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Experimental Analysis of Heat Transfer In Porous Medium With Different Material

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Abstract – *An experimental study to evaluate the dynamics of forced convection heat transfer in a thermally isolated column filled with porous medium has been carried out. The behavior of two porous media with different grain sizes and specific surfaces has been observed. The experimental data have been compared with an analytical Solution for one - dimensional heat transport for local non thermal equilibrium condition. The interpretation of the experimental data shows that the heterogeneity of the porous medium affects heat transport dynamics, causing a channelling effect which has Consequences on thermal dispersion phenomena and heat transfer between fluid and solid phases, limiting the capacity to store or dissipate heat in the porous medium.*
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Keywords- Heat Transfer, Porous Media, Nusselt Number ,Thermal conductivity, Effective Thermal Conductivity.

I- INTRODUCTION

Heat transfer in porous media has recently become an important subject in mechanical engineering. This study presents experimental and numerical investigations of the effective thermal conductivity in porous medium.Effective heat transfer is essential in a variety of energy technologies in order to enable the maximum possible power density and power conversion efficiency needed for economic competitiveness and fuel conservation. The goal of enhanced heat transfer is to encourage or accommodate high heat fluxes. This results in reduction of heat exchanger size, which generally leads to less capital cost [1]. Another advantage is the reduction of temperature driving force, which reduces the entropy generation and increases the second law Sefficiency. In addition, the heat transfer enhancement enables heat exchangers to operate at smaller velocity, but still achieve the same or even higher heat transfer coefficient [2].Heat transfer enhancement technology has been widely applied to heat exchanger applications in refrigeration, automobile, process industries etc [3-8].In general, enhanced heat transfer surfaces can be used for three purposes: 1- to make heat exchangers more compact in order to reduce their overall volume, and possibly their cost,2- to reduce the pumping power required for a given heat transfer process, or 3- to increase the overall UA value of the heat exchanger. Heat transfer enhancement techniques can be divided into two groups: active and passive techniques. The active techniques require external power to facilitate the desired flow modification and the concomitant improvement in the rate of heat transfer. Spacing 1.15 inches justified. Introduction should be in times new roman size 10 normal, line spacing 1.15 inches justified. Introduction should be in times new roman size 10 normal, line spacing 1.15 inches justified. Introduction should be in times new roman size 10 normal, line spacing 1.15 inches justified.

II-METHOLOGY

A porous medium is a medium typically filled with structures such as granular solids, foams or fibres. Typically when fibres are used the porosity of the media is increased to over 90%. Such high porosity is mainly due to the complex surface chemistry and the irregular form of the fibres [3]. The medium usually undergoes some changes due to condensation of vapour, swelling in the fibres or other deformations but will be viewed as a rigid structure in this analysis As can be seen in Figure 2.2, describing the fibres as uniform can be viewed as almost impossible as the exact shape and size distribution is highly irregular through the medium. This is a common problem in natural materials such as pulp. Since there rarely is any information regarding the consistency of properties in the material, various parameters are usually set as constant in a porous medium. As the material for the analysis is only observed in a macro scale, the medium can be seen as close to homogenous, thus regarding properties as constant is a valid assumption.

The thin outer-layer of the product consists of a breathable micro porous film. This film consists of solid man-made polymers such as polyethylene or polypropylene with additional inorganic fillers. One of the most common fillers is calcium carbonate (CaCO3) [2, 4]. As the polymers are man-made, their shape and position are more uniform than in the case of natural fibres and can more easily be chosen after desired properties Breathable micro porous films usually contain billions of small pores. Many of the micro pores are connected to each other creating channels through the film. The main function of the film is, in addition to keep the main layers of the product in place, to stop any leaking of liquid to occur. It is however of importance that vapour is able to transport through the film, in order to allow it to be breathable. Therefore the size of the pores needs to be much larger than the vapour molecules, but small enough to prevent any penetration of liquid [4].

To form the pores in the film, the plastic usually undergoes stress cracking by stretching the material mechanically. Due to the presence of fillers, the stretching can be done under normal ambient conditions and become more controlled [4]. Even though the polymers are more uniform than in natural fibres, the shape and size of the pores generally varies a lot as the channels created takes different paths through the layer. This will result in different distances for the moist air to travel in the medium and a uniform transport time cannot be guaranteed. Figure 2.3 shows a typical polymer-CaCO3 structure with some possible paths for the vapour to travel.

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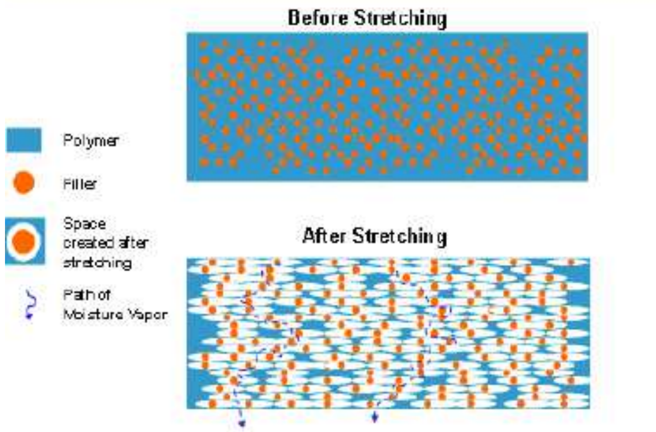

Figure 1 -Migration of moisture vapour through a micro porous film

II- CONCLUSION

This study has been done experimentally and numerically parts. Thermal conductivity of pumice was found and numerical and experimental results were compared. Air was used in porous material as the fluid. In the experimental part, steady state has been assumed and then the temperature distribution in cavity was found for different times. Using these results, thermal conductivity was obtained and used for the numerical investigations. According to the experimental analysis, thermal conductivity is about 0.28 (W/m.) which shows a subtle difference from the acceptable value. Some factors affect the procedures such as humidity and devices errors. Because of the high humidity in North Cyprus, the sample was heated from the upper part and the bottom part was cooled. Instruments errors may influence the obtained results. Comparison the numerical graphs and the experimental parts show subtle differences

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