© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 10 Issue: 03 | July - September 2019
Paper is available at www.jrps.in | Email : info@jrps.in

HEAT TRANSFER OPTIMIZATION OF FIN ARRAY CONSIDERING FIN THICKNESS AND LENGTH

1Rinku, 2Amit Mahal
Research Scholar, IIET Kinana
Assistant Professor, IIET Kinana

ISSN : 2278-6848 03
9 772278 684800
© International Journal for Research Publication and Seminar

Abstract: Heat transfer is a discipline of thermal engineering which is related to generation, use and conversion. It is also related to exchange of thermal energy among physical systems. The Fins are offering a trouble free & economical solution. It has provided solution in various situations. This type of situations demands natural convection of heat shifting. In the research work it has been concluded that if the heat transfer coefficient has been reduced then efficiency and effectiveness got increased but the Heat transfer got reduced. If length is increased then heat transfer and effectiveness got increased but the efficiency got reduced. If there is the increment in the temperature, the heat transfer got increased but the efficiency and effectiveness is not affected. The research work proposed the simulation of the Optimization of fin length to get particular effectiveness. It simulates the optimization of temperature to get particular heat transfer amount. As it could been seen the temperature should be Approximately 320 to get heat transfer of 390. The research work provides the Comparative analysis on the base of changes in heat coefficient, length and Temperature. This research is helpful in optimizing the configuration of Fin array during heat transfer.

Keywords: Heat transfer, Fin arrays, Matlab, Heat transfer coefficient, Convective heat Transfer, thermal radiation, Heat sinks

[1]INTRODUCTION

Heat transfer

Heat transfer is a discipline of thermal engineering which is related to generation, use and conversion. It is also related to exchange of thermal energy among physical systems. Heat transfers are classified in several mechanisms such as thermal convection, thermal radiation, thermal conduction & energy transfer during phase change. Engineers have considered transmission of mass of another chemical species. This might be either hot or cold in order to achieve heat transfer. However these mechanisms have different features but they often happens simultaneously in same system.

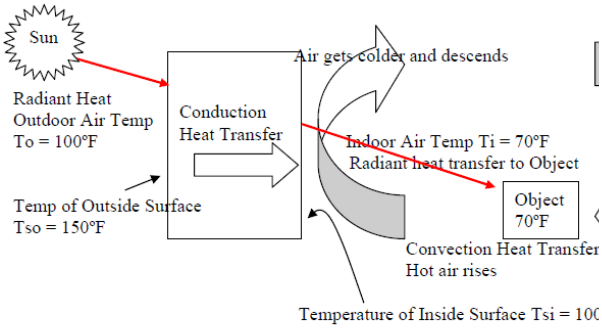

Fig 1 Heat transfer

[2]MODES OF HEAT TRANSFER

There are three modes of heat transfer among two bodies: convection, conduction & radiation. These are suggested as below:

Convection: Transmission of heat among solid surface & liquid is known as convection heat transfer. In this case heating of water due to transfer of heat from vessel is convection heat transfer the vessel of water being heated has been considered.

Conduction: Transfer of heat among two solid bodies is known as conduction. It is dependent on variation in temperature of cold & hot body. Two bodies at different temperature kept in contact with each other is example of conduction heat transfer. Another example is heating one end of metal such as copper; due to conduction heat transfer other end of metal also gets heated.

Radiation: When two bodies are at different temperatures & separated by distance, heat transfer between them is called as radiation heat transfer. In case of conduction & convection heat transfer there is a media to transfer heat, but in case of radiation heat transfer there is no media. Radiation heat transfer occurs due to electromagnetic waves that exist in atmosphere. One of most important examples of radiation heat transfer is heat of sun coming on earth.

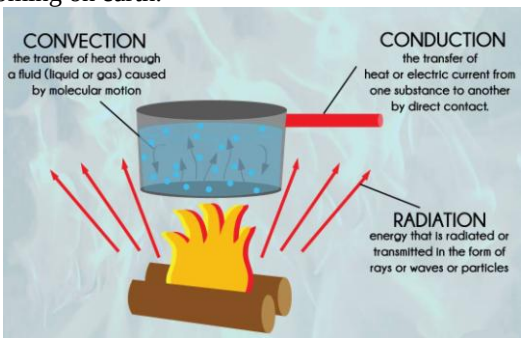

Fig 2 Modes of Heat Transfer

[3]Fin arrays

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 10 Issue: 03 | July - September 2019
Paper is available at www.jrps.in | Email : info@jrps.in

The Fins are offering a trouble free & economical solution. It has provided solution in various situations. This type of situations demands natural convection of heat shifting. Heat sinks have been found made of fin arrays on the horizontal & vertical surfaces. They have been used in a variety of engineering applications.

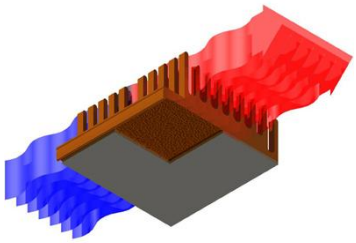

Fig 3 Heat sink with fins array

The heat shifting connected with this type of arrays is of considerable significance. Main controlling variable normally available for designer is the geometry of the fin arrays. While considering above fact, an experimental & theoretical investigation of natural convection heat shifting from the vertical rectangular fin arrays with & without notch on centre. Hence notches of various geometrical shapes have analysed for the purpose of optimization & comparison.

[4]PROBLEM FORMULATION

From the traditional work it is been observed that various researcher are using various types of fin shapes, various types of notches in fin. They have analyzed effect of various parameters such as height, length, spacing in case of heat transfer coefficient. But they are using material for fin that is aluminum. No one use other material than aluminum. In the base research author has planned to modify material of fin. For this researcher has used copper as a fin material for experimental work. Experimental setup had base copper plate of 190 ×110 millimeter that has thickness of 1 millimeter. Dimensions of fin in that experimental work were length was 127 millimeter, height was 38 millimeter and spacing among fins was 9 millimeter. Thickness of plate was 1 millimeter. Height, Length, and spacing have been fixed. Shape of the notch was rectangular. Author has compared effect of heat transfer coefficient for notch and without fins. 8 thermocouple wires have been utilized for attached to fins. The plate to measure temperature has been used. Heater coil had been used in case of heating plate.

[5] RESULT AND DISCUSSON

In simulation of Finarray has been done on Matlab platform consider influencing factors such Temperature (Temp) (T_b), Straight rectangular fins (W/m.K), Heat transfer coefficient (W/m.K), Ambient air condition (T_∞), Fin Length (L) in meter, Fin thickness (t) in meter Fin Width(w) in meter.

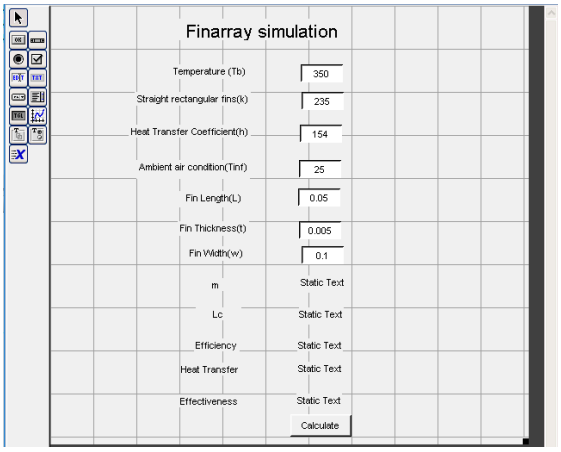

Fig 4 Matlab Based Simulation Environment

Table 1 Comparative analysis of cases then value of heat coefficient is modified

Heat transfer Cofficient 154	Heat transfer Cofficient 150
m = 16.1904 lc = 0.0525 x =0.8500 afin = 0.0105 efficiency = 0.8130 heattransfer = 427.2650 qwithoutfin = 25.0250 effectiveness = 17.0735	m = 15.9787 lc = 0.0525 x = 0.8389 afin = 0.0105 efficiency = 0.8168 heattransfer = 418.1102 qwithoutfin = 24.3750 effectiveness = 17.1532

As we could conclude that if the heat transfer coefficient has been reduced then efficiency and effectiveness got increased but the Heat transfer got reduced

Table 2 Comparative analysis of cases then value of length of is modified

Fin Length 0.05m	Fin Length 0.06m
m = 16.1904 lc = 0.0525 x =0.8500 afin = 0.0105 efficiency = 0.8130	m = 16.1904 lc = 0.0625 x = 1.0119 afin = 0.0125 efficiency = 0.7575

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 10 Issue: 03 | July - September 2019
Paper is available at www.jrps.in | Email : info@jrps.in

heattransfer = 427.2650 qwithoutfin = 25.0250 effectiveness = 17.0735	heattransfer = 473.9316 qwithoutfin = 25.0250 effectiveness = 18.9383

As we could conclude that if length has been increased then heat transfer and effectiveness got increased but the efficiency got reduced

Table 3Comparative analysis of cases then value of Temperature is increased

Temperature 350 degree	Temperature 400 degree
m = 16.1904 lc = 0.0525 x =0.8500 afin = 0.0105 efficiency = 0.8130 heattransfer = 427.2650 qwithoutfin = 25.0250 effectiveness = 17.0735	m = 16.1904 lc = 0.0525 x = 0.8500 afin = 0.0105 efficiency = 0.8130 heattransfer = 492.9981 qwithoutfin = 28.8750 effectiveness = 17.0735

As it could be concluded that if temperature has been increased then heat transfer got increased but the efficiency and effectiveness is not affected.

In following simulation the Optimization of fin length to get particular effectiveness has been made

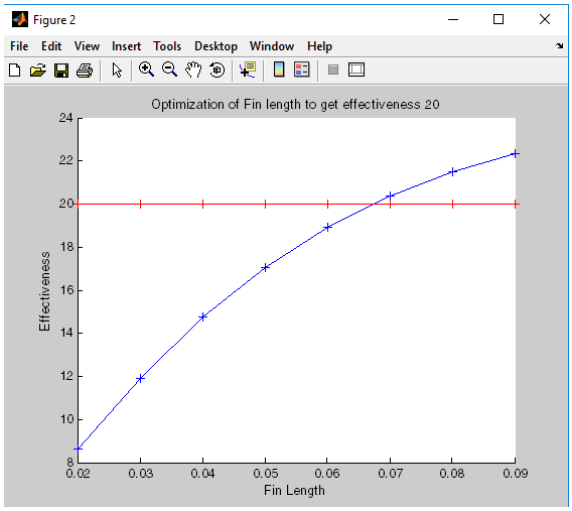

Fig 5 Optimization of fin length to get effectiveness 20

As it could been seen the fin length should be approximately 0.07m to get effectiveness of 20

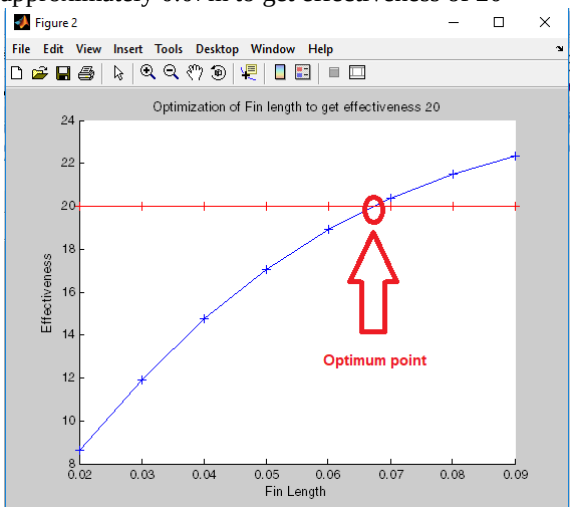

Fig 6 Getting Optimum length according to effectiveness

In following simulation the Optimization of temperature to get particular heat transfer amount has been made

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 10 Issue: 03 | July - September 2019
Paper is available at www.jrps.in | Email : info@jrps.in

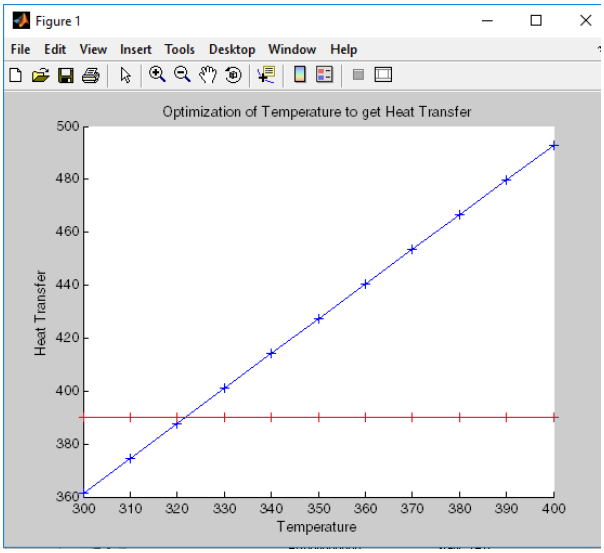

Fig 7 Optimization of Temperature to get heat transfer to 390

As it could been seen the temperature should be Approximately 320 to get heat transfer of 390

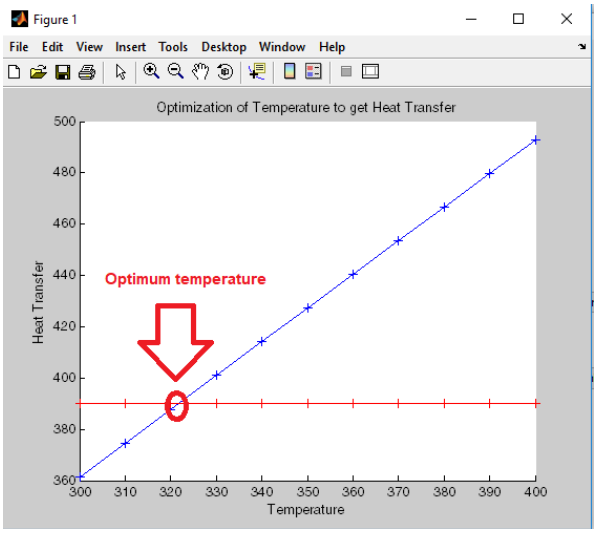

Fig 8 Getting Optimum Temperature according to Heat Transfer

In following simulation the Optimization of fin thickness to get particular Efficiency has been made

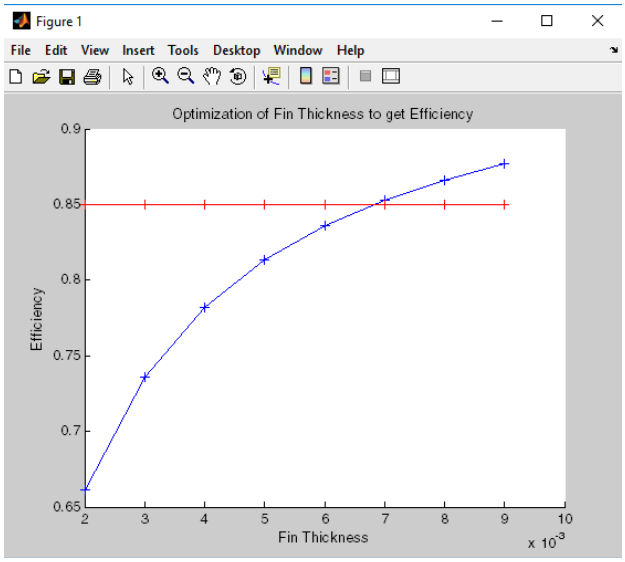

Fig 9 Optimization of Fin Thickness to get efficiency of 0.85

As it could been seen the fine thickness should be approximately 0.007 to get heat efficiency of 18

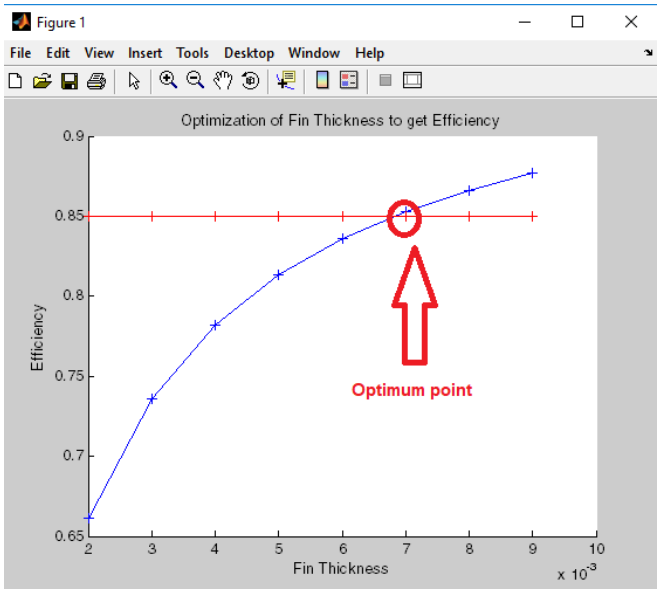

Fig 10 Getting Optimum Efficiency according to Fin Thickness

[6] CONCLUSION

From finding it has been concluded that if the heat transfer coefficient has been reduced then efficiency and effectiveness got increased but the Heat transfer got reduced. It has been also found that if length has been increased then heat transfer and effectiveness got increased but the efficiency got reduced. Another conclusion represents that if temperature has been increased then heat transfer

got increased but the efficiency and effectiveness is not affected.

It has been found that the influencing factors to calculate heat transfer, efficiency, and effectiveness in case of Fin array based Absorption heat transformers are heat transfer coefficient (h), straight rectangular fins, fin thickness, fin length and fin width. Temperature and ambient air condition is also influencing the heat transfer. The Effectiveness of fin array depends on Q. with fin and Q. without fin.

[7] FUTURE SCOPE

Using simulation it could be easily estimated how much Heat transfer coefficient (h), fin thickness; fin length and fin width should be there in order to transfer particular amount of heat. This research is helpful in optimizing the configuration of Fin array during heat transfer.

Using simulation the research could estimate how much Heat transfer coefficient (h), fin thickness; fin length and fin width should be there in order to get particular level of effectiveness. Thus this research would also help in optimizing the configuration of Fin array for effectiveness.

Reference

1. M. I. Hasan, (2018)"Enhancing the cooling performance of micro pin fin heat sink by using the phase change materials with different configurations," no. m, pp. 205–209, 2018.
2. N. Mansouri, C. Weasner, and A. Zaghlol, (2018)"Characterization of a Heat Sink with Embedded Heat Pipe with Variable Heat Dissipating Source Placement for Power Electronics Applications," 2018 17th IEEE Intersoc. Conf. Therm. Thermomechanical Phenom. Electron. Syst., pp. 311–317, 2018.
3. K. K. Pathak, A. Giri, and P. Lingfa,(2017) "Thermal Performance of a Rectangular Vertical," no. 2, 2017.
4. Davood AZIZIAN (2016) "Winding temperature prediction in split-winding traction transformer",
5. Zhiwei Ma, Huashan Bao, Anthony Paul Roskilly (2016) "Performance analysis of ultralow grade waste heat upgrade using absorption heat transformer", 2016 Published by Elsevier Ltd. under a Creative Commons
6. Gurpreet Singh, Swati Singh & Amit Singla wrote research in 2016 named "Experimental Studies on Heat shifting Performance of Double Pipe Heat Exchanger with using Baffles & Nanofluids", Indian Journal of Science & Technology, Vol 9(40),2016
7. Mr. Lalit B. Chintamani, N.C. Ghuge (2015) "A Review Paper on Experimental Heat shifting improvement using Nanofluids", International Journal of Innovative Research in highly developed Engineering Issue 2, Volume 2
8. Rajendra P. Patil, Dr. Atul Patil (2015) "Analysis of Steady State Heat Conduction in various Composite Wall", International Journal of Innovative Research in Science, Engineering & Technology, Vol. 4, Issue 7, July 2015
9. Siddiqui. M. Abdullah, Dr. A. T. Autee (2015) "Experimental Analysis Of Heat shifting From Square Perforated Fins in Staggered Arrangement", Siddiqui. M. Abdullah Int. Journal of Engineering Research & Applications , Vol. 5, Issue 8, (Part - 5) August 2015
10. Padam Singh andManoj Kumar (2014) "Free Convection in Heat shifting Flow on a Moving Sheet in Alumina Water Nanofluid", Hindawi Publishing Corporation Journal of Engineering Volume 2014
11. Anurag S.Hatwar, V.M.Kriplani (2014) "A Review on Heat shifting improvement With Nanofluid", International Journal of Advance Research In Science & Engineering, Vol. No.3, Issue No.3, March 2014
12. N. K. Chavda1, Jay R. Patel2 (2014) "Effect of Nanofluid On Heat shifting Characteristics Of Double Pipe Heat Exchanger", International Journal of Research in Engineering & Technology, Volume: 03 Issue: 12
13. Rameshwar B. Hagote, Sachin K. Dahake (2014) "Study of Natural Convection Heat shifting on Horizontal, Inclined & Vertical Heated Plate By V-Fin Array", International Journal of Scientific & Engineering Research, Volume 5, Issue 6,
14. S. Kumar (2014) "A Review: Enhancement of Heat Transfer with Nanofluids", International Journal of Engineering Research & Technology, Vol. 3 Issue 4, April – 2014
15. Dr D P Mishra, S R Dixit, (2013) "Experimental Analysis of Heat Transfer And Average Heat Transfer Coefficient Through Fin Array With or With out Notch Using Free Convection
16. Shivdas S. Kharche, Hemant S. Farkade (2012) "Heat shifting Analysis by Fin Array Using Natural Convection", International Journal of Emerging Technology & highly developed Engineering Volume 2, Issue 4, April 2012

17. R.J. Romero, Sotsil Silva (2010) "First Double Stage Heat Transformer (Dsht) In Latinamerica",
18. S. M. Peyghambarzadeh1, M. Jamialahmadi (2009) "Experimental & The Theoretical Study Of The Pool Boiling Heat Shifting To Amine Solutions", Brazilian Journal of Chemical Engineering, Vol. 26, No. 01, pp. 33 - 43, January - March, 2009
19. Sava PORNEALA in 2007 wrote paper on Performance Thermodynamic Criteria of Absorption Heat Transformers
20. Clausse, M., J. Leprieur, et al. (2011). EXPERIMENTAL TEST OF PLATE EVAPORATOR FOR SORPTION REFRIGERATION SYSTEMS. Proc. Int. Sorption Heat Pump Conf., Padua, Italy.
21. Critoph, R. E. and S. J. Metcalf (2011). PROGRESS IN THE DEVELOPMENT OF A CARBON-AMMONIA ADSORPTION GAS-FIRED DOMESTIC HEAT PUMP. Proc. Int. Sorption Heat Pump Conf., Padua, Italy.
22. Critoph, R. E. and Y. Zhong (2005). Review of trends in solid sorption refrigeration and heat pumping technology. Proc. of the Institution of Mechanical Engineers, Part E-Journal of Process Mechanical Engineering 219(E3): 285-300.
23. Dawoud, B. (2010). WATER VAPOR ADSORPTION KINETICS ON SMALL AND FULL SCALE ZEOLITE COATED ADSORBERS; A COMPARISON. Proc. Int. Symposium on Innovative Materials for Processes in Energy Systems, Nov. 29 - Dec. 1, Singapore.
24. Dawoud, B. (2012). Water vapor adsorption kinetics on small and full scale zeolite coated adsorbers; A comparison. Applied Thermal Engineering.
25. Dawoud, B., P. Höfle, et al. (2010). EXPERIMENTAL INVESTIGATION OF THE EFFECT OF ZEOLITE COATING THICKNESS ON THE PERFORMANCE OF A NOVEL ZEOLITE-WATER ADSORPTION HEAT PUMP MODULE. Proc. Int. Conference for Enhanced Building Operations, October 26-28, Texas, USA.
26. Dawoud, B., U. Vedder, et al. (2007). Non-isothermal adsorption kinetics of water vapour into a consolidated zeolite layer. Int. Journal of Heat and Mass Transfer 50(11-12): 2190-2199.
27. Frazzica, A., G. Füldner, et al. (2012). ADSORPTION KINETICS MEASUREMENTS OF ADSORBENT COATINGS FOR THE USE IN ADSORPTION CHILLERS AND HEAT PUMPS. Proc. Heat Powered Cycles, ECN, Alkmaar, The Netherlands.
28. Freni, A., L. Bonaccorsi, et al. (2009). Zeolite synthesised on copper foam for adsorption chillers: A mathematical model. Microporous and Mesoporous Materials 120(3): 402-409.
29. Freni, A., L. Bonaccorsi, et al. (2006). AN INNOVATIVE ADSORBER: ZEOLITE SYNTHESISED ON COPPER FOAM FOR ADSORPTION AIR CONDITIONING. Proc. Int. Conference on Heat Powered Cycles,11-14 September 2006; Newcastle upon Tyne, UK.
30. Freni, A., A. Frazzica, et al. (2011). Adsorbent coatings for heat pumping applications: Verification of hydrothermal and mechanical stabilities. Applied Thermal Engineering.
31. Freni, A., A. Frazzica, et al. (2013). Adsorbent coatings for heat pumping applications: Verification of hydrothermal and mechanical stabilities. Applied Thermal Engineering 50(2): 1658-1663.
32. Freni, A., F. Russo, et al. (2007). An advanced solid sorption chiller using SWS-1Ll. Applied Thermal Engineering 27(13): 2200-2204.
33. Freni, A., S. Santamaria, et al. (2012). EXPERIMENTAL TESTING OF A COATED ADSORBER. Proc. Heat Powered Cycles, ECN, Alkmaar, The Netherlands.
34. Gordeeva, L. G., A. Freni, et al. (2012). A NEW FAMILY OF METHANOL SORBENTS FOR ADSORPTIVE AIR CONDITIONING DRIVEN BY LOW TEMPERATURE HEAT. Proc. Heat Powered Cycles, ECN, Alkmaar, The Netherlands.