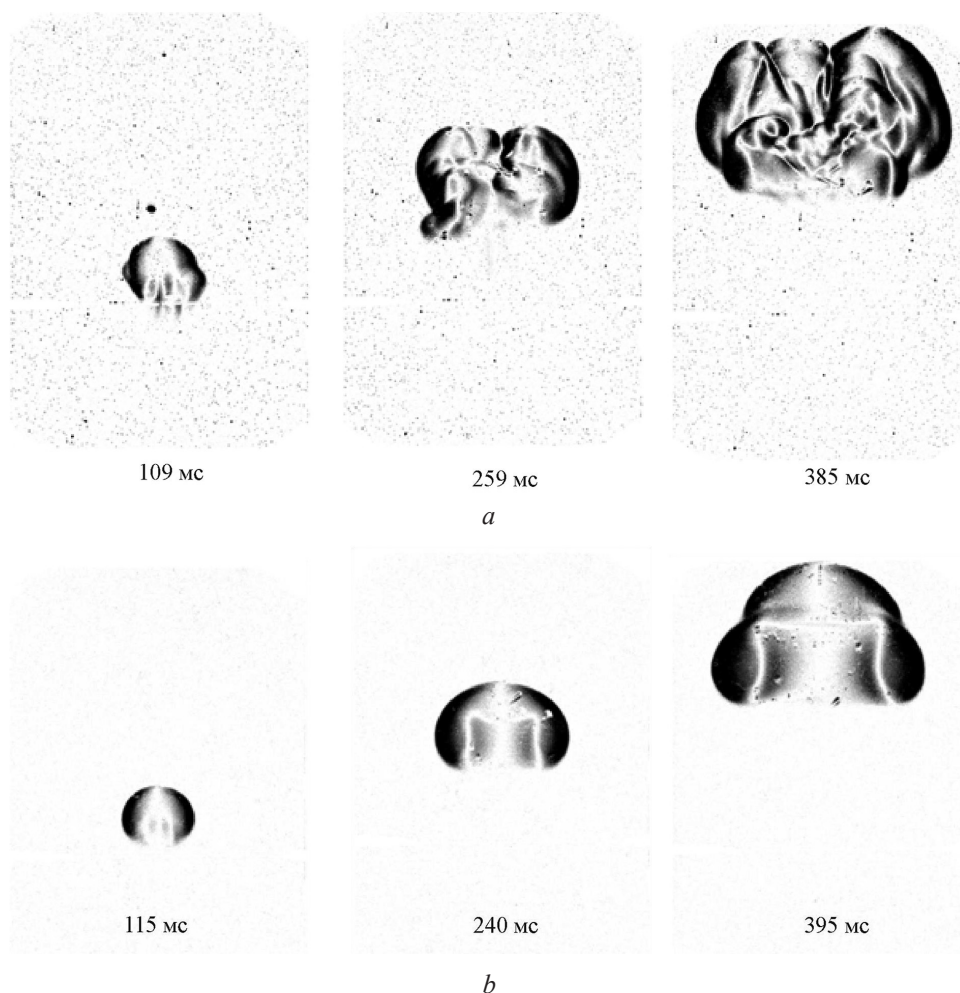


Fig. 1. Selected shadow images from the experiments with  $H_2$  concentration of 6 vol.% in air with (*a*) and without (*b*) water mist. Time is given from the moment of ignition

## References

1. **Bolodyan, I. A.** Experimental studies of the formation and combustion of hydrogen-air mixtures during liquid hydrogen spills and when exposed to water screens in a partially confined space [Text] / I. A. Bolodyan, L. P. Vogman // Bezopasnost truda v promyshlennosti [Occupational Safety in Industry]. – 2024. – No. 12. – P. 21–26. (in Russian). DOI: 10.24000/0409-2961-2024-10-21-26.
  2. **Cheikhravat, H.** Effects of water sprays on flame propagation in hydrogen/air/steam mixtures [Text] / H. Cheikhravat, J. Goulier, A. Bentaib, et al. // Proceedings of the Combustion Institute. – 2015. – No. 35. – P. 2715–2722.
-