OSCILLATORY COMBUSTION IN NARROW TUBES AND IN POROUS MEDIA.

G.A.FATEEV, O.S.RABINOVICH, M.A.SILENKOV*
A. V.Luikov Heat and Mass Transfer Institute, Academy of Sciences of Belarus, Minsk
**International Sakharov Institute on Radioecology, Minsk, Belarus*

Oscillatory combustion of propane - air mixture in tubes (d=3-7mm) and in tubes filled with porous media (spheres of aluminium oxide, d=2-3mm) with external heater was investigated. This type of oscillations was predicted early in [I]. Flame oscillations investigated in our work differs from acoustic oscillations that are the result of acoustic resonance in the tube The oscillation consists of such stages as: the ignition in the hot zone, the flame propagation against the gas flow, flame extinguishing because of heat losses in the cold part of the tube and the porous medium The dependence of the oscillation frequency on the gas flow rate was obtained.

So called "filtration combustion" is the basis of a number of new combustion technologies for a clean environment, ft was found by Babkin et al. in [2-4] this combustion is characterized by two stable modes of the flame propagation in porous medium: the fast rate mode and the slow rate mode. As the result of the computer modeling in [1] it was shown that the slow rate mode can be unstable.

The aim of this work was to confirm by the experiment the existence of flame oscillations predicted in [1].

Two hollow quartz tubes with the inner diameter of 3.3 and 4 mm and the outer diameter of 5 3 and 6 4 mm respectively and the quartz tube of 6.5 mm inner and of 9 mm outer diameters filled with aluminum oxide spheres of 2 - 3 mm diameters were used in the experiment. To obtain the sharp temperature gradient (500 K/cm) the part of the tube (2 -3 cm) was heated by the external flame. The stoichiometric air - propane mixture was used. The mixture flow rate was 1 - 30 cm/s at ntp. After heating the oscillations appeared spontaneously. Pressure vibrations were registered by the electromagnetic sensor installed in the tube inlet.

Flame oscillations in hollow tubes were regular. Its frequency was increased with the rise of the gas flow rate. This dependence was in a good agreement with the theoretical model. There were no oscillations at the flow rate of 20 - 30 cm/s At the flow rate more than 30 cm/s acoustic resonant oscillations were observed.

The dynamics of the flame oscillations were recorded by the video camera. It was shown that the oscillation consists of such stages as: the ignition in the hot zone, the flame propagation towards the flow rate, flame extinguishing in the cold part of the tube.

Oscillations of the same type were registered in tubes filled with porous media. But their period was not regular

This work was the first experimental evidence of flame oscillations predicted in [1].

REFERENCES.

1. Rabinovich O.S., Fcfelov A.V., Pavlyukevich N.V., Modeling of Premixed Gas Combustion in Porous Media Composed of Coarse-Sized Particles: 1-D Description with Discrete Solid Phase 26th International Symposium on Combustion. Combustion Institute, 1996, paper No. 746,20 p.
2. Babkin V.S. et al. Flame Propagation in Porous Inert Media Combuslion of Gases and Natural Fuels - Chernogolovka: 1980.-p. 87-89.
3. Babkin V.S. et al. Gas Combustion in the Vessel Filled with Fine Porous Inert

Medium. - Combustion and
4. Kxplosion Physics.- 1985,-V2J. N5.-p. 17-22.
5. Babkin. V.S., Laevsky, Yu.M., Filtrauon gas combustion, in 'Hot Vawe propagation in Heterogeneous Media' - Novosibirsk: Nauka, 1988. - p. 108-145.