

# Simulation of Spray Cooling with Impact on a Wire Mesh Inducing a Water Film

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## ABSTRACT

Spray cooling enhances heat dissipation compared to air convection. But in heat exchangers, harmful water films sometimes block air flowing through fins using spray cooling, lowering heat exchange while increasing pressure losses. Improved fin geometries are required to maintain a high transfer rate using spray cooling. Formation and evaporation of water films created by a spray are therefore studied.

Numerical approaches using the VOF method are employed to study the water-air interface. The complex topography of the wire mesh is achieved by solidifying the air, i.e., increasing its density and imposing boundary conditions on the velocity field. The clogging rate measure in 2D/3D simulations characterizes the influence of drop diameter, mesh geometry, and water flow.

Consequently, the mesh creation method uses the routines simulating air/water interactions to simulate the mesh/water interactions. Nonetheless, water penetrates slowly through the mesh. The clogging rate is higher for finer grids and low water flow rates. One assumption is that the film formation requires that the mesh size be smaller than the capillary length and the impact of more droplets helps to destroy the film. The spread of the impacted surface increases with time on fine grids. Droplets' impingement on the size of a mesh does not create water films. Their kinetic energy is high, so they pass through the mesh, depositing little water on its surface (see fig. 1). Low water flow rates are evaporated quickly and do not allow the creation of a water film. Therefore spray cooling requires a delicate balance of parameters.

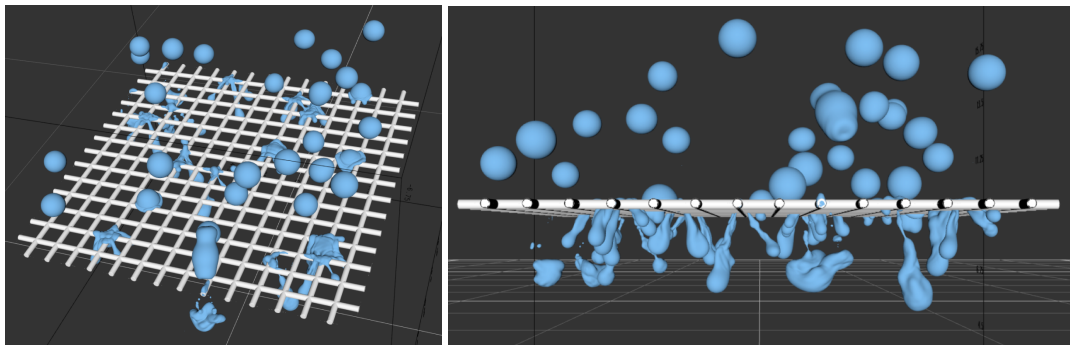


Figure 1: Droplets' impingement of the size of the mesh