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Droplet dynamics in parallel plate capillary channels

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Spray are more effective in dissipating heat compared to forced air convection. However, in heat exchangers, there is one drawback: harmful water films can obstruct the airflow through the fins during spray injection. Consequently, the study investigates the clogging processes related to water films generated by the spray.

Numerical methods using the Volume Of Fluid (VOF) approach were employed to model the water-air interface. The heat exchanger is represented by two parallel plates, namely two thins, as a channel and treated as an embedded boundary. A single droplet of variable size represents spray droplet aggregates at the channel entry, slides down the plates.

The outcome of the droplet penetration is contingent upon factors such as the gap width between plates, droplet size, and contact angle. In this context, overcoming an energy barrier is crucial for droplet penetration. The energy required, influenced by capillarity, makes hydrophobic surfaces challenging to penetrate. Furthermore, hydrophilic surfaces complicate droplet exit. Drop break-up and crossing time are analyzed to identify the delicate balance of parameters essential in preventing channel clogging.

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