EFFECT OF E/D AND P/E RATIO ON VARIOUS PARAMETERS IN SOLAR AIR HEATER PERFORMANCE

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Abstract: Artificial roughness has been found to enhance the rate of heat transfer from the collector plate to the fluid (air). Investigators reported various roughness geometries in literature for studying heat transfer and friction characteristics of an artificially roughened duct of solar air heaters. In the present paper an attempt has been made to categorize and review the reported roughness geometries used for creating artificial roughness. Heat transfer coefficient and friction factor correlations developed by various investigators for roughened ducts of solar air heaters have also been reported in the present paper.

Keywords: Nusselt number, height of roughness (e), Relative roughness height, Solar air heater, Friction factor.

Nomenclature:

Nu- Nusselt number of smooth duct (Dimensionless)
P- Pitch (m)
h- heat transfer coefficient($wm^{-2}k^{-1}$)
Pr- Prandtl number (Dimensionless)
Re- Reynold number (Dimensionless)
Cd- Coefficient discharge of orifice meter
f- friction factor (Dimensionless)
k- thermal conductivity
m- mass flow rate (Kgs^{-1})
Nu- Nusselt number of roughness duct
Ac- Area of absorber plate (m^2)
Cp- Specific heat of air ($JKg^{-1}K^{-1}$)
V- Velocity of duct (ms^{-1})
W- Width of duct (m)
St- Stantum number
e- Height of roughness element (m)
L- Length of collector (m)

Greek Symbol:

ΔP- Pressure drop in test length (pa)
ϱ- Density of air (Kgm^{-3})
α- Angle of attack of flow

Introduction

Now a day's government majorly develops different schemes to increase to consumption of energy. The rapid use of non renewable sources is vital for better energy utilization. The renewable source energy is better option for the non renewable source like solar, wind, etc. Energy in various forms has been playing an increasingly important role in world wide economic progress and industrialization.

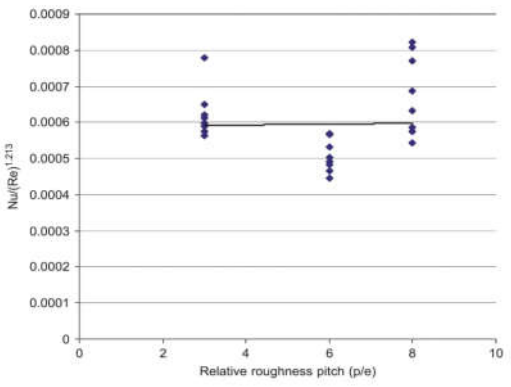
The growth of world population coupled with rising material needs has escalated the rate of energy usage. Rapid increase in energy usage characteristic of the past 50–100 years cannot continue indefinitely as finite energy resources of earth are exhaustible. On the other hand, environment degradation with the use of fossil fuels is a threat to life on this planet earth. In view of world's depleting fossil fuel reserves and environmental threats, development of renewable energy sources has received an impetus.

Of many alternatives, solar energy stands out as brightest long range resource for meeting continuously increasing demand for energy. It is considered to be a dominating renewable energy source due to its large potential. The freely available solar radiation provides an infinite and non-polluting reservoir of fuel.The simplest method to utilize solar energy for heating applications is to convert it into thermal energy by using solar collectors.

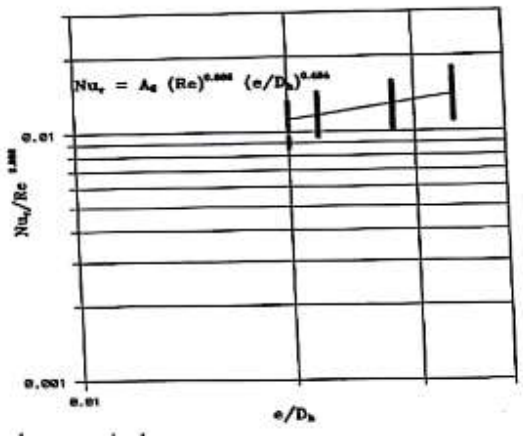
Solar water heaters and solar air heaters are flat plate collectors which are generally used for heating water and air respectively. Solar air heaters are considered to be compact and less complicated as compared to solar water heaters. These are also free from corrosion and freezing problems. Solar air heater can be fabricated using cheaper as well as lesser amount of material and is simpler to use than solar water heater. Solar air heaters are generally considered to be useful for applications like space heating, crop drying, seasoning of timber etc. A solar air heater occupies an important place among solar thermal systems because of minimal use of materials and cost. The thermal efficiency of a solar air heater is generally considered to be less because of low rate of heat transfer capability between absorber plate and air flowing in the duct. In order to make a solar air heater more effective solar energy utilization system, thermal efficiency needs to be improved by enhancing heat transfer rate. In present work, the effect of various friction and flow parameters has been summarized.

Effect of the Combination of Incline and Transverse Ribs on the Solar Air Heater

Varuna et al., Perform the experiment on the thermal performance of the solar air heater having roughness element of the combination the inclined and transverse rib on absorber plate. For the effect of the height of the roughness and the pitch in solar air Heater is study I.ep/e ratio on the solar air Heater performance. the below diagram show the the effect of the p/e ratio on nussult and Reynold no on the transverse and p/e of give best performance Plot of the Nusselt number with Reynold number Bo is fact function of other influencing parameter. The other parameter is relative roughness pitch p/e value of (Nu/Re) has been plotted against relative roughness pitch (p/e)



Plot of Nu/Re 1.23 with Relativ roughness pitch p/e
The following co-relation for Nusselt number
Nu/Re^1.213=0.0006*(p/e)^0.0104
A similar method has been used to develop the friction factor function fig show a plot of friction factor function of Reynold number for entire data for combination rib geometer.

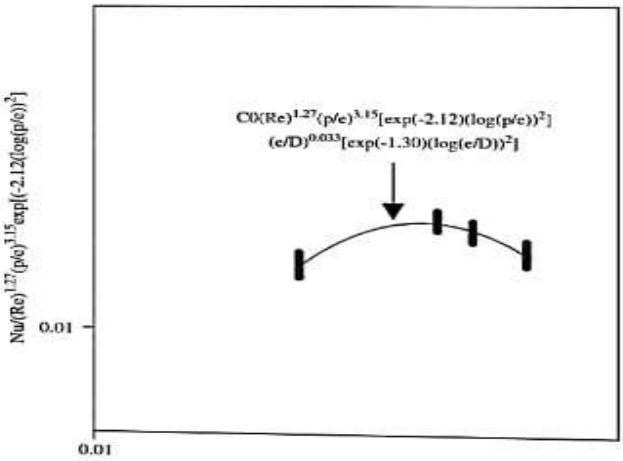


5.plot of f/Re^-0.3685 with relative roughness pitch

2 .Effect Of e/D and p/e V-Shaped Rib Roughness On The Absorber Plate

Abdul-Malik Ebrahim Momin a,*, J.S. Saini b, S.C. Solanki b perform the experiment and obtain the some value for the 45 and 60 degree v-shaped rib also have higher ribbedfor heat transfer and pressure drop than corresponding angle After completing the whole arrangement of the v shaped rib.The some experimental value was obtain the comparison of the value and those predicted by correlation for Nusselt number and friction factor of smooth duct proposed by modified diffuse bolter correlation for Nusselt number abd by modified blasius correlation for Nusselt number range applied friction factor. The effectof the e/D ratio on the v shape incline plate for nusselt number and Reynold no ratio is given by following graph is given as

relation between the e/D and ratio of Reynold and nusselt Theeffectofthee/Dratioonthevshapeinclineplateforfriction factor andReynoldnoratioisgivenby followinggraphisgivenas

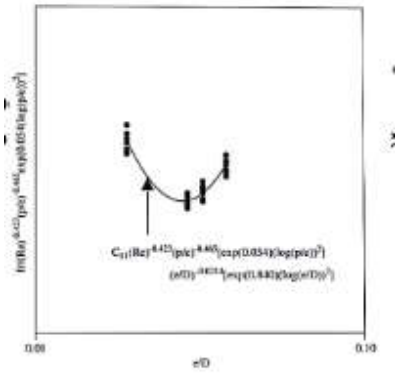


Effect of the e/D on the ratio of the friction factor and Reynold number

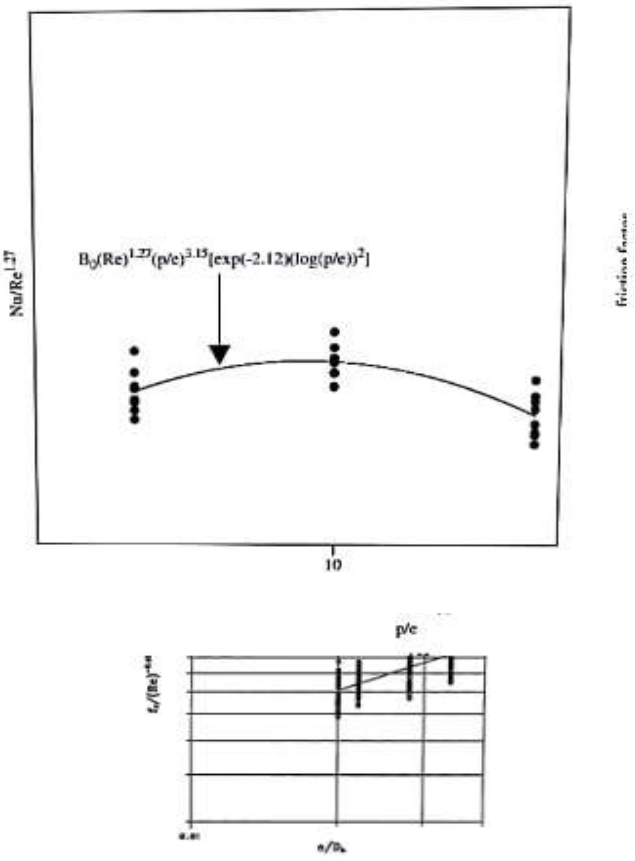
3) Effect of e/D and p/e ratio the dimple-shape artificial roughness on solar air heaters

R.P. Saini _, Jitendra Verma is performing the experiment on dimple shape artificial roughness on the solar air heater. Theeffectofthee/Dratioonthedimpled platefornusseltnumberandReynoldnoratioisgivenbyfollowinggraphisgivenas

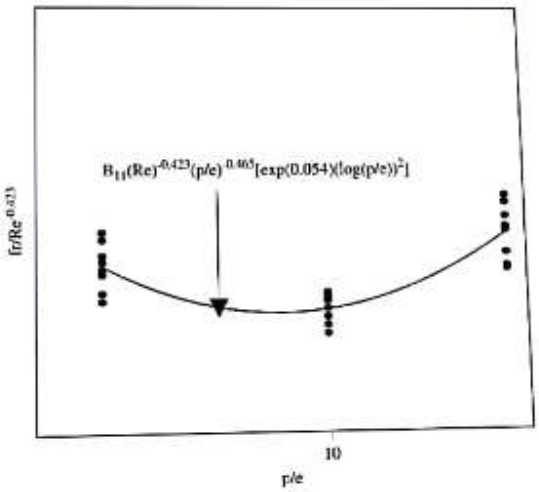
Effect of the e/D on the nuand Re



Theeffectofthee/Dratioonthedimple shape plateforReynold and friction factor ratioisgivenby followinggraphisgivenas



Effect of the fr/Re and e/D



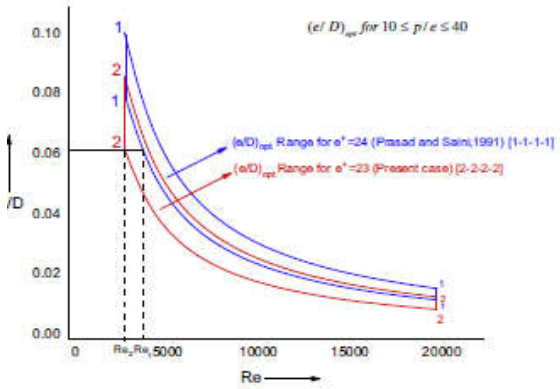
Theeffectofthep/e ratioonthedimple shapeinclineplatefornusseltnumberandReynoldnoratioisgivenbyfollowinggraphisgivenas

EffeRe of the p/e on ratio of the Nu/Re

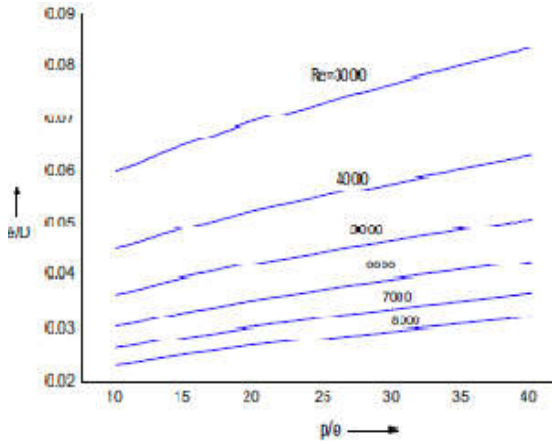
Theeffectofthep/eratioonthedimpleshapeinclineplateforfriction factorandReynoldnoratiois given byfollowinggraphisgivenas

4)Effect Of The Three Side Artificial Roughness On Solar Air Heater.

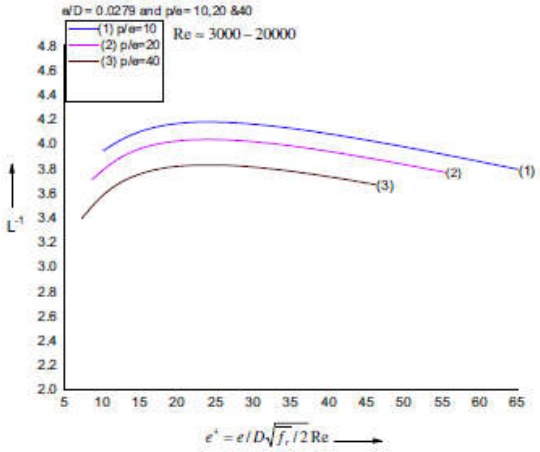
B.N. Prasad, Ashwini Kumar, K.D.P. Singh They perform the experiment on three side artificial roughness on solar air heater the get better heat transfer rate than other one. shows the optimal range of the values of relativeroughness height, (e/D)opt for 10,<= p/e<= 40, at varying values of flow Reynolds number from 3000 to 20,000, for thepresent case and that of Prasad and Saini (1991), whichshows that the range of optimal values of (e/D)opt, forthe present is below that of Prasad and Saini (1991), and decreases with increasing values of flow Reynolds number.



Optimal range of e/D. Below figure show the variation of the Optimal thermohydraulic performance curve for three sidesartificially roughened solar air heater.



Below The Figure also show the Effect of e+ on L^-1 for varying values of p/e.



B.N. Prasad, Ashwini Kumar, K.D.P. Singh

After completed of the experiment they get some important result as for the same values of roughness parametersand mass flow rate, three sides roughened solar air heaterswill be qualitatively under optimal thermo hydraulic performancecondition, better than those of one side roughenedsolar air heaters.

CONCLUSIONS

1) Optimal thermo hydraulic performance of three sides artificially roughened solar air heater of high aspect ratio has been analyzed.

2) there was much effect of e/D take place on the solar air Heater performance

3) Such solar air heaters are both quantitatively and qualitatively better than one side artificially roughened solar air heaters under optimal thermo hydraulic performance conditions.

4) In generaltherewasmucheffectofp/e takeplaceonthesolarairHeaterperformance

5) It was found that e/D and p/e ratio effect on all roughness like dimple shape, v shape ,transverse and inclined ,and three side artificial roughness

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