World Academy of Science, Engineering and Technology
International Journal of Mechanical and Industrial Engineering
Vol:8, No:11, 2014

# Experiments to Study the Vapor Bubble Dynamics in Nucleate Pool Boiling

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**Abstract :** Nucleate boiling is characterized by the nucleation, growth and departure of the tiny individual vapor bubbles that originate in the cavities or imperfections present in the heating surface. It finds a wide range of applications, e.g. in heat exchangers or steam generators, core cooling in power reactors or rockets, cooling of electronic circuits, owing to its highly efficient transfer of large amount of heat flux over small temperature differences. Hence, it is important to be able to predict the rate of heat transfer and the safety limit heat flux (critical heat flux, heat flux higher than this can lead to damage of the heating surface) applicable for any given system. A large number of experimental and analytical works exist in the literature, and are based on the idea that the knowledge of the bubble dynamics on the microscopic scale can lead to the understanding of the full picture of the boiling heat transfer. However, the existing data in the literature are scattered over various sets of conditions and often in disagreement with each other. The correlations obtained from such data are also limited to the range of conditions they were established for and no single correlation is applicable over a wide range of parameters. More recently, a number of researchers have been trying to remove empiricism in the heat transfer models to arrive at more phenomenological models using extensive numerical simulations; these models require state-of-the-art experimental data for a wide range of conditions, first for input and later, for their validation. With this idea in mind, experiments with sub-cooled and saturated demineralized water have been carried out under atmospheric pressure to study the bubble dynamics- growth rate, departure size and frequencies for nucleate pool boiling. A number of heating elements have been used to study the dependence of vapor bubble dynamics on the heater surface finish and heater geometry along with the experimental conditions like the degree of sub-cooling, super heat and the heat flux. An attempt has been made to compare the data obtained with the existing data and the correlations in the literature to generate an exhaustive database for the pool boiling conditions.

**Keywords :** experiment, boiling, bubbles, bubble dynamics, pool boiling
**Conference Title :** ICTHT 2014 : International Conference on Thermophysics and Heat Transfer
**Conference Location :** London, United Kingdom
**Conference Dates :** November 28-29, 2014