Initiation of quasi-plastic shear in liquids as a method of micro-explosive spraying of fuel

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Initiation of micro-explosive spraying of fuel is considered in the links with hydro- and sonoluminescence during the flow of hydraulic oil in a narrow channel using an original experimental setup [1]. The assumptions are substantiated that liquids can exhibit mechanisms of quasi-plastic momentum transfer at strain rates $\dot{\varepsilon} > 10^5$ s^{-1}. One of the manifestations of localized shear in liquids at strain rates $\dot{\varepsilon} \sim 10^5$ s^{-1} is the hydroluminescence effect in the near-wall region flowing in the channel. It has been experimentally established that there is a threshold value of the strain rate at the Reynolds number Re ~ 1350 (∇P ~ 1.2 GPa/m) when a sharp increase in the intensity of hydro- and sonoluminescence signals is observed.

The obtained experimental results made it possible to propose a method for initiating secondary fuel spraying by a microexplosion at the appropriate topology of hydroluminescence pattern. When fuel passes through a narrow nozzle channel at strain rate $\dot{\varepsilon} > 10^5$ s^{-1}, a pseudoplastic momentum transfer mechanism is realized with pronounced hydroluminescence effect. When the fuel leaves the nozzle into the combustion chamber, due to the pressure drop, cavitation bubbles (microexplosions) are intensively formed due to shear activation of hydroluminescence centers. Explosive spraying of droplets enhances local mixing of fuel with air in the combustion zone, which leads to more complete and efficient combustion.

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