Disintegration of Thin Liquid Jet Injected from Several Tens Micrometer Hole

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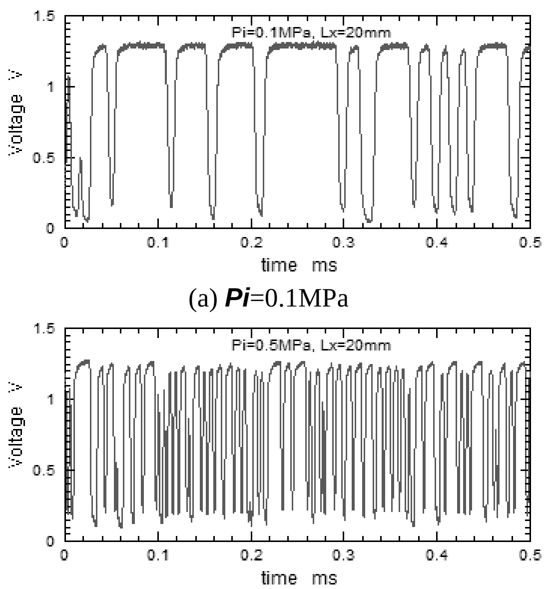
Abstract

Water jet from the thin plate nozzle is already disintegrated into droplets array at 10mm of ***Lx*** (distance from the nozzle hole exit). The droplets move inline. The interval of the droplets array becomes larger with ***Lx***. The number density of droplets is estimated to decrease with increase of ***Lx*** and ***SMD*** increases with ***Lx***. Therefore, some droplets combine into one because the relative velocity of droplets is small. Since ***SMD*** at far from nozzle exit depends on the droplets collapse, ***SMD*** at far from nozzle exit can be influenced by various disturbances caused by share force with circumstance air, complicated hole shape, etc. Although breakup length should be discussed with initial diameter of a droplet, there are not enough data to evaluate quantitatively. Therefore time changes of the light intensity caused by the shadowgraph of moving droplets are measured. Since laser beam size at focus point is 0.07mm, the measurement volume is not so larger than droplets. The shadow of the droplet decreases light intensity extremely when the droplet passes through the central axis of the laser beam. When the distance of droplets is larger than the laser beam size, light intensity reaches the maximum. The number of shadows of droplets increases with injection pressure ***Pi***. The time interval of shadows passing through the measurement volume increases with ***Lx***. In the case of ***Pi***=0.5MPa, number of shadows of droplets increases and the time interval of shadows passing through the measurement volume is shorter than that in the case of ***Pi***=0.1MPa as shown in figure 1. These phenomena agree with the decrease of ***SMD*** and the increase of the velocity of the droplets. Data at lager ***Lx*** are obtained since the droplets moves stably. When ***Pi*** increases to 0.7MPa, each shadow of a droplet is hard to be separated at ***Lx***=10mm. The movement of droplet is not as stable as that in the case of ***Pi***=0.5MPa. In the case of ***Pi***=1.0MPa, shadow of a droplet cannot be separated well to the other shadows. The autocorrelation function related with the frequency of the droplet passing through the measurement volume. The first peak point corresponds to the time difference of the next droplets if the interval of the droplets are constant and droplet size is constant. The first peak point shift to zero with increase of ***Pi***. The first peak point increase extremely with ***Lx*** as shown in figure 2. This means that the number of droplets decrease with ***Lx***. That is the coalescence of droplets occurs extremely near nozzle exit.



(a) ***Pi***=0.1MPa

(b) ***Pi***=0.5MPa

Figure 1 Variation of light intensity caused by shadows of droplets (***Dn***=0.03mm, ***Lx***=20mm)

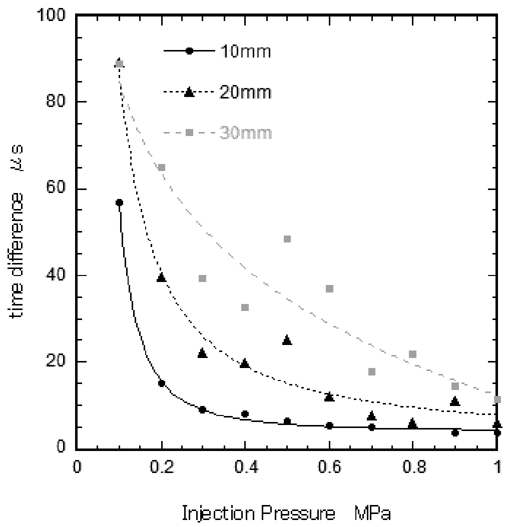


Figure 2 The first peak point of autocorrelation of light intensity caused by shadows of droplets (***Dn***=0.03mm)