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Numerical study on performance of perforated plate applied to cryogenic fluid flowmeter

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Merits of perforated plate

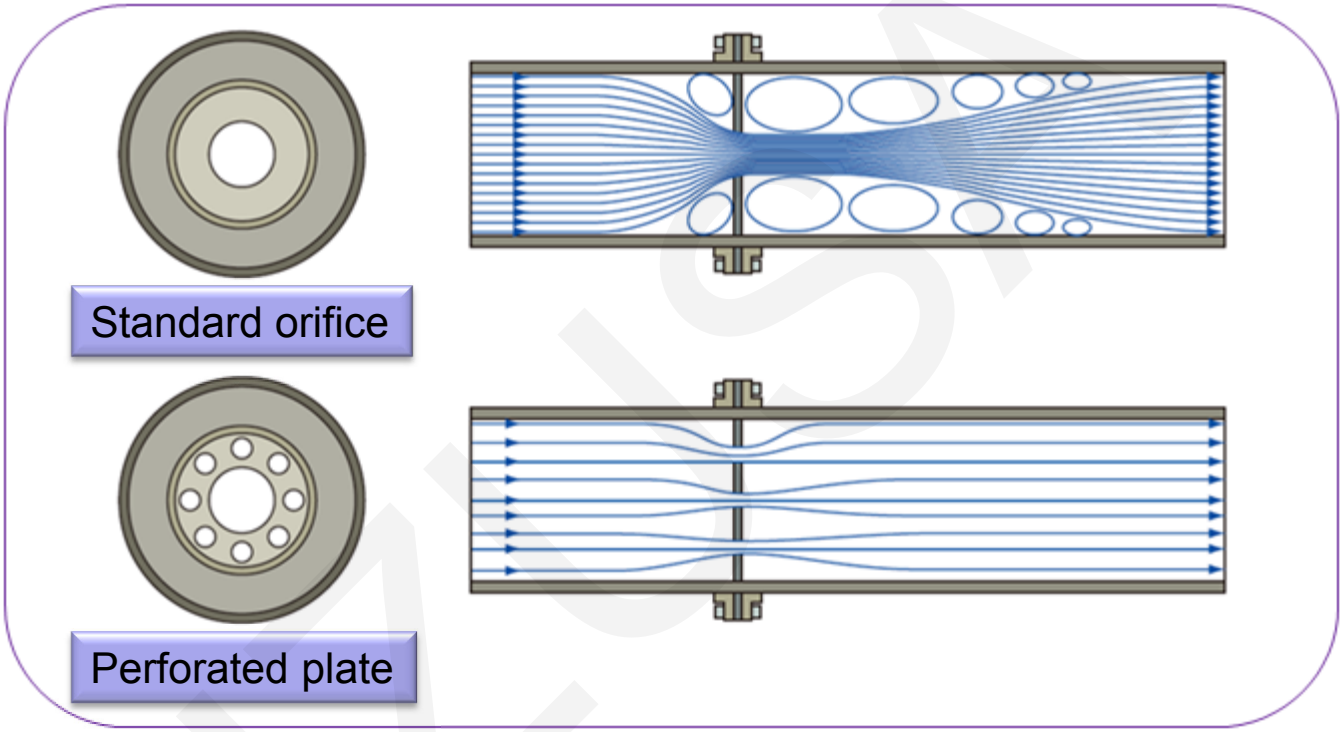
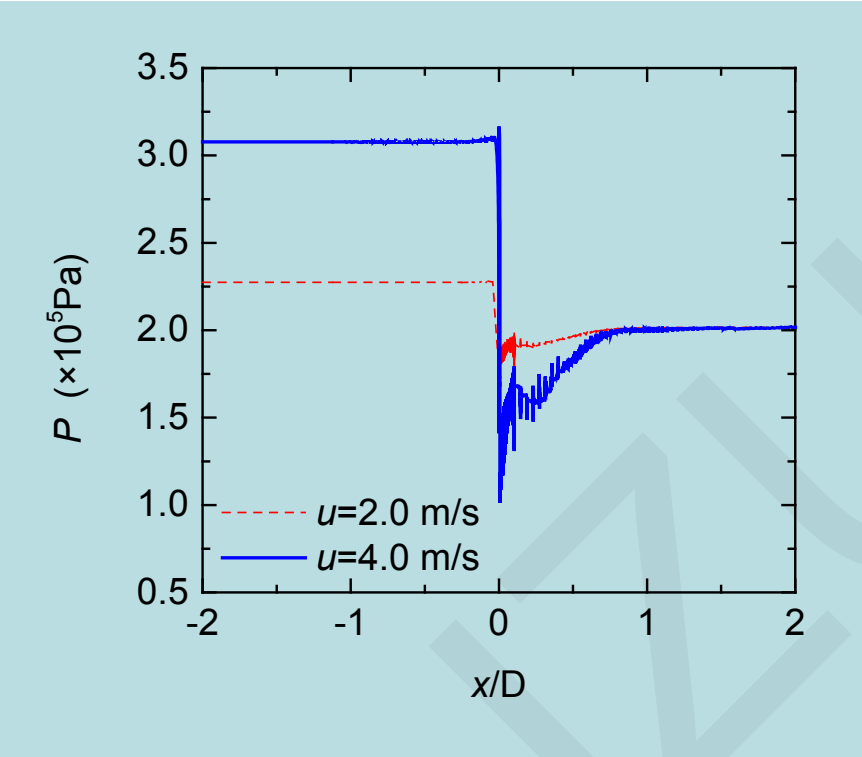


Fig. 1. Merits of perforated plate compared with standard orifice

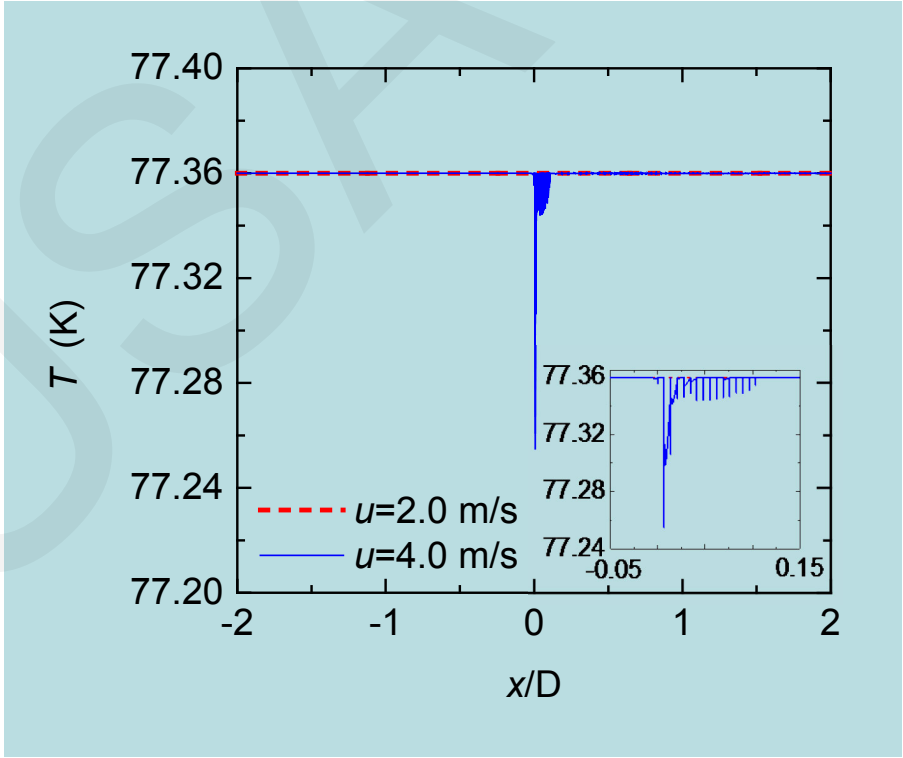
Better flow balance & Less turbulence
Weaker dead flow effect & Lower energy loss

Typical simulated results

Pressure and Temperature



(a)



(b)

Fig. 2. Pressure (a) and temperature (b) profiles upstream/downstream of the perforated plate along the pipe

Typical simulated results

Contour of volume fraction

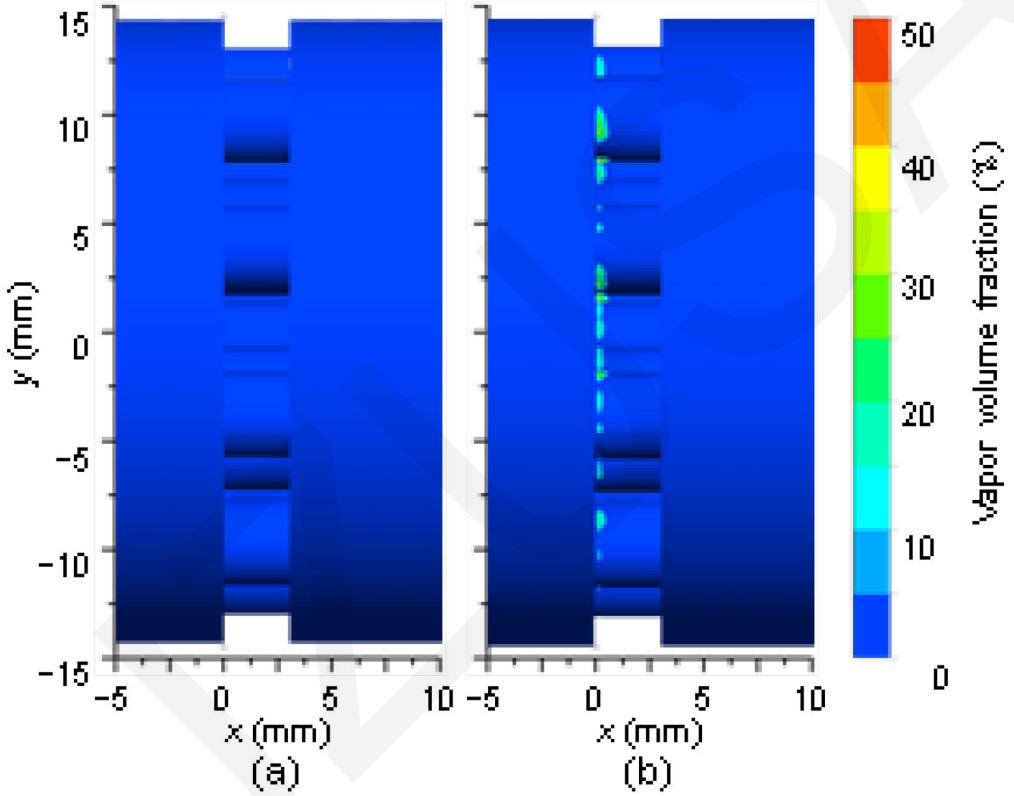
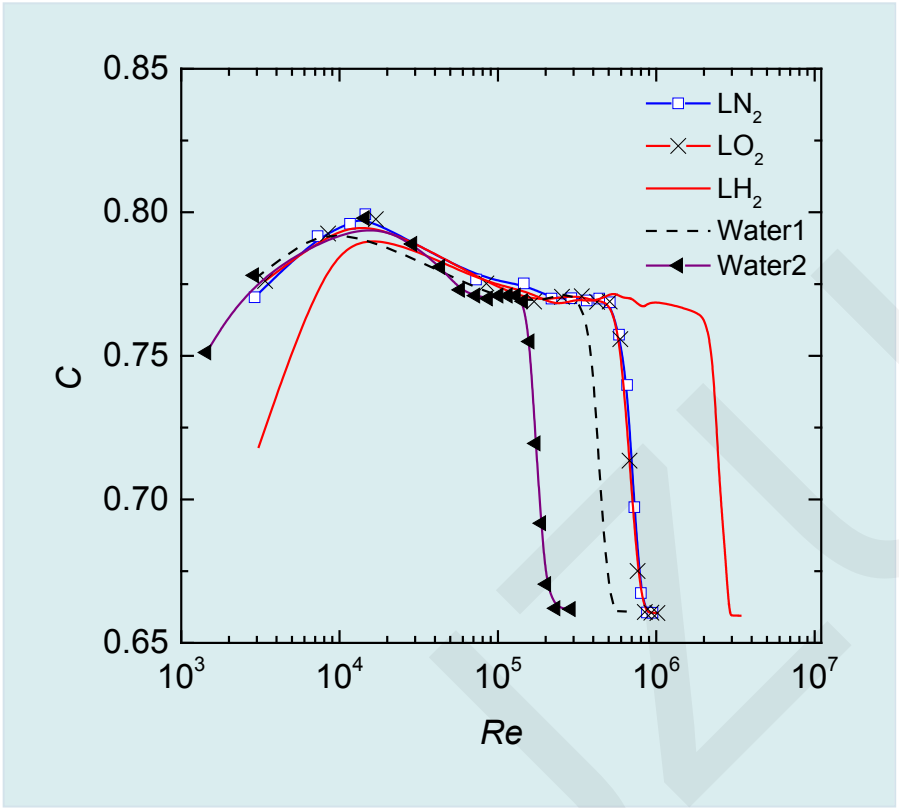


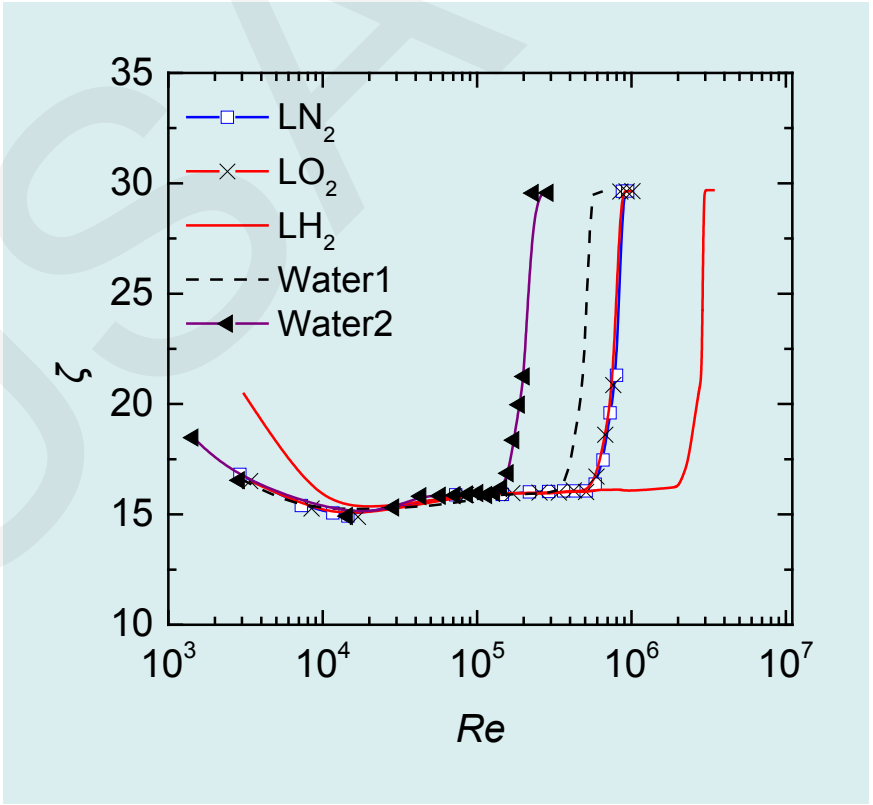
Fig. 3. Contour of vapor volume fraction of LN_2
(a) u=2.0 m/s; (b) u=4.0m/s

Two performance parameters

Discharge Coefficient and Pressure Loss Coefficient



(a)



(b)

Fig. 4. Discharge coefficient *C* (a) and pressure loss coefficient ζ (b)

Conclusions

- Compared with water, the cryogenic fluids have wider stable Reynolds number ranges, which are beneficial for the flow rate measurement. The lower limits of the Reynolds number of the stable region, which may be determined mainly by the geometry of the perforated plate, are relatively close for the five fluids investigated. However, the upper limits of the Reynolds number， determined by the product of the density and the squared kinematic viscosity, i.e., ρv^2, and related to the cavitation are much higher for the cryogenic fluids.

An effective device for measuring cryogenic fluid flow rate accurately.