FEASIBILITY SPREAD OF THE METHOD OF NUCLEATE BOILING SYSTEMS THERMAL TRANSMITTTERS

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Abstract. *The development of cooling systems that can be packaged into electronic boards of telephone exchanges aimed at better control of temperature, because the natural cooling efficiency is not forced to keep the system functional, so it was realized the feasibility of building a system to engage to these circuits, using a refrigerant. This study involves the theoretical analysis of the experimental heat transfer mechanism by boiling in a reservoir of flat plates. The experimental apparatus was adapted for simulating heat exchange in an electronic component, the experiment was used as refrigerant acetone and methylene chloride, aluminum billet heated internally with electrical resistance, specific heat flow ranging from 0 to 100W/cm^2.*

Keywords: *Electronic Cooling Plate, Heat Exchanger for Phase Change, Thermosyphon.*

1. INTRODUCTION

The nucleate boiling is one of the most effective mechanisms for removing heat from a heated surface. In satellites and space equipment is necessary the use of thermal control devices whose operating principle is based on the heat transfer process (Passos *et al*., 2003).

The rational use of energy in industrial processes requires appropriate devices (Cardoso, 2005). Among these devices, the heat pipes and in particular biphasic thermosyphon are over-exchangers used in heat exchangers. The two-phase thermosyphon or heat pipe is ted by gravity is a heat transfer device with certain applications that affect the cooling of electrical and electronic equipment, solar applications , heat exchangers , especially those intended for heat recovery, among others. As a device that operates with phase change of the working fluid, the two-phase thermosyphon can transfer W/cm^2 with several small temperature difference. When the thermosyphon is used in embedded systems, they must operate under several adverse factors, especially various inclinations. The slope influences the thermal performance and limits of operation of this device. The amount of fluid within the thermosyphon is shown as an important parameter because a high degree of filling can bloc k the capacitor, while a s mall degree of filling may cause drying section of the evaporator, resulting in overheating of the tube wall and possible damage to the device (Cavalcante *et al*., 2002).

To the boiling heat transfer, the most important and at the same time, the most difficult is the nucleation process and the interaction between neighboring nucleation sites (Calka and Judd, 1985). The heated surface, determining the interaction or thermal influences the distribution of four temperatures which in turn includes two aspects: the thermal interaction between the bubble and the heated surface and the interaction between nucleation sites. In the fluid, the hydrodynamic interaction dominates the behavior of bubbles and is divided into: hydrodynamic interaction between bubbles and hydrodynamic interaction between bubbles and bath (Foster and Greif, 1959). Given the above, the purpose of this paper is to analyze the mechanism of nucleate boiling between flat sheets of aluminum with the coolant acetone and dichloromethane, in order to improve the cooling system of boards of telephone e changes.

2. DEVELOPMENT

2.1 Construction

The heat exchanger was constructed to control the dissipation of heat emitted by a hot source. It consists of two aluminum plates together, and the hollow means, thus the internal volume is filled with the liquid used for cooling study. These plates are in contact with a small aluminum block that includes an electrical resistance used as a heat source, simulating the electronic component. The top of the aluminum plate is finned. At the s ide fins with the fan there is a function of cooling plates which comprise the liquid. The entire heat exchanger is surrounded by a foam wall to provide isolation of the same.

2.2 Data Collection

The experimental data collection was obtained by thermocouples Type K located in the heat exchanger. These temperatures were obtained for different values of power. In Figure 1, shows the location of the temperature acquisition. This thermocouples was chosen because it is most widely used in industry (resistance to oxidation and the temperature range is from -200 to 1260°C). The wall foam acts as a thermal insulator inhibiting the heat transfer from the environment into the interior, thus the heat exchange is carried out by a refrigerant.

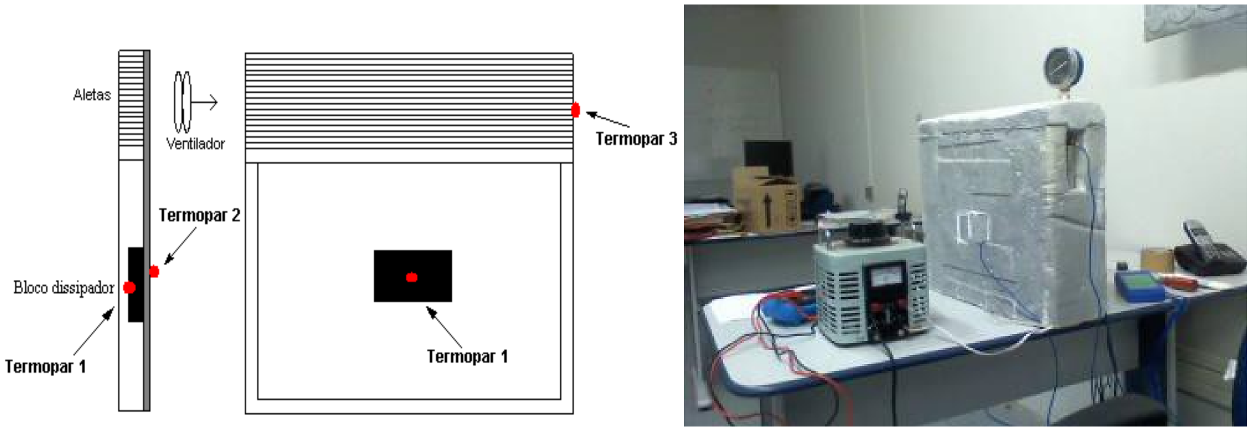

Figure 1. Location of thermocouples and Experiment in activity.

3. EXPERIMENTAL RESULTS

To obtain the experimental results were used to acquire three-point temperature. The experimental results were separated in two stages, firstly to obtain the temperature values without working fluid and secondly, using the working fluid to compare the values and to verify the efficiency of the system.

3.1 Operation without a working fluid

At room temperature, it begins the experiment without the coolant with 100 W/cm2 of power with the initial purpose of verifying the maximum temperature that the system can reach. The first thermocouple temperature (T1) concerning the heat source temperature, temperature reached 270°C in 30 minutes. Although the heat sink source has reached 270°C, the system easily reach values above this temperature, but to prevent the damage suffered system was turned off. The goal is that the system with the refrigerant does not exceed 100ºC. There fore, there was no need to check how this higher temperature working fluid without the reach.

3.2 Operation with the working fluid

3.2.1 Acetone

It was charging the working fluid (acetone) all security measures have been taken to make sure nothing happens in a harmful manner, see Fig. 2.

Figure 2. Charging of the working fluid.

We can observe that the system takes 215 min. to stabilize leaving the heat exchanger off and running directly to a dissipation of 100W/cm^2. After obtaining these data, the power has been gradually reduced to 20W/cm^2, as it can be observed in Fig. 3.

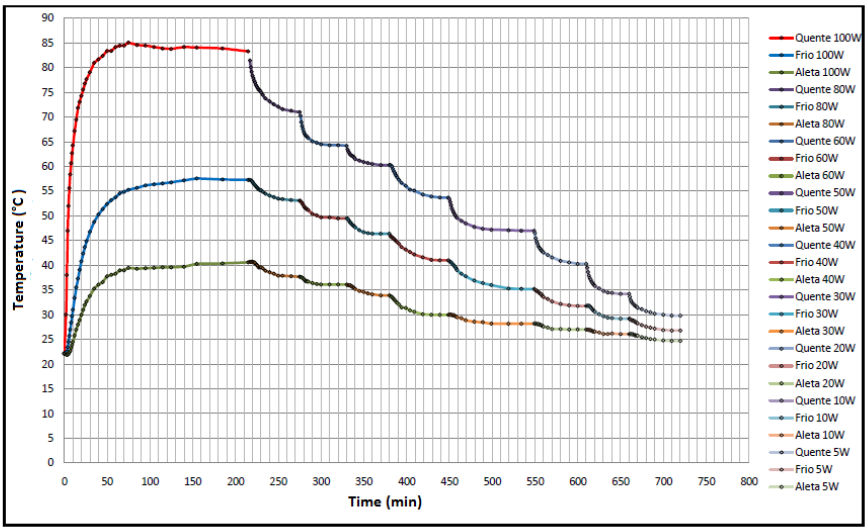

Figure 3. Temperature versus time for different powers.

Figure 3 shows that there is a total control of the temperature, as compared with the data obtained for experiment without the refrigerant temperature versus time obtained was high, a fact which shows the heat exchange of the refrigerant.

3.2.2 Methylene Chloride

With the system at room temperature (25°C) the experiment was started directly dissipating a value of 100W/cm^2. We can observe that the system takes 155 min. to stabilize leaving the heat exchanger off and running directly to a dissipation of 100W/cm^2. After obtain these data, the power has been gradually reduced to 20W/cm^2, as it can be observed in Fig. 4.

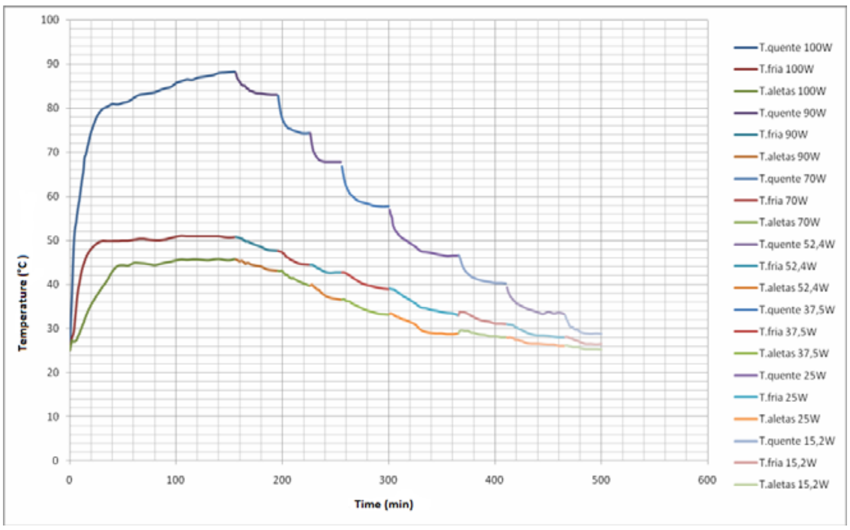

Figure 4. The graph of temperature versus time in different powers.

4. DISCUSSION

In numerical simulations and real devices in the system is in critical condition, where the natural cooling forced reached its limit Fig. 5. This simulation shows accumulation points of temperature, reaching critical areas that can exceed the 80°C, in arriving at this temperature the system rack phone may stop working, causing the shutdown of the system today is a telephone system to stop the damage to society are relevant, basic care such as police, fire and res cue will be affected. These wings are composed of drawers , and these units are composed of a number of plates as shown in Fig. 6 only dissipate less heat, but which cause problems in large quantities .

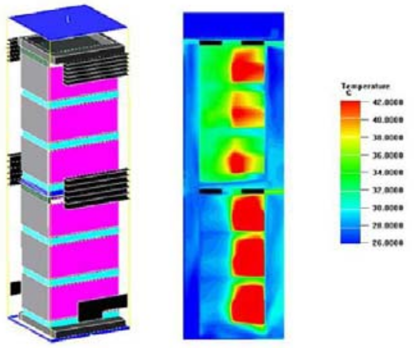

Figure 5. Thermal analysis of a call center rack using ANSYS ICEPAK.

To perform the analysis of heat transfer in printed circuit boards and also to perform validation of changes to the construction project.

Figure 6. MMA card, Tropic Telephone Company.

5. CONCLUSION

The method of cooling electronic components through the use of a refrigerant with low vaporization temperature is effective. Without the use of the fluid, it was noted that the block internal temperature reached 270°C, and acetone - refrigerant - the temperature did not exceed 84°C. This temperature difference is above 180 ° C, the system is efficient because dichloromethane showed that the fluid res ponded well in the experiment, had a good abs option of energy, the temperature of the heat source was stable in the range of 80-90°C, which is a very significant result (removal efficiency of 68.52%). Putting all the factors in the balance, the use of the compounds is feasible, provided it does not do contact (leakage) and liquid contact with the heat sinks (circuit), since acetone is flammable.

6. REFERENCES

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7. RESPONSIBILITY NOTICE

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