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Impact of Jet Inclination on Heat TransferEnhancement in Liquid Jet Impingement.

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Abstract— *Water jet impingement heat transfer is widely used in electronic component cooling, steel making, nuclear power plants and many other high heat transfer rate applications. Jet impingement heat transfer has been the subject of numerous studies over the past decade. There are various parameters that influencethe heat transfer in the jet impingement processes, including the heat flux, flow rate,inlet pressure, and nozzle size and working medium properties.*

The present work is devoted to study the effect of interaction of the jets stream on the heat transfer coefficient by changing the strength of one, two and three jets, as well as changing thespace between the three jets. The heat transfer and fluid flow between a horizontal heated plate and impinging circular triple jets studied experimentally. The parameters investigated are the Reynolds number of each jet and jet-to-jet spacing. Experiments are carried out covering a range for Reynolds number from 4000 to 18500 for each jet, the jet-to-jet spacing from16.66 to 66.66. The results indicated that increasing the Reynolds number of one jet than the others increases local Nusselt numbers.

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I. INTRODUCTION

Heat transfer from impinging jets is a relatively new technological development that has already attracted the interest of heat transfer engineers and designers, involved with the design of modern jet power plants and related machinery. This group of people is mainly interested in heat transfer from impinging jets because of its promise to succeed where applications of convective heat transfer often fail - in situations where the rates of heat flux are high and the space is restricted - such as at the leading edge of a turbine blade.

This sudden spurt of interest of engineers primarily interested in applications had, as acounterpart, an equivalent response among the more research oriented circles.

II. OBJECTIVE OF THE PROJECT

- Understand the basic principal of the project.
- Automatic cooling of electronic devices.
- Variation of both local average Nussle numbers with variation in increasing the Reynoldsnumber of one or two jet out of three.
- Minimum cost as compare to other device.
- Easy operated compare to other device.

III. Literature Review

[1] T. Iwana, K. Suenaga, K. Shirai, Y. Kameya, M. Motosuke and S. Honami

[2] investigated Flow fluid and heat transfer features of a rolling aircraft with an integrated integrated device. The integrated device consisted of triangular tabs and a synthetic jet array that provided occasional disruption to the jets shear layer. Heat transfer was not controlled by jet speed, RMS, and occasional speed fluctuations. These results indicate that the flow of fluid and the heat transfer characteristics of a pressing jet can be controlled by adjusting the operating conditions of the active integrated device. Mohamed A. Teamah and Mohamed M.
Khairat

[3] investigated the experiments. The parameters investigated are the Reynolds number for each flight and the jet-to-jet space. Tests are being made covering the range of Reynolds numbers from 7100 to 30,800 per jet, a flawless jet-to-jet range from 22.73 to 90.1. During the test stages, the Reynolds right jet number was higher

than the Reynolds left jet number. Results have shown that increasing the number of Reynolds in one plane by another increases both local and Nusselt average numbers. Additionally, increasing the jet-to-jet space at the same Reynolds number increases Nusselt's central number. M-M. Wannassi and
F. Monnoyer
[4] investigated the flow and heat transfer characteristics of an amazing combination ofstraight and circular jets. studied the flow field and heat transfer features of a series of regular and circular jets roaming the flat surface.

IV. CONSTRUCTION

Stainless Steel plateHeater
Nozzles Rotameter Motor Holding StandThermostat
Pipes and rubber tubes

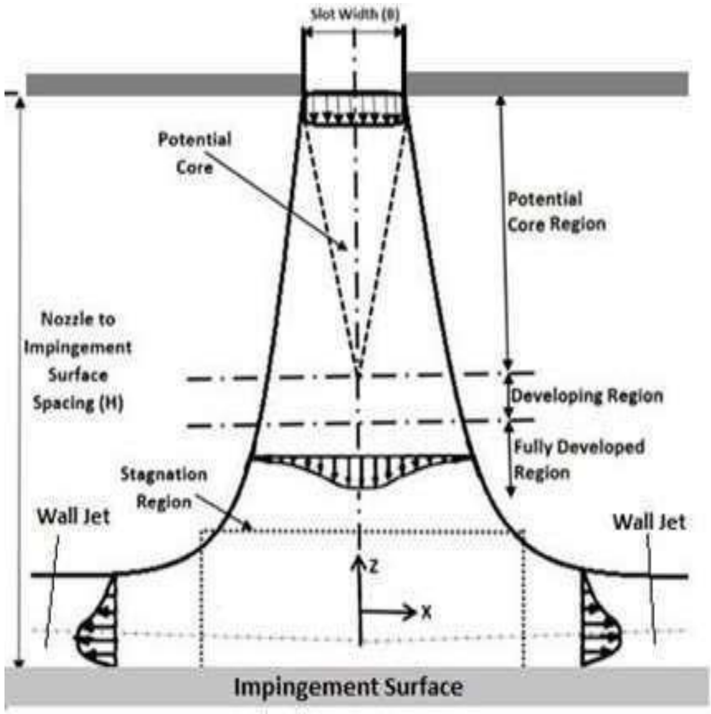

Figure 1.1: Schematic diagram of Impinging Jet

V. WORKING:

HEATER:
The heater is housed between a stainless steel plate and other non-conductive plates. The maximum temperature required for testing should be 60 to 100C. The heater is therefore chosen accordingly. The heater is not directly connected to the AC supply. The heater is connected to a dimmerstat. The heater is designed in such a way that the stainless steel plateheats up the same way.

NOZZLE:
Choosing a nozzle is a very important factor in obtaining a fully developed flow and avoiding the effect of a nozzle in the mouth. Various diameters 3, 6, 9mm are selected to vary the flowrate. Stainless steel material is highly resistant to corrosion which is why stainless steel pipes are used in this test.

VI. FUTURE SCOPE

1. The current study contains 12 point temperatures, but for best results the point temperaturemeasurement can be increased to be more accurate.
2. Various parameters can be read, rather than the parameters used in Currentinvestigation.
3. Current activities can be extended for computer analysis for future research.
4. Different nanofluids can be used for the purpose of testing and obtaining high temperature transfers.
5. Therefore the effect of direct calculation of different parameters on the variable heat transfercoefficient can be transferred and the techniques can be used to cool the PC and other small electronic components.
6. The data acquisition system can be used for an effective and accurate result.

VII. ADVANTAGES:

1. Increasing jet-to-jet space increases the Nusselt space number.
2. Increasing the jet space reduces the temperature of the wall away from the center line of the plate.
3. As the space of the Dimensionless aircraft increases the average Nusselt area value increases. With the same seamless jet space enlarging the Dimensionless radius, the central Nusselt area decreases.
4. Increase heat transfer and overall efficiency.
5. The average nusselt number for three aircraft is more than one plane.

VIII. APPLICATIONS:

1. Impinging cooling is an effective way to produce the best cooling rate in many engineering fields such as the metal, glass, extinguishing and paper industries.
2. Imping jets used to cool products after rolling.
3. To dissipate heat in high temperature conditions.
4. It is also used to dry the application.
5. Metal and plastic sheeting and mirror heating.
6. Used to cool turbine blades and fire chamber walls on gas turbine engines.
7. Used for laser or plasma cutting processes and cooling of electrical equipment.

IX. CONCLUSION

Testing experiments are performed on a set of generated test, with varying the diameter of the pipes with different flow levels, changing the space between the outlet and the target area and converting the jet into jet spcing. Twelve temperatures are measured at 12 different points in the target area. By measuring these temperatures a local nusselt number is tested at these points. X / d ratings vary as

22.22 to 66.66. Nu variability results are compared to the results obtained bychanging these different parameters.

The following observations were made while dealing with the test.

1. Nusselt number values are higher by three jet impinging compared to single anddouble jet entry.
2. The thickness of the film in the stagnation zone is very low and this leads to highradio speed which makes the Nusselt number values high.
3. Experimental results clearly show that the effect of increasing Reynolds numberson one aircraft increases Nusselt's local numbers of the same jet-to-jet space as the water speed increases.
4. Increasing the number of Reynolds increases the thickness of the water film in theinteraction area causing turbulence.
5. The size of the water film decreases as the jet separation increases with the watervelocity decreasing.

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