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ANALYSIS OF TEMPERATURE DISTRIBUTION OF HEAT TRANSFER COEFFICIENT IN COOLING SYSTEM (SIMULATION) USING POROUS MEDIA WITH POROSITY VARIATION

Ahmad Hamim Su'udy [1], Eko Siswanto [2], Rudy Soenoko[3]
Faculty of Engineering, Universitas Brawijaya

Abstract *Internal combustion engine is an engine that is old enough and today has much alternative energy that is found to shift from the role of motor fuel, The cooling system in internal combustion engine, if not handled properly will cause something that is fatal is the occurrence of overheating. Cooling during this time using the fin and radiator, and research continues to grow in terms of heat transfer, that is by using porous media, with the help of computer simulation then the role of the fin and radiator can be replaced with porous media with porosity variation 10%, 15%, 20% 25%, 30% so that the temperature distribution will be obtained. The result of the research by using simulation shows that the porosity value of porous media, the temperature distribution value is also bigger. The lower porosity of the value of (h) the heat transfer coefficient will increase.*

Keywords*: Porosity, Temperature, Heat Transport*

1. Introduction

Science and technology continue to evolve in providing solutions to cooling system problems that often arise from the heat generated by the engine and how to improve engine cooling functions. an experimental study of the effect of the fins surface grooves on a motor vehicle engine cooling system, which mentions the use of a fin form in the direction of the flow of fluid will accelerate the discharge of heat to the environment [1].

Heat transfer research is also evolving about investigating the dynamics of thermal flux and thermal conductivity that occur during condensation by experimental method [2]. then proceed simulated about the porous media to observe the porosity effect of the porous medium through a mixture of hot fluid and cold fluid. The results of this study explain that porosity is very influential on heat transfer that occurs in the porous media [3]. Furthermore, it was observed that heat transfer with natural convection of varied viscosity fluid in porous medium resulted in a high porosity condition that the value of Prandtl was proportional to Nusselt value, causing the flow value to increase also [4].

* Corresponding author. Email : suudy
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Referring from the exposure data above many methods or ways to improve engine cooling function, where the researcher is interested to do research about porous porosity variations of media simulated on the motor fuel cooling system.

Then the purpose of this research is to get the temperature distribution that occurs in motor fuel coolant system using porous media. The hypothesis can be drawn from the literature review that the greater the percentage of porosity, the distribution of heat transfer in the porous media increases and the slower the heat transfer rate, then the greater the effective thermal conductivity value, the heat transfer distribution in the porous media decreases, the faster the rate of displacement the heat.

2. Method

This research is done numerically by using FEA Software (Finite Element Analysis), so it can be known the influence of the use of media axle model on the internal combustion engine cooling system. Besides, a literature study of conduction and convection heat transfer is also carried out.

Porous media is a porous medium, in which a structured material therein contains or contains a blank space called pore and is

surrounded by a solid or semi-solid matrix. Then for the formula used for porosity:

$$\varepsilon = \frac{\text{volume of pores}}{Total\ material\ volume} \times 100\% \qquad (1)$$

The effectiveness of thermal effectivity occurring in porous media it can use the K effective (K_eff)

$$K_{eff} = [(1-\varepsilon^{2/3}) + \{\varepsilon^{2/3} / [(1-\varepsilon^{1/3}) + \varepsilon^{1/3}(kp/ka)]\}]\ kp$$

The value (h) Searching from heat transfer coefficient then use

$$h = Nu \frac{K_{eff}}{D} \qquad (3)$$

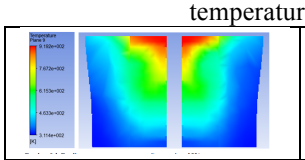
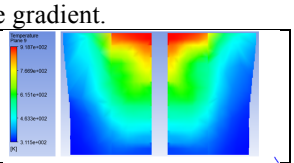
Previously we searched about *Nusselt Number* (Nu)

$$Nu = 0{,}53\ (Gr.Pr)^{1/4} \qquad (4)$$

3. Results and Discussion

The results of the data that have been obtained from the results of simulation research will describe the temperature gradient and temperature distribution value table in porous media.

Table 1. The data of simulated Porous media temperature gradient.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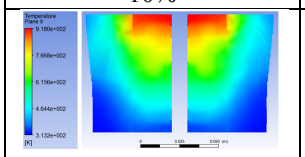	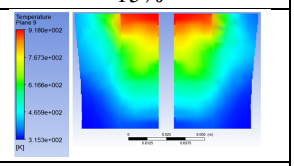
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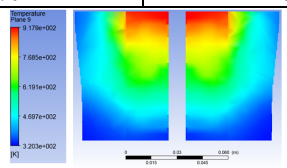	
30%	

The heat transfer coefficient is one of the parameters used in looking at the temperature distribution that occurs in heat transfer. The value of (h) is closely related to the K effective and the value of Nu.

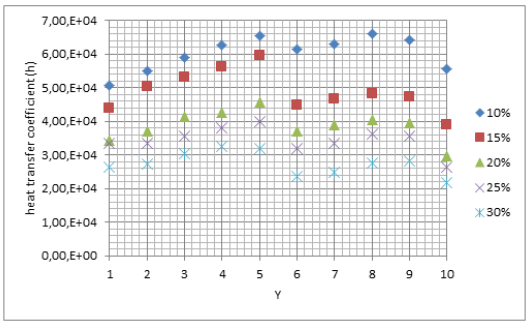

Figure 1. Graph of Coefficient of heat transfer value (h) in Column A

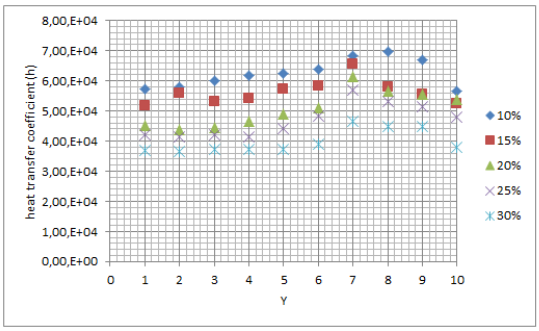

Figure 2. Graph of Coefficient of heat transfer value (h) in Column B

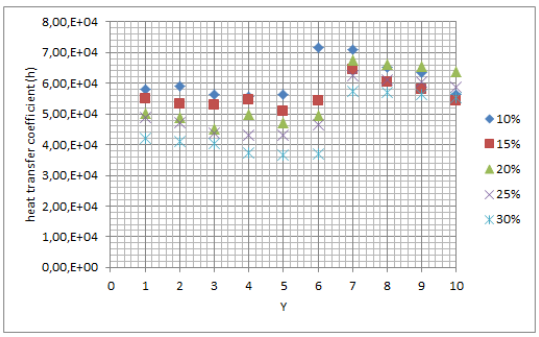

Figure 3. Graph of Coefficient of heat transfer value (h) in Column C

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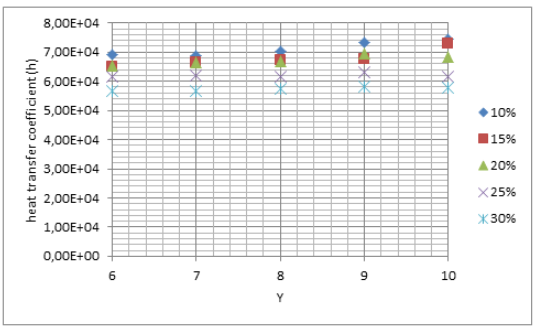

Figure 4. Graph of Coefficient of heat transfer value (h) in Column D

The graphic image of the above heat transfer coefficient when viewed from the point of view A or Figure 1. the porosity of 10% has the highest h value and the value of the heat transfer coefficient is also followed by the change in the porosity value, where the coefficient value of heat transfer is lowest if it is sculpted from the column A monitor is present in 30% porosity. Next in Figure 3, Figure 3, and Figure 4. show the same thing.

4. Conclusion

One of the causes that affect the value of his the effective thermal conductivity, which when the large porosity value eats the effective value of K is small. So it can be concluded that the greater the porosity the value of the heat transfer coefficient will be lower.

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