INTERNATIONAL WORKSHOP ADITIVE MANUFACTURING

1ST INTERNATIONAL CONGRESS ON ADDITIVE MANUFACTURING BOOK OF ABSTRACTS

IWAM 22

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João Rocha, Instituto Politécnico de Bragança, Portugal
João Eduardo Ribeiro, Instituto Politécnico de Bragança, Portugal
Jorge Santos, Instituto Politécnico de Bragança, Portugal
Rui A. Lima, Universidade do Minho, Portugal

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WELCOME

Additive manufacturing technologies are playing a decisive role in the laboratory environment, making a significant difference in STEAM education. Students use additive manufacturing to create physical models, topographic maps, biology artifacts, artwork, all types of engineering prototypes and solving mathematics challenges. By bringing additive manufacturing capabilities to the classroom, educators can raise interest in STEAM, introduce new concepts and capabilities, and help set the future for more skilled STEAM professionals.

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Cooling performance of an acrylic serpentine with a rectangular cross section

G.T.V. Nobrega[1,2,3*], F.M Barbosa[1], F. Soares[1], R. Ralha[1], R.R. Souza[1,2], J.E. Ribeiro[3,4], A.S. Moita[5,6], R.A. Lima[1,2]

[1] University of Minho, Campus de Azurém, University of Minho, 4800-058 Guimarães, Portugal

[2]Mechanical Engineering and Resource Sustainability Center (MEtRICs), UMinho, Guimarães, Portugal

[3]Centro de Investigação de Montanha (CIMO), Instituto Politécnico de Bragança (IPB), Campus de Santa Apolónia, 5300-253 Bragança, Portugal

[4]Instituto Politécnico de Bragança, 5300-253, Bragança, Portugal

[5]IN+, Center for Innovation, Technology and Policy Research, Instituto Superior Técnico, Universidade de Lisboa, Av. Rovisco Pais, 1049-001 Lisboa, Portugal

[6]CINAMIL, Department of Exact Sciences and Engineering, Portuguese Military Academy, R. Gomes Freire 203, 1169-203 Lisboa, Portugal

(*)*Email:* glaucotvn@hotmail.com

ABSTRACT

In recent years, photovoltaic panels have established as one of the main sources of electricity considered to be clean. Its efficiency and lifetime are greatly influenced by the operating temperature. Active cooling using cylindrical copper serpentines is one of the most common methods for many systems. However, due to the cylindrical geometry of the tubes, the contact with the plate is a point and its area tends to zero. In this way, serpentines that provide a bigger contact area between the heat removal system and the solar panel board are desired. Serpentines manufactured by machining acrylic plates in CNC milling machines allow the construction of a channel with rectangular cross section with a considerable area of contact between the channel and the plate. The obtained results show that there was a significant improvement of the heat exchange between the plate and the thermofluid when the acrylic serpentine with rectangular section was used.

INTRODUCTION

Solar panels have a paradox that they need sunlight to heat and generate energy, but high temperatures end up decreasing their performance. The use of active cooling systems can increase the efficiency of the system by up to 22%, with the material of the tubes used having a great influence on the heat exchange (Hasanuzzaman et al., 2016; Marinić-Kragić et al., 2020). The lifespan of solar panels is about 25-30 years and can be extended to up to 48 years if there is an efficient cooling system (Nižetić et al., 2016).

RESULTS

From an 8 mm thick acrylic plate, 5x5 mm channels were made in the Mini-milling machine CNC ROLAND SRM-20 according to the figure 1. A 2 mm thick steel plate was used in place of the solar panel.

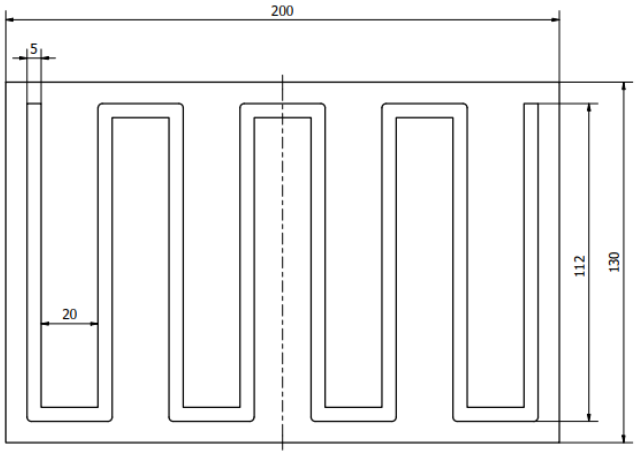

Figure 1: Main dimensions of the proposed serpentine.

For comparison level, a copper serpentine was used, following the same route counted with the same hydraulic diameter (5 mm). A 400 W Halogen spotlight was used as a heat source and thermocouple sensors were used on the surface of the plate and on the inlet and outlet of the fluid figure 2.

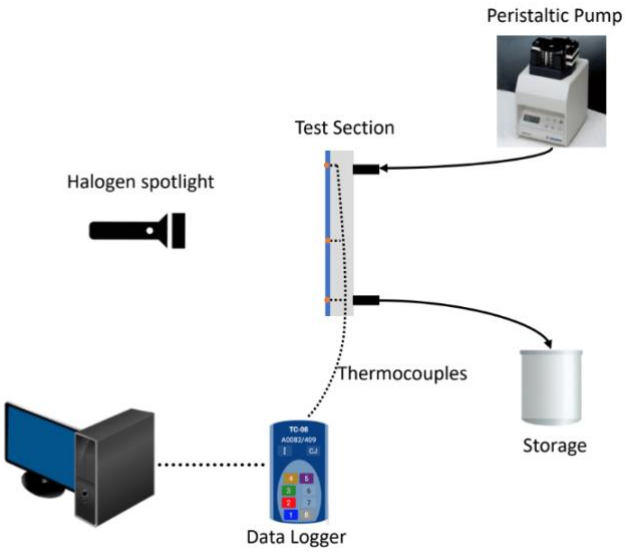

Figure 2: Experimental setup.

The results of the difference between the plate temperature and the fluid inlet temperature are shown in figure 3.

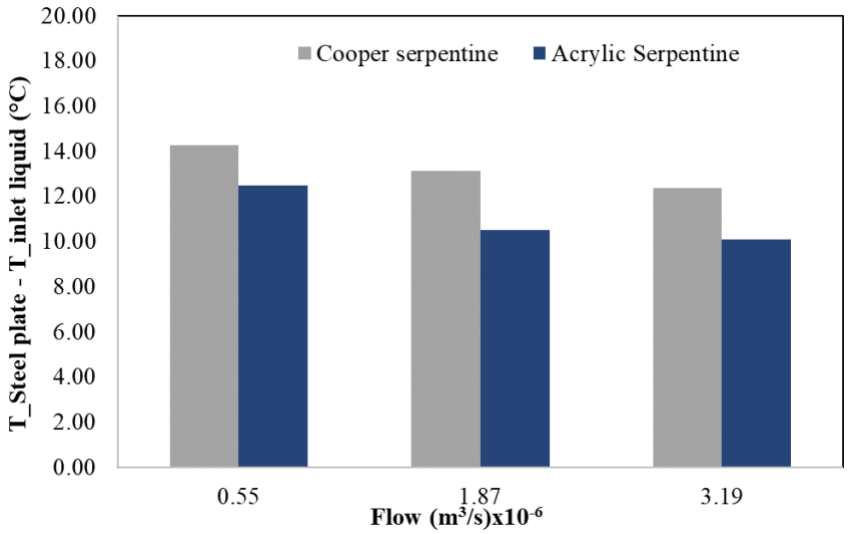

Figure 3: Temperature difference between the plate surface and the inlet fluid according to each flow rate.

CONCLUSIONS

The obtained results show a higher efficiency of the serpentine with rectangular geometry made in acrylic. This is due to the fact that the contact surface between the fluid and the acrylic plate is superior to the copper serpentine, where the contact area is only at the tangent between the tube and the plate and, therefore, tends to zero. New studies should be carried out in a more controlled temperature environment in order to increase the reliability of the preliminary tests.

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