EXPERIMENTAL INVESTIGATION OF HEAT TRANSFER CO-EFFICIENT FOR DROP WISE AND FILM WISE CONDENSATION OF DYE SOLUTION

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ABSTRACT

Visual experiments were employed to investigate heat transfer characteristics of steam on vertical copper plates with one is polished and other is non-polished (groove) plated copper surface. Film wise condensation and Drop wise Condensation was achieved on two surfaces. And Summaries the main out come through its correspondence application. During processes of this set up visually examine the exchange of heat during drop wise and film wise condensation. This unit controlled with an included steam generator boiler and steam removal through control valve to the Borosilicate Glass tube. Condensation of steam on the surface of tubes causes high temperature transferred from steam to tubes, into Dye solution as heat exchange medium, at maximum phase due to temperature variation may condense in to two ways-drop wise or film wise on tube surfaces in film -wise condensation, the heat from the vapour to the cooling medium is transferred through the film of the condensate formed on the surface, where as in drop wise condensation process, only a part of surface is enclosed with condensate. Due to excellent contact between the vapour and surface very excessive heat transfer rates are announced in drop wise process. However, it has been not easy to maintain drop wise condensation commercially for extended periods of time.

INTRODUCTION

Condensation heat transfer has important practical applications, for example, in thermal power plant, in VCR and in A.C systems. Whenever a saturated vapor at a temperature T_{sat} is brought in contact with a surface maintained at temperature T_s such that T_s is less thanT_{sat}, vapours condense on a surface. Thus condensation is the reverse of boiling process. The vapors may condense lying on a surface in one of the two modes: film wise condensation or drop wise condensation. Compared to the boiler section of modern steam power plants, the condenser has received very little notice and consequently superior always thus a little in terms of presentation and size decrease. large improvement in condenser design will appear, however, when the drop-wise mode of condensation is utilized. It has been shown that heat transfer coefficients for drop wise condensation can be 30 to 40 times superior to film wise condensation. Drop wise condensation is much more valuable then film wise condensation & for this motive the previous is advantageous although in practical plants it rarely occurs for extended periods**.** In film wise condensation a laminar film of vapor is created upon a surface. This film can then flow downwards, increasing in thickness as other vapor is picked up along the way .In drop wise condensation vapor droplets form at a sharp angle to a surface. These droplets then flow downwards accumulating fixed droplets lower them along the way. The second objective of this is to examine the variation in heat flux between the two forms of condensation for the same set of situation. Third objective is to examine what effect the presence of air in the condenser has on the heat flux and surface heat transfer coefficient. This experiment would be used in every industry which is trying to increase the efficiency of heat transfer. An example of this is any vapour power cycle such as the Rankin cycle. By increasing the efficiency of the condenser, its operational pressure can be reduced and the Overall efficiency of the cycle can be increased.

LITERATURE SURVEY

M. Rama Narasimha Reddy, Dr M.Yohan, K.Harshavardhan Reddy (2012) show that the out line of Heat transfer coefficient for circular copper tube of polished and non-polished through vapor bubbles form of film wise or drop wise condensation and summaries the main result with its correspondence application. In this paper through modal calculation lastly observed that the heat transfer coefficient connected with drop wise condensation is quite large equal with film wise condensation. The drop wise condensation of steam has heat transfer co-efficient 2 to 10 times as large as film condensation. However, it has been not easy to maintain drop wise condensation commercially for long duration. This can be realized in this prototype in terms how the condensation form on the vertically non polished copper tube and vertically plane polished copper tube with similar size when these are inside of non condensable closed chamber, and also can be observed the nonstop formation of vapour drops on the copper tubes when the continuous steam pressure out for spatial time (min 30 seconds) through working pressure control valve from the boiler. From this phase have been observed that when pressure of vapour increase the rate of heat transfer increases in indicates that the rise of pressure of vapour is directly proportional rate of heat transfer.

The vapour shear or pressure effects. And also this paper recommend that when always the necessity of condensation is more, the surface should be non polished. [1]

Saurabh pandey(April-2012) shows that The Particular notice are given to heat transfer measurements, theory, effect the presence of air in the condenser has on the heat flux and surface heat transfer coefficient..This testing would be used in every industry which is trying to increase the efficiency of heat transfer. Finally, more precise measurements have shown good stability and..The equilibrium of proof suggests that drop wise condensation is a more helpful method of heat transfer than film wise condensation, and the presence of air in steam vapor significantly reduces the heat transfer. [2]

Bum-Jin Chung, Min Chan Kim and Mehrdad Ahmadinejad show that Film-wise and drop-wise condensation experiments were carried out at atmospheric pressure varying the condensing plates, their inclinations and orientations (upward or downward facing), and the air concentrations. More predictable, drop wise condensation showed much higher heat transfer rates than corresponding film-wise condensation in the pure steam cases. However, with the presence of air, both modes of condensation showed similar heat transfer rates due to the high thermal resistance of the air-rich layer. Both modes of condensation showed systematic decreases in heat transfer as the angle of the plate to the horizontal decreased and as the concentration of air increased. A important observation made during the tests on the plate orientation showed that condensation heat transfer rates on the upward facing plate were slightly higher than below the downward facing plate in the pure steam cases but that the trend were reversed in the steam and air mixture cases.[3]

Gagan Deep Bansal, Sameer Khandekar, and K. Muralidhar (2009) have investigated on the Heat transfer coefficients connected with drop-wise condensation are quite large. Because the resulting driving temperature difference is small, experimental determination of heat transfer coefficient is a challenge. The statistical natures of droplet distribution in the all together contribute to the complexity of analysis and explanation. Against this background, the spatial sharing of temperature during drop-wise condensation over a polyethylene substrate was calculated using liquid crystal thermographs (LCT) simultaneously with actual visualization of the condensation process by videography. Experiments were conducted in such a way that suspended drops form on the bottom of the liquid crystal sheet. Temperature variation at the base of the droplets, as small as 0.4 mm, was suitably resolved. The signature of the drop shape was visible in the LCT images. The drop size distribution on the substrate was simultaneously visualized. Static contact angles of water on polyethylene are calculated and drop shapes were estimated a mathematical model for comparison. Using a one-dimensional heat transfer approximation, heat flux profiles through individual droplets were obtained. The temperature profiles from LCT joint with drop sizes from direct visualization provide sufficient data for understanding the heat transfer mechanism during drop-wise condensation. Results show that the measured heat flux as a function of drop diameter matches published data for large drop sizes but fails for small drops where the thermal resistance of the LCT sheet is a limiting factor. To a first approximation, the present work shows that drop size can be correlated to the local heat flux. Hence, the average heat flux over a surface can be obtained completely from the drop size distribution.[4]

S. Vemuri, K.J. Kim (2004) it says that Hydrophobic coatings have been created through self-assembled mono layers (SAMs) of n-octadecyl mercaptan (SAM-1) and stearicacid (SAM-2) on copper alloy (99.9% Cu, 0.1% P) surfaces to improve steam condensation through drop wise condensation. When compared to whole film wise condensation, n-octadecyl mercaptan (SAM1) covered surface increased the condensation heat transfer rate by a factor of 3 for copper alloy surfaces, under vacuum condition (33.86 kPa) and to about eight times when operate under atmospheric condition (101 kPa). A model using the population balance concept is used to derive a theoretical formula to expect the drop-size distribution of small drops which grow mainly by direct condensation. All the important resistances to heat transfer such as the heat conduction through the drop, vapor–liquid line are considered in developing this model. By knowing the contact angle of the drop made with the condensing surface and the highest drop radius the sweeping effect of large falling drops could be calculated which is also included into the model. The effect of interfacial heat transfer coefficient on heat transfer rate is also considered in developing the theoretical model. This is combined with the well known size distribution for large drops proposed by Le Fever and Rose There has been a satisfactory agreement between our experimental data and the present theoretical model.[5]

A. Bani Kananeh, M.H. Rausch, A.P. Fro¨ba, A. Leipertz (2006) show that Plasma-ion implantation was used to achieve stable drop wise condensation of saturated steam on stainless steel tubes. For the search of the efficiency of plasma-ion implantation about the condensation process a condenser was constructed in order to calculate the heat flux density $\dot{q}$ and the heat transfer coefficient $h_c$for the condensation of steam on the outside surface of a single horizontal tube. For tubes fixed with a nitrogen ion dose of 10^{16} cm^{-2}, the heat transfer coefficient $h_c$was found to be larger, by factor of 3.2, in comparison to values theoretically calculated by the corrected Nusselt film theory. The heat flux density q and the heat transfer coefficient were found to rise with increasing ion dose and steam pressure. The heat transfer coefficient decreases with rising surface sub cooling as it has been establish in former work for drop wise condensation on ion implanted vertical plates.[6]

SCOPE OF WORK

This experiment would be used in any industry which is trying to increase the efficiency of heat transfer. Subsequently, more accurate measurements have shown good consistency and the theory of the drop wise and film wise condensation has become better understood. The balance of evidence suggests that drop wise condensation is a more effective method of heat transfer than film wise condensation, and the presence of air in steam vapor significantly reduces the heat transfer.

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CONCLUDING REMARKS

From the review of given paper we can say that Drop wise condensation is connected with higher heat transfer coefficient than film wise condensation occurrence. For drop wise condensation to happen the surface must not to be wetted by condensate. Communally this requires that metal surface be specially treated. Drop wise condensation is an attractive occurrence for application where extremely large heat transfer rates are desired. At present it is not easy to maintain this condition for several reasons. Because of its undecided environment and the preservation approach of a design based on lower heat transfer coefficient, film wise condensation is the type mainly used in design.

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