Studying fluid-to-particle heat transfer coefficients in vessel cooking processes using potatoes as measuring devices

This paper presents and demonstrates a novel idea of using spherical potatoes as a dispensable, cheap device for determining the fluid-to-particle heat transfer coefficient, \( h_{fp} \) in vessel cooking processes. The transmission of heat through the potato can be traced by measuring the distance from the surface to the gelatinization front, which is easy to identify visually. Knowing this distance, the gelatinization temperature, the period of immersion, and the average radius of the potato, the heat transfer coefficient can be calculated. Either a numerical model based on the Finite Element Method (FEM) or an analytical solution of the Fourier equation can be applied for the calculation. The gelatinization temperature of the potatoes used was determined to be 67°C by a direct temperature measurement and by visual inspection of the progression of the gelatinization front. A sensitivity analysis demonstrates that the method is rather precise at relevant values of \( h_{fp} \) in vessel cooking (100–300 [W/m²K]), allowing a prediction of the centre temperature within ±0.6°C.

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