COLLECTIVE EFFECTS IN THE SECONDARY FRAGMENTS FORMATION AS A RESULT OF MICROEXPLOSIVE FRAGMENTATION OF COMPOSITE FUEL

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Abstract: Microexplosive fragmentation is a key phenomenon on which modern methods of secondary atomization of composite fuels are based in industry. The implementation of the corresponding processes makes it possible to reduce the size of secondary droplets by a multiple (from 10–15 to 100–200 times) relative to the initial values of the sizes of the parent droplets formed during spray disintegration. This study presents the results of studying the collective effects in the formation of secondary fragments as a result of microexplosive fragmentation of composite fuels. The characteristics of secondary fragments during microexplosive fragmentation of a group of three droplets of composite fuels are analyzed. Two fuel compositions were used: 90% diesel / 10% water and 10% diesel / 90% water. Using the Shadow Photography method, the typical sizes of secondary fragments, which are formed during the fragmentation of each of the three droplets in a group, are determined. The limiting distances (from 8 to 10 radii) between droplets are established, at which the integral characteristics of the fragmentation of a group of droplets satisfactorily correspond to the similar characteristics of the disintegration of single droplets. At smaller distances between droplets, significant differences in the characteristics of secondary droplets formed as a result of microexplosive fragmentation of composite fuels were registered.

Keywords: group of droplets; water/diesel compositions; microexplosive fragmentation; secondary fragments; collective effects; Shadow Photography

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Figure Captions

Figure 1 Experimental setup for recording the fragmentation characteristics of a group of three droplets: *1* — tubular muffle furnace; *2* — metal cylinder; *3* — a group of three two-liquid droplets; *4* — nichrome holders; *5* — National Instruments temperature recording system; *6* — light source; *7* — high-speed video camera; and *8* — coordinate mechanism

Figure 2 Typical video frames of disintegration (fragmentation) of two-liquid droplets in a group of three droplets: (*a*) diesel fuel 90% / water 10%, $T_{\text{gas}} \approx 604.3$ K, $l \approx 9.86$ mm, $R_{d0} \approx 0.88$ mm; (*b*) diesel fuel 90% / water 10%, $T_{\text{gas}} \approx 604.3$ K, $l \approx 6.14$ mm, $R_{d0} \approx 0.84$ mm; and (*c*) diesel fuel 10% / water 90%, $T_{\text{gas}} \approx 604.4$ K, ≈ 3.55 mm, $R_{d0} \approx 0.81$ mm

Figure 3 Size distributions of secondary fragments with varying the distance between droplets in a group: *1* — lead droplet; *2* — middle droplet; and *3* — downstream droplet. Experimental parameters: $T_a = 604 \pm 10$ K, $R_{d0} = 0.91 \pm 0.02$ mm, $L = 9.86 \pm 0.05$ (*a*), 6.48 ± 0.04 (*b*), and 3.55 ± 0.05 mm (*c*); left column — diesel fuel 10% / water 90%; and right column — diesel fuel 90% / water 10%

Table Caption

Main properties of liquids (based on the data of [24]) used in the experiments at their initial temperature of about 300 K

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