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THE CRITICAL MARANGONI NUMBER DEPENDENCE WITH ASPECT RATIO IN HIGH PRANDTL FLUID

Abstract

Many experiments to determine the critical Marangoni number at the onset of oscillatory flows WITH high Prandtl number (Pr) fluids have showed dependence of the diameter of the liquid column, although the aspect ratio of the column is the same. This fact contradicts the similarity principle in fluid physics. The Marangoni experiments have been being done to make clear what is Marangoni transition behavior by using Silicone oil with 50mm diam. The results were compared with previous experiment results with 30 mm diam.(JAXA experiments of MEIS1 and 2) and 5mm diam. obtained on ground. The dependency of critical Marangoni number can be expressed by the order of 2/3 power of the critical number, which is good agreement with our modeling by considering thermal boundary layer formed around the both heating and cooling desks. Different aspect ratio(Liquid length/Diam.) of 0.1 to 1.25 of liquid bridges were also studied by defining critical Marangoni number. The experiments has carried out as steps with 1 K holding time of almost 60 min to get equilibrium condition. The Prandtl number used in this experiments is 67, which is the as previous JAXA experiments, MEIS1 and 2. The results that can be concluded are as follows: 1) The critical Marangoni number vs aspect ration curves shows as follows; Firstly, critical Marangoni numbers decreases with increasing aspect ratio until 0.4 aspect ratio, and after that increases with increasing aspect ration having maximum value at around 1.25 aspect ratio. THE CRITICAL MARANGONI NUMBER OBTAINED HERE WITH 50MM DIA. ARE LARGER THAN THAT WITH 30MM. THIS FACT SHOWS US OUR MODELING IS CORRECT. THE MARANGONI NUMBER DEPENDENCE WITH THE ASPECT RATIO DEPENDENCE CAN BE EXPLAINED BY CONSIDERING THE THERMAL BOUNDARY LAYER. THE tendency of the ASPECT RATION DEPENDENCE CAN BE EXPLAINED BY numerical simulation AS WELL AS SEMI-QUANTITIVE ANALYSIS.