# ABSTRAK

Tujuan dari penelitian ini adalah (a) membuat program untuk menghitung distribusi suhu, laju perpindahan kalor, efisiensi, dan efektivitas pada sirip mengerucut berpenampang segi enam yang terdiri dari dua material pada kondisi tak tunak. (b) mengetahui pengaruh komposisi bahan sirip terhadap distribusi suhu, laju perpindahan kalor, efisiensi, efektivitas pada sirip mengerucut berpenampang segi enam pada keadaan tak tunak. (c) mengetahui nilai efisiensi dan efektivitas pada sirip mengerucut yang terdiri dari dua bahan berpenampang segi enam dengan variasi nilai koefisien perpindahan kalor konveksi h pada keadaan tak tunak, (d) mengetahui pengaruh variasi ukuran sisi dasar terhadap distribusi suhu, laju perpindahan kalor, efisiensi, efektivitas pada sirip mengerucut berpenampang segi enam pada keadaan tak tunak.

Penelitian ini dilakukan dengan cara komputasi numerik, menggunakan metode beda-hingga cara eksplisit. Variasi penelitian dilakukan terhadap bahan material penyusun sirip, nilai koefisien perpindahan kalor konveksi, dan ukuran sisi penampang dasar. Bahan penyusun sirip diasumsikan mempunyai massa jenis (ρ), kalor jenis (c), dan konduktivitas termal bahan (k) yang tidak berubah terhadap perubahan suhu. Suhu dasar sirip, $T_b$ = 100°C dipertahankan tetap dari waktu ke waktu. Pada saat t = 0 s, suhu awal sirip merata sebesar T = $T_i$ = 100°C, dan suhu fluida di sekitar sirip diasumsikan merata dan tetap 30°C.

Hasil penelitian terhadap sirip mengerucut berpenampang segi enam yang terdiri dari dua bahan ini adalah : (a) program komputasi dengan metode numerik selesai dibuat dan berhasil untuk menghitung distribusi suhu, laju perpindahan kalor, efisiensi, dan efektivitas sirip. (b) komposisi material sirip mempengaruhi difusivitas termal. Semakin besar nilai difusivitas termal suatu bahan, maka efisiensi dan efektivitas yang didapat pada sirip juga semakin besar. Komposisi Besi dengan Tembaga memiliki nilai distribusi suhu, laju perpindahan kalor, efisiensi, dan efektivitas sirip yang paling besar. (c) Semakin besar nilai koefisien perpindahan kalor konveksi h, maka nilai laju aliran kalornya semakin besar, namun nilai efisiensi dan efektivitasnya semakin rendah. Hal tersebut dapat dibuktikan pada detik ke-100 dengan komposisi bahan Besi-Alumunium ; suhu dasar, $T_b$ = 100°C, suhu awal, $T_i$ = 100°C ; suhu fluida di sekitas sirip; $T_\infty$ = 30°C untuk variasi koefisien perpindahan kalor konveksi 50 W/m$^2$°C, 100 W/m$^2$°C, 250 W/m$^2$°C, 500 W/m$^2$°C, 1000 W/m$^2$°C, menghasilkan laju aliran kalor berturut-turut sebesar 12,46 W; 20,46 W; 34,85 W; 50,53 W; 73,46 W dan nilai efisiensi sebesar 78,06%; 64,09%; 43,65%; 32,65%; 23,00% serta nilai efektivitasnya sebesar 13,70; 11,25; 7.66; 5,55; 4,03, (d) ukuran sirip yang divariasikan adalah ukuran sisi penampang dasar (sd). Variasi ukuran sirip mempengaruhi nilai laju perpindahan kalor, efisiensi, dan efektivitas pada sirip. Semakin besar ukuran sirip, maka nilai efisiensi dan efektivitas akan semakin besar, sedangkan nilai laju perpindahan kalor yang didapatkan semakin kecil.

Kata Kunci : efisiensi, efektivitas, metode beda hingga cara eksplisit, penampang segi enam, sirip

# *ABSTRACT*

The purpose of this research is (a) to make a program to calculate the distribution of temperature, heat transfer rate, efficiency, and effectiveness of a hexagon-crossed conical fin consisting of two materials under unsteady conditions. (b) to determine the effect of the fin material composition on temperature distribution, heat transfer rate, efficiency, and effectiveness of conical fins with a hexagon cross-section in unsteady conditions. (c) to know the efficiency and effectiveness value of a conical fin from two materials with a hexagon cross-section with variations in the value of the convection heat transfer coefficient *h* at an unsteady state, and (d) to know the effect of the base part size variations on temperature distribution, heat transfer rate, efficiency, and effectiveness of the conical fin with a hexagonal cross-section at unsteady conditions.

This research was carried out with numerical computation using the finite difference method in an explicit way. The research on variations was carried out on the materials that formed the fins, the value of the convection heat transfer coefficient, and the size of the base cross-section. The fins were assumed to have a density ($\rho$), a specific heat ($c$), and a thermal conductivity ($k$) which do not change as the temperature changes. The base fin temperature, $T_b$ = 100 $^oC$ was maintained constant over time. At $t$ = 0 $s$, the initial temperature of the fins is uniformly distributed at $T = T_i$ = 100 $^oC$, and the temperature of the fluid around the fins is assumed to be uniform and constant at 30 $^oC$.

The results of the research on conical fins with a hexagonal cross-section that formed by two materials are as follows. (a) A computational program with numerical method has been completed and successfully calculated the temperature distribution, heat transfer rate, efficiency, and effectiveness of the fins. (b) The composition of the fin material affects the thermal diffusivity. The greater the value of the thermal diffusivity of a material, the greater the efficiency and effectiveness of the fins. The composition of Iron with Copper has the greatest value of temperature distribution, heat transfer rate, efficiency, and effectiveness of the fins. (c) The higher the convection heat transfer coefficient of *h*, the heat flow rate also get higher, but lower the efficiency and effectiveness. This proved at the 100th second with the composition of Iron-Aluminum. The base temperature is $T_b$ = 100 $^oC$, with initial temperature $T_i$ = 100 $^oC$, with the temperature around the fins $T_\infty$ = 30$^o$ C, and for the variations of the convection heat transfer coefficient is 500 W/m$^2$ $^oC$, 100 W/m$^2$ $^oC$, 250 W/m$^2$ $^oC$, 500 W/m$^2$ $^oC$, 1000 W/m$^2$ $^oC$. These condition resulted the heat flow rates are respectively as follows; 12,46 W; 20,46 W; 34,85 W; 50,53 W; 73,46 W and with an efficiency value of 78,06%; 64,09%; 43,65%; 32,65%; 23,00% and effectiveness value of 13,70; 11,25; 7.66; 5,55; 4,03, (d) the size of the fin variations in the base section size cross-section (sd). Variations in fin size affect the value of heat transfer rate, efficiency, and effectiveness on the fins. The larger the fin size, the higher the heat flow rate and efficiency, while the lower the effectiveness value.


Keywords: efficiency, effectiveness, fins, hexagon cross-section, and explicit method finite difference