Review of Biomass Gasification for Increasing Calorific Value

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ABSTRACT:

which degrades its performance. So to improve the performance of device, it is necessary to maintain device at room temperature. For maintaining the temperature heat sink is used, which extract heat continuously from the heat source and maintain temperature in the permissible range. The performance of heat sink depends on the different process parameters. So to improve the performance of heat sink, here in this work effect of different shapes of perforated fins was analysed. For analysing the effect of different shapes of perforation on heat sink fins, it considered four shapes of perforation. Through analysis it is found that heat sink fins having circular perforation shows maximum heat transfer and lower thermal resistance as compared to other shape. After analysing the effect of different shapes of perforation, it also analysed the effect of arrangement of perforation that is in-line and staggered. After CFD analysis of heat sink,

Keywords- *Heat sink, Perforation, shapes, thermal resistance, fins*

1. INTRODUCTION:

Heat Transfer Enhancement Techniques

The way to improve heat transfer performance is referred to as heat transfer enhancement (or augmentation or intensification). The research in this field was strongly stressed by the need of developing high performance thermal systems. The development of heat transfer enhancement during the past 2-3 decades is such that enhanced surfaces are used routinely in refrigeration, automotive, electronic industries, food industries, textile industries and even more and more often in process industries. The improvement of the heat transfer coefficient requires quite different approach according to the phase of the fluid (gas or liquid) and to the process type: techniques are quite different for only sensible heat transfer or for phase change such as evaporation or condensation.

Heat transfer enhancement techniques can be classified as active methods, which require external power, or passive methods, which require no direct application of external power. The major passive cooling solutions are obtained through conduction (heat spreaders, thermal interface materials), natural convection (heat sinks, liquid immersion), radiation (coating, surface treatments) or phase change (heat pipes, phase change materials). However, passive cooling techniques have low cooling performance requiring a large device size. Consequently, high-power systems require active techniques, which require input power but have larger heat removal capacity.

Passive Techniques

Treated surfaces: This method involves the fine-scale alteration of the surface finish which affects single-phase heat transfer. This method is used for condensing and boiling.

Rough surfaces: This application is generally chosen to promote turbulence rather than heat transfer enhancement and its application is directed to single-phase flow. These surfaces are produced in many configurations ranging from random sand-graintype roughness to discrete protuberances.

Extended surfaces: This technique is one that is currently the focus of many studies (including this study). The method involves the extension of the surface and examples of this method that are being used in practice are micro-fin tubes and most recently, herringbone type tubes.

Displacement enhancement devices: These devices are inserted into the flow channel so as to improve the energy transport indirectly at the heated surface and these devices are used with forced flow.

Swirl-flow devices: Examples of such devices are coiled tubes, inlet vortex generators, twisted tape inserts and axial-core inserts. These devices create a rotating flow and/or a secondary flow. **Surface tension devices:** These devices consist of wicking or grooved surfaces to direct the flow of liquid during condensing or boiling.

Additives for liquids and gasses: Additives for liquids include solid particles and gas particles in single-phase flow, while for gas additives, liquid droplets or solid particles are used.

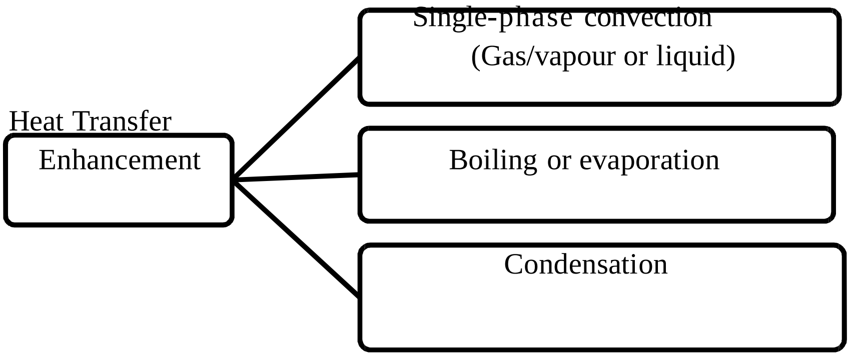

Fig.1.6: Heat Transfer Coefficient Enhancement Technique

Active Techniques

Mechanical aids: These aids stir the fluid by mechanical means or by rotating the surface. Equipment with rotating heat exchanger ducts is found in commercial practice (Bergles and Chyu, 1988; Lasance, 1997). Surface vibration: To improve single-phase heat exchange, the surface is vibrated at either low or high frequencies.

Fluid vibration: The fluid is vibrated at pulsations of 1 Hz with ultrasound. This is the most practical type of vibration enhancement and is used in single-phase flow.

Electrostatic fields: These fields are applied in many different ways to dielectric fluids. The electrostatic fields can be directed to cause greater bulk fluid mixing in the vicinity of heat transfer surfaces.

Injection: This method involves the supplementation of gases to a flowing liquid through a porous heat transfer surface, or by injecting another liquid into the liquid upstream.

Suction: Here liquids or gases are removed by suction through a porous heat transfer surface.

2.**LITERATURE REVIEW:**

Anbumeenakshi et.al In his study, they had investigated through series of experiments on the common effects of nanofluids and uneven heat on the cooling effect of microchannel sinks. The microscopic radiation that is considered in this study distributes 30 rectangles with a 0.727 millimetre diameter. In the experimental experiments, three machines of the same size were used. Uneven heat is provided by opening two of three heaters at the same time. The maximum temperature of the pulse rays is lowest when the chipper is placed above the flow.

Soni et.al examined the changes in the heat transfer in the equilibrium state in the variation in heat energy and the heat efficiency between the rectangular shaped fin heat sink and pin fin heat sink from the vertical orientation base plate. After creating and confirming the existing analytical results for continuous fins, a systematic study of the effect of the elliptical fin is performed. ANSYS and SOLIDWORKS design software were used to create three-dimensional digital models to investigate the different fins geometry effects. The results showed that the changes in the fins geometry to the vertical oriented base plate fins increase the thermal efficiency of the fins and reduce the weight of the fins array, resulting in lower production costs. The optimum distance for the maximum heating efficiency of the grid is limited. The study shows that the most important geometric parameters that affect the thermal transfer are the ratio of diameter of the fin by the centre gap.

Wan et.al in his work, here are four different types of micro pin fin heat sink (square, diamond, circular and streamline) had been produced by a microscopic milling process for two-stage cooling system. Experiments with boiling water were performed to demonstrate the two-stage boiling point of these different shapes micro pin fins. As a result, the reduction of the pressure of four micro-microbes increases when the heat fluxes increases. This diamond shape showed a slight drop of pressure, then by square and circular shaped fins. Square shaped rings have the greatest pressure for general use. Experimental results suggested that pin with square shaped fins have the best proportion and should be selected for the heat absorption in micro pin fins during a bifurcation process in two flows. Micro pin fins with circular shape is also a good choice when pumping power is not worried.

Park et.al In his study, a cooling system incorporating a hollow cylinder and a radial shaped heat sink that could be applied to LED (light-emitting diode) were proposed. The energy change of natural convection is simulated by digital samples and is validated by experiment. The airflow pattern around the heat sink with fin in radial direction is just same like chimney and going to the side of the heat sink and moving to the top. When the hollow cylinder is mounted, the large air velocity to the fins of heat sink enhances, resulting in increased thermal performance of heatsink. The effect of the height and the material of the hollow cylinder has been investigated and the efficiency of the heat sinks with the various types is calculated. The results showed that the heat efficiency of the heat sink was improved up to 43% after installation of the coil layer.

Duangthongsuk et.al In his article, they had tested the thermal conductivity and flow characteristics of the heat sinks with shapes like circular and square pin (MCFHS and MSFHS) with SiO2, dispersed in DI water having fractional volumes of 0.2, 0.4 and 0.6% of the sound strength. The description is the impact of needle structure, particle concentration, and flow rate of heat exchanger and pressure drop across the test site. It is assumed that the coefficient of heat emission increases with increasing the concentration of particles and Reynolds numbers. Finally, it would suggest that the use of square shaped heat sinks should be avoided when case comes to circular shaped structure of fins.

Ho. et.al speaks about the alumina and microencapsulated phase change material as the working fluid. Experimental results obtained reveal that the heat dissipation effectiveness of the nanoÀuid and PCM suspension depends signifcantly on their flow rates through the heat sink. For the nano fluid, the highest enhancement of 57% in the averaged heat transfer coefficient was detected under the highest flow rate; while for the PCM suspension, the highest enhancement of 51% under the lowest flow rate. For the hybrid water-based suspensions, the effect of simultaneous dispersion of the nanoparticles and MEPCM particles in water appears to be supplementary with added benefit of simultaneous increases in the effective thermal conductivity and specific heat such that the heat transfer effectiveness could be further increased up to 56% with little dependence on the flow rate.

CALCULATIONS

Total Energy Contents and Power Generation Structure from 8 Months old

(approx.), Gulmohar Plants

Component	Calorific Value (kcal/t, dry basis)	Biomass Production (t/ha, dry basis)	Energy Value (kcal/ha)
Main wood	4532×10^3	21.00	95172×10^3
Leaf	3907×10^3	7.00	27349×10^3
Nascent branch	3997×10^3	9.50	37971.5×10^3

Energy Calculation:

* Data from filed studies (biomass production)

On even dried basis, total energy from one hectare of land

$$= (95172+27349+37971.5) \times 10^3$$

$$= 160492.5 \times 10^3 \text{ kcal}$$

It is assumed that conversion efficiency of wood fuelled thermal generators = 26 % and mechanical efficiency of the power plant = 85 %.

Energy value of the total functional biomass obtained from one hectare of land at 26%

conversion efficiency of thermal power plant = $160492.5 \times 10^3 \times 0.26$

$$= 41728.05 \times 10^3$$

$= 41728.05 \times 10^3 \times 4.186 \div 3600$

$= 48520.45$ kWh

Power generation at 85 % mechanical efficiency

$= 48520.45 \times 0.85$

$= 41242.38$ kWh/ha

Land required to supply electricity for entire year

$= 73 \times 10^5 / 41242.38$

= 177 hectares

Total Energy Contents and Power Generation Structure from 4 Months old

(approx.), Cassia Tora Plants

Component	Calorific Value (kcal/t, dry basis)	Biomass Production (t/ha, dry basis)	Energy Value (kcal/ha)
Main wood	4344×10^3	4.00	17376×10^3
Leaf	4013×10^3	1.50	6019.5×10^3
Nascent branch	3672×10^3	2.50	9180×10^3

* Data from filed studies (biomass production)

Energy Calculation:

On even dried basis, total energy from one hectare of land

$= (17376+6019.5+9180) \times 10^3$

$= 32575 \times 10^3$ kcal

It is assumed that conversion efficiency of wood fuelled thermal generators = 26 % and mechanical efficiency of the power plant = 85 %.

Energy value of the total functional biomass obtained from one hectare of land at 26%

conversion efficiency of thermal power plant = $32575.5 \times 10^3 \times 0.26$

$= 8469.63 \times 10^3$ kcal

$= 8467.29 \times 10^3 \times 4.186 \div 3600$

= 9848.30 kWh

Power generation at 85 % mechanical efficiency

$= 9848.30 \times 0.85$

= 8371.05 kWh/ha

Land required to supply electricity for entire year

$= 73 \times 10^5 / 8371.05$

= 872.05 hectares

CONCLUSIONS

In the present work two non-woody biomass species Gulmohar and Cassia Tora were selected. Experiments to determine the proximate analysis, calorific values and ash fusion temperature was done on each of the components of the selected species such as main wood; leaf and nascent branch were performed. Estimation was done to analyse how much power can be generated in one hectare of land from each of these species. The following are the different conclusions drawn from the present work:

1. Both plant species (Gulmohar and Cassia tora) showed almost the similar proximate analysis results for their components, the ash contents being more in their leaves and volatile matter content less in Cassia tora wood and leaf.
2. Mixed ratio of Both biomass with coal(in four different ratio) also showed the same proximate analysis results, the ash contents being more when 95% coal mixing with
5% biomass and volatile matter is more when 80% coal mixing with 20% biomass.

3. The non-wood biomass species showed highest energy values for their wood, followed by nascent branch and leaf.

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