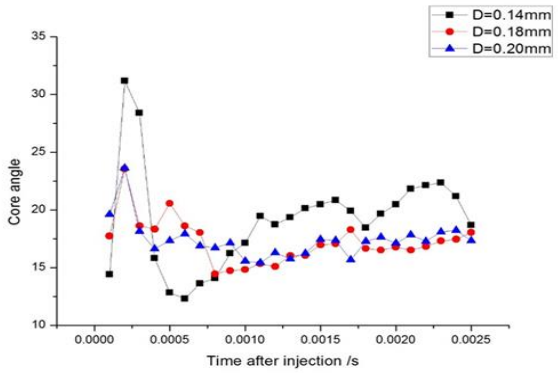


**Figure 8.** Variety of core angle with injection time

### 3.3 The nozzle diameters effect on core angle

Spray core angle increases sharply as the energizing time early on, then decreases gradually to a constant value and keep it until the end of injection, as shown in Fig8. Penetration length is lower at the beginning of injection, primary break-up leads to larger radial length which results in larger core angle. With the continuation of fuel injection, penetration length and spray radial length produced by break-up keep a constant value, core angle waves in a narrow range. It was observed that core angle varies among a certain value at different diameters. So nozzle diameters have a lower effect on far-field spray cone angle.

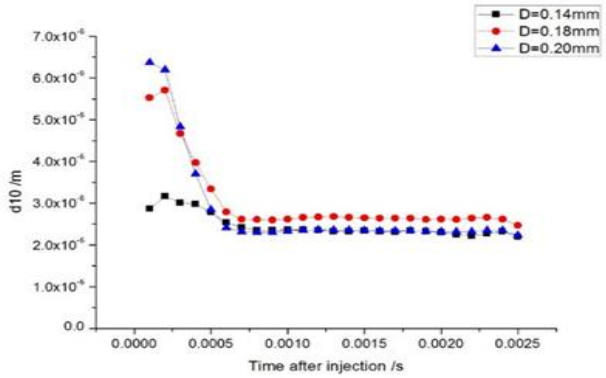


**Figure 9.** Variety of d10 with injection time

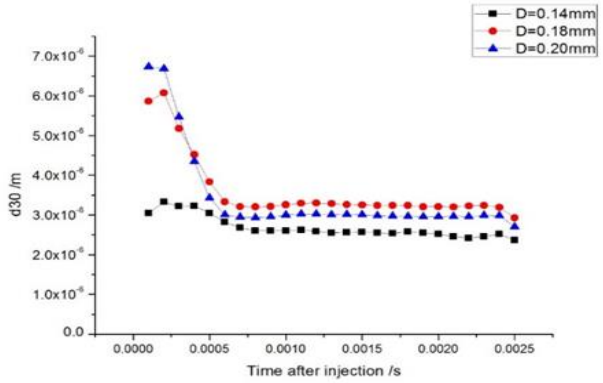


**Figure 10.** Variety of d30 with injection time

### 3.4 The nozzle diameters effect on d10 and d30

Fig 9 and 10 shows the d10 and d30 decrease with the increase of injection time and later tend to a constant value. The d10 is defined as arithmetic mean diameter and d30 as volume mean diameter. At the beginning of fuel injection, droplets diameter are decided by boundary conditions, initial conditions and fluid properties. When break-up, atomization and evaporation occur, droplets diameter decrease, and producing much little droplets.

## 4. CONCLUSION

(1) With the continuation of fuel injection, penetration length increases sharply, then leads to a certain value and keep invariant. When nozzle diameter enlarges, penetration length increases.
(2) The increased nozzle diameters have a relatively little influence on far-field spray cone angle.
(3) For microscopic spray characteristics like SMD, d10 and d30, they appear similarly regular changes, nozzle diameter have larger impact on them originally.

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