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Natural Convection in Vertical Slots

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ABSTRACT

Fundamental properties of natural convection in vertical slots were investigated. The left plate was smooth and isothermal while the right plate was corrugated and exposed to sinusoidal heating, providing the means to study the effects of the interaction between heating and topography patterns. It has been determined that the addition of grooves to the right plate while keeping it isothermal led to a reduction of the vertical fluid flow and an increase of the transverse heat flow, that is, grooves were found to act as surface roughness. Exposing the right plate to sinusoidal heating while keeping it smooth produced convection in the form of counter-rotating rolls with no net vertical flow. The addition of grooves to the sinusoidally heated right plate resulted in the formation of flow patterns involving a combination of rolls and stream tubes carrying the fluid in the vertical direction. The vertical flow was driven by the pattern interaction effect whose direction was dictated by the relative position of the heating and corrugation patterns; overlapping hot spots with groove peaks produced upward flow while overlapping them with groove troughs produced downward flow. Increase of the groove and heating wave number eventually eliminated the pattern interaction effect with grooves playing the role of surface roughness and the plate behaving as a hot plate for the hot spots overlapping with the groove peaks and as a cold plate for the cold spots overlapping with the groove peaks. The addition of a sufficiently strong uniform heating washed away the pattern interaction effect.

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