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Novel Algorithm for Conduction Heat Transfer in Cylinder Body

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Abstract

In this paper, new algorithm of conduction heat transfer without and with heat generation for cylinder is presents. Temperature and Conduction heat transfer Equations are essential in application in all Material, bodies or structure that has the same shape like the cylinder. For the cylinder without heat generation use sandstone material like cylindrical shape where assumed that it has, temperature value on the inside radius and on the outside radius, value of cross sectional area, value of thermal conductivity, Therefore, one can determine the temperature at any point with different radius to study and analysis any parameter along the radius of the limestone material and the quantity of heat transfer that transferred from the inside to the outside radius in the limestone material. For the cylinder with heat generation the limestone material in cylinder shape assuming the radius is present with the temperature value on the inside and outside. Additionally, the value of cross sectional area, thermal conductivity and value of heat generation, is considering. Results shows that the heat transfer equation in the limestone give better performance and accurate calculation compared with conventional equations.

Introduction

Heat is thermal energy that is in transit. The idea of heat moves (transfers) and that heat moves from warmer matter to cooler matter [7]. But how exactly is heat transferred from warmer matter to cooler matter, conduction is one way that heat moves from one substance to another [6]. Have you ever grabbed the handle of a hot metal pan or walked barefoot across asphalt on a scorching summer day, why do these objects feel hot to you [5]. In both of these situations, heat is transferred to your body because it is direct contact with matter that is at a higher temperature [4]. You are at a lower temperature than the hot matter so heat moves from the hot matter to your cooler hand or foot. This form of heat transfer is called conduction [3]. Conduction is the transfer of thermal energy between matters that is in direct contact. Some materials conduct heat better than others [2].Why, when a metal pan is first placed on a stove and the stove is turned on for a few moments, a person can touch the pan without feeling any discomfort [1]. But as the metal pan heats up, energy moves from the stove burner to the bottom of the pan, then form the bottom of the pan to the metal sides of the pan, and eventually moves up to the handle of the pan [8]. Why does this happen energy from the stove burner causes the particles (atoms) making up the pan to move more rapidly. In some materials such as metals which are good conductors of heat, the rapidly moving particles readily cause neighboring particles in the same object to move faster. In turn, these particles cause their neighboring particles to move faster and so on up through the pan [9]. So that, causing a rise in temperature. This explains the experience of discomfort when touching the handle even through your hand is not directly touching the stove burner conduction transferred heat to all parts of the pan making the handle hot. Conduction happens through the successive collisions of molecules. Different materials conduct heat differently depending on the way their particles are arranged [10]. The closer the molecules are arranged, the more rapid the transfer. Both solids and liquids can transfer heat by conduction. The sample of sandstone and limestone used in this research is illustrated in Figure 1and Figure 2 respectively.

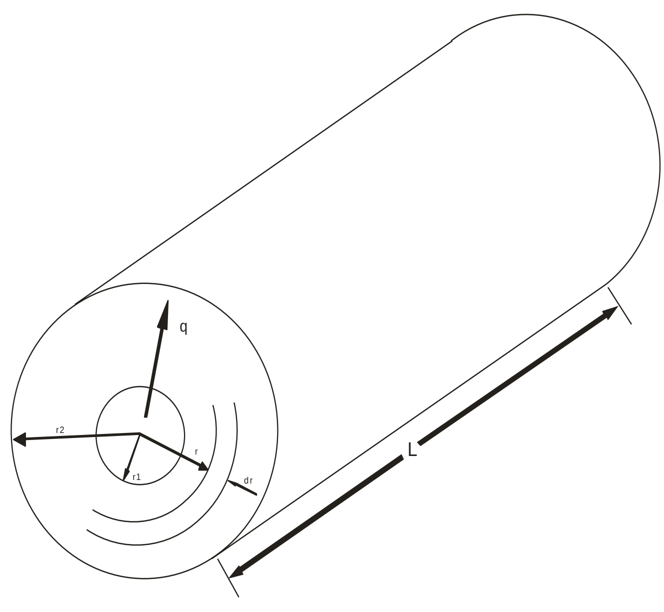

Figure 1. One-dimensional heat flow through a hollow cylinder.

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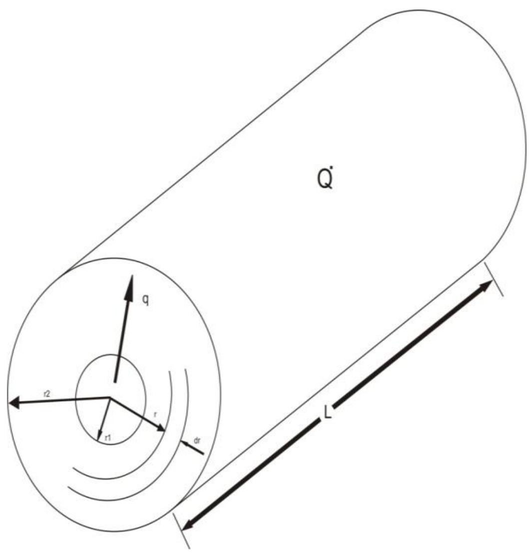

Figure 2. One-dimensional heat flow through cylinder with heat generation.

Mathematics Background

The Well-Posed Problem:

Before we go further with heat conduction problems, we must describe how to state such problems so they can really be solved [11]. This is particularly important in approaching the more complicated problems of transient and multidimensional heat conduction that we have avoided up to now. A well-posed heat conduction problem is one in which all the relevant information needed to obtain a unique solution is stated. A well-poised and hence solvable heat conduction problem will always read T(x, y, z, t) such that [12].

$$\Delta(k\Delta T) + q = (\rho c)(\partial T / \partial t) \quad (1)$$

For 0< t < Γ (where Γ can to infinity) and for (x, y, z) belonging to some region, R, which might extend to infinity [13].

$$T = Ti(x, y, z) \text{ at t = 0} \quad (2)$$

This is called an initial condition, i.e.

(a) Condition 1 above is not imposed at t = 0.
(b) Only one will require.

In the steady- state case: Δ. (kΔT) + q = 0. For periodic heat transfer, where q or the boundary conditions vary periodically with time, and where we ignore the starting transient behavior [14-15]. T must also satisfy two boundary conditions, or boundary conditions (bc), for each coordinate. The b.c. is very often of two common types.

(a) Dirichlet conditions or b.c.s of the first kind [16].
T is specified on the boundary of R for t > 0.
(b) Neumann conditions, or b.c.s of the second kind

The derivative of T normal to the boundary is specified on the boundary of R for t > 0. Such a condition a rises when the heat flux, k (əT/əx), and equal to zero [17].

The general solution

Once the heat conduction problem has been posed properly, the first step in solving it is to find the general solution of the heat diffusion equation [18]. This is usually can be remarked as an easiest part of the problem. We have considered some examples of general solution.

One-Dimensional Steady Heat Conduction

Problem 1 emphasizes the simplicity of finding the general solutions of linear ordinary differential equations [19-20]. By asking for a table of all general solutions of one-dimensional heat conduction problems [21].We shall work out some of those results to show what is involved. We begin the heat diffusion Equation with constant k and q [22].

$$\Delta^2 T + (q / k) = (1/\alpha)(\partial T / \partial t) \quad (3)$$

Cartesian coordinates: steady conduction in their direction. Equation (3) reduces as follows: [23]

$$(\partial^2 T / \partial x^2) + (\partial^2 T / \partial y^2) + (\partial^2 T / \partial z^2) + (q / k) = (1/\alpha)(\partial T / \partial t)$$
(4)

$$X = r\cos\theta \quad y = r\sin\theta \quad (5)$$

Cylindrical coordinates with a heat source: Tangential conduction. This time, we look at the heat flow that results in a cylinder when the inside and outside radius are held at different temperatures [24]. We now express eqn. (3) in cylindrical coordinates with the help of Equation 5.

$$(1/r)(\partial/\partial r)[(r)(\partial T/\partial r)] + [(1/r^2)(\partial^2 T/\partial \Phi^2)] + [\partial^2 T/\partial z^2] + (q/k) = (1/\alpha)(\partial T/\partial t)$$
(6)

Proposed Algorithms

From the theory mentioned above one could be determined the temperature and conduction heat transfer equations without and with heat generation for cylinder. The proposed equations derivation steps are discussed in details as showing below. The conduction heat transfer equation is given by [8] as:

$$q=-KA\ (\partial T/\partial r) \quad (7)$$

For one dimension heat transfer equation, the general three dimension heat transfer conduction equation could be proven as follow:

$$(\partial^2 t/\partial r^2) = (1/\alpha)\ (\partial t/\partial \tau) \quad (8)$$

$$\partial t/\partial \tau=\alpha\ [(\partial^2 t/\partial r^2) + (1/r)\ (\partial/\partial r)\ (r)\ (\partial t/\partial r) + (1/r^2)\ (\partial^2 t/\theta^2) + (\partial^2 t/\partial \theta^2) + (\partial^2 t/\partial z^2)] \quad (9)$$

Consequently, the general three dimension heat transfer conduction equation with heat generation is

$$\partial t/\partial \tau=\alpha\ [(\partial^2 t/\partial r^2) + (1/r)\ (\partial t/\partial r) + (1/r^2)\ (\partial^2 t/\theta^2) + (\partial^2 t/\partial z^2)] + (Q/\rho c) \quad (10)$$

Derivation Results

For the case of the generation without heating, the obtained results are:

$$\partial t/\partial \tau=\alpha[(\partial^2 t/\partial r^2)+(1/r)(\partial/\partial r)(r)(\partial t/\partial r) +(1/r^2)(\partial^2 t/\theta^2)+(\partial^2 t/\partial z^2)] \quad (11)$$

Assume for steady state $\partial T/\partial \tau=0$, therefore, in one dimensional the change of temperature is: $\partial^2 t/\partial \theta^2=0$, $\partial^2 t/\partial z^2=0$ Then, the first and second integration could be formulated as in equation 10 and 11 respectively as:

$$(\partial t/\partial r)=A/r \quad (12)$$

$$t=ALnr+B \quad (13)$$

Substations the Boundary condition of $r = r_1$, $t = t_1$, $r = r_2$ and $t = t_2$ in Equation 13 which are given by:

$$t_1=ALnr_1 + B \quad (14)$$

$$t_2=ALnr_2 +B \quad (15)$$

$$t_1- t_2 =ALn_1 – Alnr_2$$

$$t_1-t_2=A\ (Lnr_1- Lnr_2)$$

$$A= [(t_1-t_2)/ (Lnr_1- Lnr_2)] \quad (16)$$

Once, subsisting the variable A in equation 14 resulting:

$$t_1= [(t_1-t_2)/ (Lnr_1- Lnr_2)]\ [Lnr_1] + B \quad (17)$$

$$B=t_1- [(t_1-t_2)/ (Lnr_1-Lnr_2)]\ [Lnr] \quad (18)$$

The temperature (T) in equation 19 could be represented by mean of equation 13 and 15 as:

$$t= [(t_1-t_2)/ (Lnr_1-Lnr_2)]\ Lnr + t_1-[(t_1-t_2)/ (Lnr_1-Lnr_2)]\ Lnr_1$$

$$t= [(t_1-t_2)/ (Lnr_1-Lnr_2)][Lnr-Lnr_1] +t_1 \quad (19)$$

Where, K is thermal conductivity constant, A is a cross sectional area which is equal to2*3.14rL. As a result, the quantity of heat transfer is:

$$q=-KA(\partial t/\partial r) \quad (20)$$

$$q=-3.14K_2 rL(\partial t/\partial r) \quad (21)$$

$$q=-3.14K_2 rL[(t_1-t_2)/(Lnr_1-Lnr_2)] \quad (22)$$

Once, for the case of the generation with heating, the obtained partial temperature with partial time becomes:

$$\partial t/\partial \tau=\alpha\ [(\partial^2 t/\partial r^2) + (1/r)\ (\partial t/\partial r) + (1/r^2)\ (\partial^2 t/\theta^2) + (\partial^2 t/\partial z^2)] + (Q/\rho c) \quad (23)$$

Assume for steady state $\partial T/\partial \tau = 0$, therefore, in One dimensional the change of temperature

$$\partial^2 t/\partial \theta^2=0,\ \partial^2 t/\partial z^2=0 \quad (24)$$

Then, the first and second integration could be formulated as in equations 23 and 24 respectively as:

$$\alpha\ (\partial^2 t/\partial r^2) + (Q/\rho c) =0$$

$$\alpha\ (\partial^2 t/\partial r^2) = - (Q/\rho c)$$

$$\partial t/\partial r=-(1/\alpha)(Q/\rho c)(r)+A \quad (25)$$

$$t/r= - (1/\alpha)\ (Q/\rho c)\ (r^2/2) +Ar+B$$

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$$t = -(1/\alpha)(Q/\rho c)(r^3/2) + Ar^2 + Br \quad (26)$$

Substations the boundary condition of $r = r_1$, $t = t_1$, $r = r_2$ and $t = t_2$ in Equation (26) given:

$$t_1 = -(1/\alpha)(Q/\rho c)(r_1^3/2) + Ar_1^2 + Br_1 \quad (27)$$

$$t_2 = -(1/\alpha)(Q/\rho c)(r_2^3/2) + Ar_2^2 + Br_2 \quad (28)$$

$$A = \{(t_1 + (1/\alpha)(Q/\rho c)(r_1^3/2) + Br_1\} / r_1^2 \quad (29)$$

By substitute A in equation 27 resulting

t_1=- (1/α) (Q/ρc) (r^3_1/2) + [{t_1+ (1/α) (Q/ρc) (r^3_1/2) +Br_1}/r^2_1] r^2_1 + Br_1

Where B is given by

$$B = [(t_2 - \{(-(1/\alpha)(Q/\rho c)\}\{(r_2^3/2) - (\alpha r_1 r_2)/2\} + (t_1 r_2^2/r_1^2)]/[(r_2^2 + r_1 r_2)/r_1] \quad (30)$$

Then, by substituting equation 29&30 in equation 18 given

t=- (1/α)(Q/ρc) (r³/2) +[{{t_1+ (1/α)(Q/ρc) (r^3_1/2)} + t_2-{(-1/α) (Q/ρc)} {(r^3_2/2)-(αr_1r_2)/2} + ($t_1r^2_2/r^2_1$)/ {(r^2_2+r_1r_2)/r_1}}/(r^2_1)] r² + [{t_2-{(-1/α) (Q/ρc)} {(r^3_2/2)-(αr1r2)/2} + ($t_1r^2_2/r^2_1$)}/ {(r^2_2+r_1r_2)/r_1}] [r] (31)

Ət/ər= - (1/α) (Q/ρc) (r) + [{t_1+ (1/α) (Q/ρc) (r^3_1/2)} + t_2-{(-1/α) (Q/ρc)} {(r^3_2/2)-(αr_1r_2)/2} + ($t_1r^2_2/r^2_1$)/ {(r^2_2+r_1r_2)/r_1}]/ [r^2_1]

q=-K_2*3.14L [- (1/α) (Q/ρc) (r) + [{t_1+ (1/α) (Q/ρc) (r^3_1/2)} + t_2-{(-1/α) (Q/ρc)} {(r^3_2/2)-(αr_1r_2)/2} + ($t_1r^2_2/r^2_1$)/ {(r^2_2+r_1r_2)/r_1}]/ [r^2_1]]

Applications: Sandstone without Heat Generation

For cylinder of sandstone without heat generation assuming, K= 1.83 w.m/m².ċ, t_1= 10 ċ, t_2= 20 ċ, r=0.4 m, r_1= 0.25 m, r_2= 0.5 m and L= 1 m

Then, the temperature is equal to:

t= [(t_1-t_2)/ (Lnr_1-Lnr_2)][Lnr-Lnr_1] +t_1

= [(10-20)/ (0.25Ln-0.5Ln)][0.4Ln-0.25Ln]+10

= 24.96ċ

Subsequently, the variation of temperature compared with the cylinder radius is:

(Ət/ər)= (t_1-t_2)/ (r_2-r_1) = (10-20)/ (0.5-0.25) =-40 ċ/m

And the amount of heat transfer value is

q=-K_2*3.14rL [(t_1-t_2)/ (Lnr_1-Lnr_2)]

= - 1.83* 2*3.14*1[(10-20)/ (0.25Ln-0.5Ln)]

= -120.94 w

Limestone with Heat Generation

For cylinder of limestone with heat generation assuming, Q = 20 w/s, K = 1.3 w.m/m².ċ, t_1 = 15ċ, t_2 = 25ċ, r = 0.4 m, r_1 = 0.3 m, r_2 = 0.6m, and L = 3 m, ρ = 2500 kg/m³, c = 0.19 w/m²cº, α = 0.0027m^4/kg, then, the temperature could be calculated as below,

t=- (1/α)(Q/ρc) (r³/2) +[{{t_1+ (1/α)(Q/ρc) (r^3_1/2)} + t_2-{(-1/α) (Q/ρc)} {(r^3_2/2)-(αr_1r_2)/2} + ($t_1r^2_2/r^2_1$)/ {(r^2_2+r_1r_2)/r_1}}/(r^2_1)] r² + [{t_2-{(-1/α) (Q/ρc)} {(r^3_2/2)-(αr_1r_2)/2} + ($t_1r^2_2/r^2_1$)}/ {(r^2_2+r_1r_2)/r_1}] [r]

t=(1/0.00052/0.0027)(20/2500*0.1/0.00025/0.0027)(20/2500*0.0027)}{(0.4³/2)[{(0.00025/0.0027)(0.3*0.6)}/2]+(15*0.6²/0.3²)/{(0.6²+ 0.3*0.6)/0.3}}/(0.3)]*0.4²+[{25-{1/0.00052/0.0027)(20/2500*0.0027)}{(0.6³/2){(0.00052/0.0027)(0.3*0.6)}/2}+(15*0.6²/0.3²)}/{0.6²+(0.3*0.6)}/0.3][0.4]
= (38.4799/0.0027)+157.9769
=14409.7917 cº

Consequently, the variation of temperature compared with the cylinder radius is:

(ƏT/ər)=- (1/α) (Q/ρc) (r) + [{t_1+ (1/α) (Q/ρc) (r^3_1/2)} + t_2-{(-1/α) (Q/ρc)} {(r^3_2/2)-(αr_1r_2)/2} + ($t_1r^2_2$/r²1)/ {(r²2+r1r2)/r1}]/ [r²1]
=-(1/1.3/2500*0.19) (20/2500*0.19) (0.4) + [{15 + (1/1.3/2500*0.19) (20/2500*0.19) (0.3³/2)} + 25-{(-1/1.3/2500*0.19) (20/2500*0.19)} {(0.6³/2)-(1.3/2500*0.19*0.3*0.6)/2}+ (15*0.6²/0.3²)/ {(0.6²+0.3*0.6)/0.3}]/[0.3²]
= 32470.4-(0.047/0.19)
= 32470.1526w

And the amount of heat transfer value is

q= -KA (əT/ər) =-K_2*3.14L [- (1/α)(Q/ρc) (r) + [{t_1+ (1/α)(Q/ρc) (r^3_1/2)} + t_2-{(-1/α) (Q/ρc)} {(r^3_2/2)-(αr_1r_2)/2} + ($t_1r^2_2$/r²1)/ {(r^2_2+r_1r_2)/r_1}]/ [r^2_1]]

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=-1.3*2*3.14*0.4*1.5* [-(1/1.3/2500*0.19) (20/2500*0.19) (0.4) + [{15 + (1/1.3/2500*0.19) (20/2500*0.19) (0.3³/2)} + 25-{(-1/1.3/2500*0.19) (20/2500*0.19)} {(0.6³/2)-(1.3/2500*0.19*0.3*0.6)/2}+ (15*0.6²/0.3²)/ {(0.6²+0.3*0.6)/0.3}]/[0.3²]
= 2805.05-(0.206/0.19)
= 2803.9657w

Results and Discussion

The conduction heat transfer Equation depends on the value of thermal conductivity, cross sectional area, the length of radius, the length of the cylinder, the temperature on the inner radius and on the temperature, on the outer radius and the length of the inner and outer radius as illustrated in Figure3. The shape of the mathematically Equation, where it is the relation between the radius of the cylinder and temperature, where done selecting differences radiuses along the inner and outer radiuses of the cylinder, where it is, r = 0.25 m, r = 0.3 m, r =0.35 m, r = 0.4 m, r = 0.45 m and then obtained a values of temperature according to the radius and it is, t = 10^o c, t=12.6^o c, t = 14.78^o c, t = 16.95^o c, t = 18.54^o c, by subsisting in the equation that mentioned before, assuming that the temperature of the inner and the outer radius for the cylinder it is equal to $t_2 = 20^o$ c, $t_1 = 10^o$ c and it's a constant and assuming that the distance between the inner and outer radius for the cylinder is equal to (0.25 m) and the distance of the inner and outer radius of the cylinder its equal to r_1 = 0.25 m, r_2 = 0.5 m, respectively. One could note that the relation between the differences radiuses and the temperature that obtained as a result to the differences of the radiuses for the cylinder it's a logarithm relation. The relation between radiuses and temperature were plotted as illustrated in Figure 3. The increasing in values of the radiuses leads to increasing in temperature, the heat transfer is from the left direction to the right direction, and this is the better direction because the temperature of the outer radius is bigger than the inner radius of the cylinder.

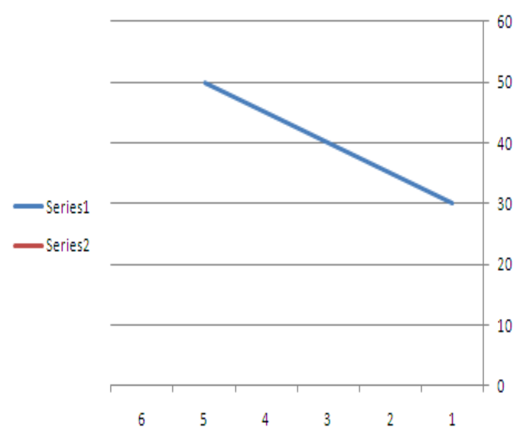

Figure 3. The relation between the radius and the temperature.

The relation between the temperature of the inner radius and the quantity of heat transfer for the cylinder, where done a selecting a differences of radiuses for the cylinder, where it is, r = 0.25 m, r = 0.3 m, r = 0.35 m, r =0.4 m, r = 0.45 m, and then obtained values of quantity of heat transfer according to the differences values of radiuses for the cylinder and respectively and it is, q = 13.78 w, q = 16.54 w, q = 19.3 w, q = 22.06 w, q = 24.81 w, by subsisting in the equation that mentioned before, where done assuming that the thermal conductivity factor is equal to k = 1.53w/mc and it is a constant value, and done assuming that the length of the cylinder is equal to L = 1m and done assuming that the value of the distance of the inner and the outer radius for the cylinder is equal to r_1 = (0.25 m), r_2 = (0.5 m) and respectively and done an assuming that the temperature of the inner and outer radius of the cylinder it is $t_1 = 10^o$ c, $t_2 = 20^o$ c and respectively and it is a constant and from the figure 4 note that the relation between the differences of the radiuses for the cylinder and the quantity of heat transfer it is a logarithmic relation.

To show the effect of increasing the values of radiuses of the cylinder leads to increasing in quantity of heat transfer, this relation is plotted as shown in Figure 4. The heat transfer is from the left to the right direction and this direction it is the better direction because the temperature of the outer radius is larger than the inner radius of the cylinder.

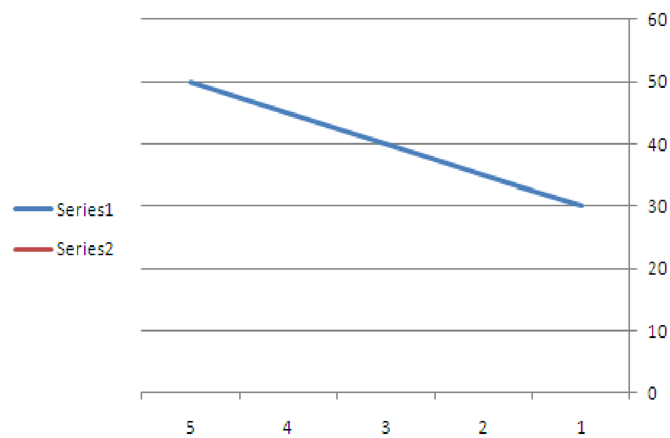

Figure 4. The relation between the radius and the quantity of heat transfer.

Consequently, the increasing in values of temperature of the inner radius of the cylinder, that leads to increasing in quantity of heat transfer, the direction of heat transfer being from the right to the left direction and that it's the not better direction, because of the inner radius temperature is less than the outer radius temperature of the cylinder as show in Figure 5. According to figure 5 that explain below, represent the shape of the mathematically equation, where it is the relation between the temperature of the inner radius and the quantity of heat transfer for the cylinder, where done a selecting a differences of temperature for the inner radius for the cylinder, where it is, $t_1 = 10^o$ c, $t_1 = 12^o$ c, $t_1 = 14^o$ c, $t_1 = 16^o$ c, $t_1 = 18^o$ c, and then obtained values of quantity of heat transfer according to the differences values of temperature of the inner radius 0f the cylinder and respectively and it is, q = -66.52 w, q = -53.21 w, q = -39.91 w, q = -26.61 w, q = -13.3 w, by subsisting in the Equation that mentioned before, where done assuming that the thermal conductivity factor is equal to k = 1.83 w/mc and it is a constant value, and done assuming that the length of the cylinder is equal to L = 1m and done assuming that the value of the radius of the cylinder is equal to (0.3m)and the radius of the inner and the outer for the cylinder is equal to $r_1 = 0.25$ m, $r_2 = 0.5$ m and respectively and done an assuming that the temperature of the outer radius of the cylinder it is $t_2 = 20^o$ c and it is a constant and from the Figure 5 note that the relation between the differences of the temperature for the inner radius of the cylinder and the quantity of heat transfer it is a logarithmic relation.

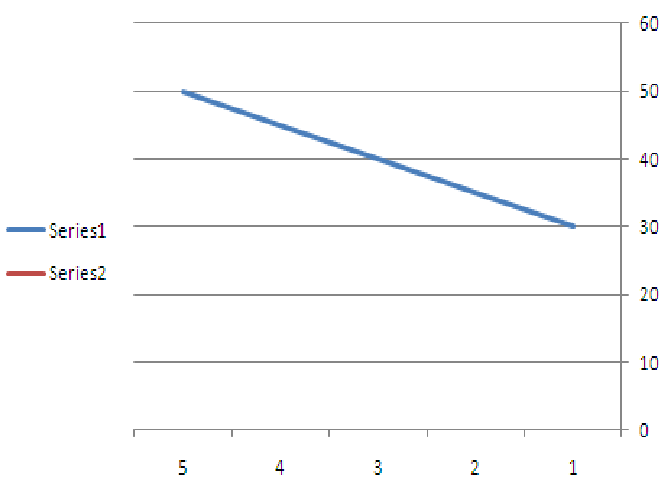

Figure 5. The relation between the inner radius temperature and the quantity of heat transfer.

In the same time, the increasing of values of the outer radius leads to decreasing in the quantity of heat transfer, the heat transfer being from the outer radius to the inner radius direction for all values of the temperature of the outer radius the and that it is the not better because the outer radius temperature is bigger than the inner radius temperature as highlight in Figure 6. However, the increasing of values of the inner radius temperature leads to increasing in quantity of heat transfer, the direction of heat transfer is from the outer radius to the inner radius and this is the not better as clear in Figure 5. According to figure 6, that explains as above, represent the shape of the mathematically equation, where it is the relation between the outer radius temperature of the cylinder and the quantity of heat transfer , where done selecting differences of the outer radius temperature of the cylinder, where it is, $t_2=10^o$ c, $t_2 = 12^o$ c, $t_2 = 14^o$ c, $t_2 = 16^o$ c, $t_2 = 18^o$ c and then obtained a values of quantity of heat transfer according to the outer radius temperature and it is, q = 0 w, q = -13.31 w, q = -26.61 w, q = -39.91 w, q = -53.21 w, by subsisting in the Equation that mentioned before, assuming that the temperature of the inner radius for the cylinder it is equal to $t_1 = 10^o$ c, and its a constant and assuming that the radius for the cylinder is equal to 0.4 m and the radius of the inner and outer of the cylinder its equal to $r_1 = 0.25$ m, $r_2 = 0.5$ m, respectively and assuming that the thermal conductivity factor and length of the cylinder it is equal to k = 1.83 w/mc, L = 1 m and respectively, from Figure3 noting that the relation between the differences radiuses and the temperature that obtained as a result to the differences of the radiuses for the cylinder it's logarithmic relation.

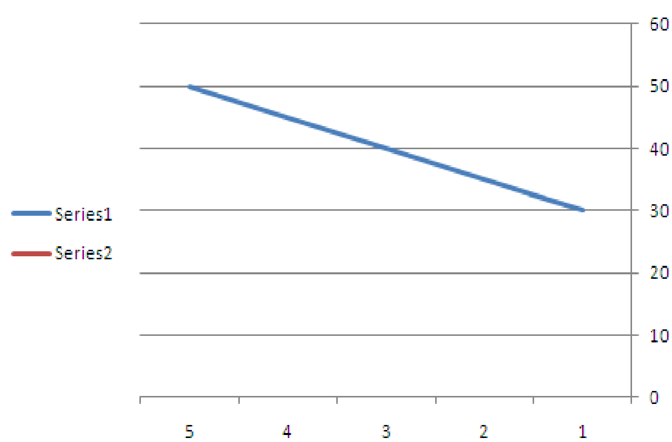

Figure 6. The relation between the outer radius temperature and the quantity of heat transfer.

According to Figure 7, that explains as below, represent the shape of the mathematically Equation, where it is the relation between the radius of the cylinder and the temperature, where done selecting a differences radiuses along the inner and outer radius of the cylinder, where it is, r = o.35 m, r = o.4 m, r = o.45 m, r = 0.5 m, r = 0.6 m, and then obtained a values of temperature according to the radius and it is, $t = 10.7661^o$ c, $t = 36.6694^o$ c, $t = 44.6412^o$ c, $t = 48.1037^o$ c, $t = 65.3888^o$ c, by subsisting in the Equation that mentioned before, assuming that the temperature of the inner and the outer radius for the cylinder it is equal to t1=15c, t2=25c and its a constant and assuming that the inner and outer radius of the cylinder its equal to r1=0.3m, r2=0.6m, respectively, assuming that the density and thermal conductivity and the quantity of heat generation of the cylinder it is equal to, $\rho = 2500\ kg/m^3$, k = 1.3 w/m.c, Q = 20 w and respectively, from Figure7 noting that the relation between the differences radiuses and the temperature quantity that obtained as a result to the differences of the radiuses for the cylinder it's a third degree curve relation.

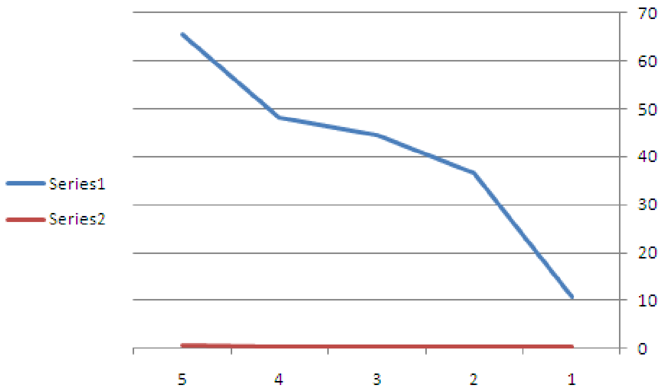

Figure 7. The relation between the radiuses and the temperature with heat generation.

According to Figure 8, that explains as below, represent the shape of the mathematically Equation, where it is the relation between the radiuses of the cylinder and the quantity of heat transfer, where done selecting a differences radiuses along the inner and outer radius of the cylinder, where it is, r=o.35m, r=o.4m, r=o.45m, r=0.5m, r=0.6m, and then obtained a values of quantity of heat transfer according to the radius and it is, q=-9492.98w, q=-9386.89w, q=-9280.81w, q=-9174.73w, q=-8962.57w, by subsisting in the Equation that mentioned before, assuming that the temperature of the inner and the outer radius for the cylinder it is equal to t1=15c, t2=25c and its a constant and assuming that the inner and outer radius of the cylinder its equal to r1=0.3m, r2=0.6m, respectively, assuming that the density and thermal conductivity and the quantity of heat generation of the cylinder it is equal to, $\rho=2500kg/m^3$, k=1.3w/m.c, Q=20w and respectively, from Figure8 noting that the relation between the differences radiuses and the heat transfer quantity that obtained as a result to the differences of the radiuses for the cylinder it's a third degree curve relation.

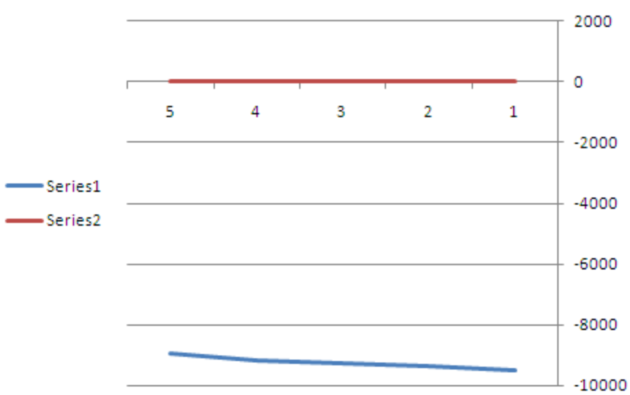

Figure 8. the relation between the radiuses and the heat transfer quantity with heat generation.

Figure 9 and Figure 10 shows the effect of changing the temperature of the heat transfer. Here one could explain the increasing in values of temperature for the inner radius of the cylinder, leads to decreasing in the quantity of heat transfer, the heat transfer direction is from the right to the left and this is the not better direction and it must changing in values of temperature of the outer radius of the cylinder to be the direction from the left to the right direction and that is the better. According to Figure 9 that explain below, represent the shape of the mathematically equation, where it is the relation between the temperature of the inner radius and the quantity of heat transfer for the cylinder, where done a selecting a differences of temperature for the inner radius for the cylinder, where it is, t1=20c, t1=25c, t1=30c, t1=35c, t1=40c, and then obtained values of quantity of heat transfer according to the differences values of temperature of the inner radius for the cylinder and respectively and it is, q=-12351.35w, q=-14534.53w, q=-16812.09w, q=-18927.9w, q=-21120.08w, by subsisting in the Equation that mentioned before, where done assuming that the thermal conductivity factor is equal to k=1.3w/mc and it is a constant value, and done assuming that the length of the cylinder is equal to L=(1.5m) and done assuming that the value of the radius of the cylinder is equal to (0.4m)and the distance of the inner and the outer radius for the cylinder is equal to r1=(0.3m), r2=(0.6m) and respectively and done an assuming that the temperature of the outer radius of the cylinder it is t2=25c and it is a constant, assuming that the quantity of heat generation it is equal to q=20w and from the figure8 note that the relation between the differences of the temperature of the inner radius of the cylinder and the quantity of heat transfer it is a straight line relation. According to Figure 10 that explain below, represent the shape of the mathematically Equation, where it is the relation between the temperature of the outer radius and the quantity of heat transfer for the cylinder, where done a selecting a differences of temperature for the outer radius for the cylinder, where it is, t2=30c, t1=35c, t1=40c, t1=45c, t1=50c, and then obtained values of quantity of heat transfer according to the differences values of temperature of the outer radius for the cylinder and respectively and it is, q=-12351.35w, q=-13031.68w, q=-13712.01w, q=-14392.35w, q=-15072.68w, by subsisting in the Equation that mentioned before, where done assuming that the thermal conductivity factor is equal to k=1.3w/mc and it is a constant value, and done assuming that the length of the cylinder is equal to L=(1.5m) and done assuming that the value of the radius of the cylinder is equal to (0.4m)and the distance of the inner and the outer radius for the cylinder is equal to r1=(0.3m), r2=(0.6m) and respectively and done an assuming that the temperature of the inner radius of the cylinder it is t1=15c and it is a constant, assuming that the quantity of heat generation it is equal to q=20w and from the figure 10 note that the relation between the differences of the temperature of the outer radius of the cylinder and the quantity of heat transfer it is a straight line relation.

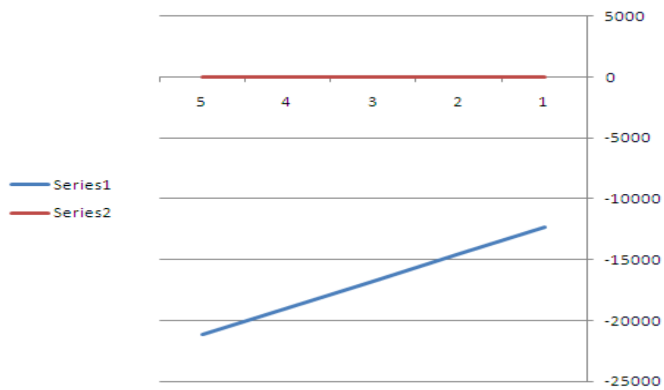

Figure 9. The relation between the inner radius temperature and the heat transfer quantity with heat generation.

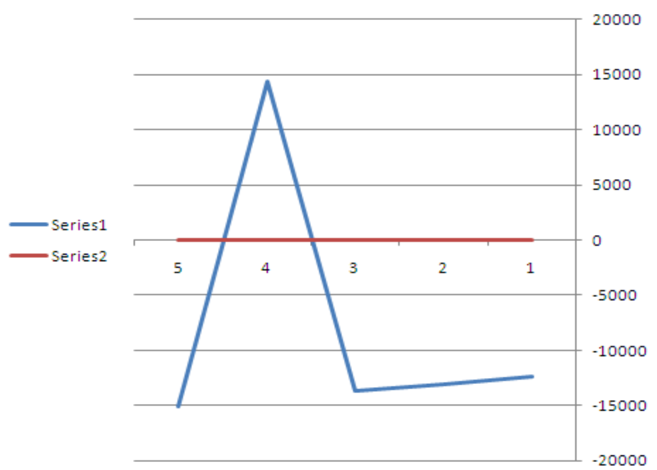

Figure 10. The relation between the outer radius temperature and the heat transfer quantity with heat generation.

Conclusion

In this research, the Equations of temperature heat transfer with different radius for cylinder have been developed and a novel Equation is presented. The new formula will support and help all researchers in this topic to get any temperature directly by using the proposed Equation without more derivation. By using the proposed Equation, the complexity and time will decrease with and without heat generation by approximately 80% compared with current procedures. Consequently, this novelty could be support the current and future research in the field of heat transfer.

References

[1] Y.C Shih, "Heat Transfer" NTUT,2013.
[2] H. S Carslow; J.C Jeager "Conduction Of Heat In Solids", Oxford University, 1946.
[3] E. R.G. Eckert; R.M. Drake, Jr. "Analysis Of Heat & Mass Transfer", Mc Graw-Hill Book Company,New York, 1972.
[4] Y. S. Touloukian, "Thermophysical Properties Of Matter", Purdue University Journal Vol. 1-6; 10, 1970 to 1975.
[5] C. Y. Ho Powell; P.E. Liley, "Thermal Conductivity Of Elements", J. Phys. Chem.,1974.
[6] P. J. Mohr; B.N Taylor, "Recommended Values Of The Fundamental Physical Constants, J. Mod. Phys; Vol 77 No 1-107, 2005.
[7] P. E. Glaser; I.a Black; P. Doherty, "Multilayer Insulation", Mech. Eng. August, P.23, 1965.
[8] R. Barron. "Cryogenic System", McGrew-Hill Book Company, New York, 1967.
[9] W. D. Dewitt; N.C Gibbon; R.l. Reid. "Multifold Type Thermal Insulation", Aerospace Electron Syst. Vol 4 No. 5 Pp 263-271, 1968.
[10] R. G. Eckerte; M. Robert. " Analysis Of Heat & Mass Transfer", Mc. Graw Hill Book Company P 1-19, 1972.
[11] P. j. Chneider; "Conduction Heat Transfer" Addison. Wesley Company, 1955.
[12] B. H. Jennings, "Environmental Engineering Analysis & Practice", International Text Book co., 1970.
[13] W. B. Harper; D.R. Brown, "Mathematical Equations For Heat Conduction In The Fins Of Air-Cooled Engines",NACA Report 158, 1922.
[14] K. A. Gardner, "Efficiency Of Extended Surfaces", Trans. Asme, Vol. 67, PP621-631, 1945.
[15] C. J. Moore, "Heat Across Surfaces In Contact Studies Of Transients In One Dimensional Composite Systems", Southern Methodist University, Journal Vol. 67 N0.2,1967.
[16] L. J; J.E. Sunderland, "Heat From Extended Surfaces", Bulletin. Mechanical Engineering Education. Vol 5, PP. 229-234, 1966.
[17] C. J. Moore; H.A. Blum; H Atkins, "Subject Classification Bibliography for Thermal contact Resictance Studies", ASME Paper 68. WA/HT, 18 December 1968.
[18] A. M. Clausing, "Transfer At Interface Of Dissimilar Metals", International Jourunal Of Heat Transfer, Vol. 9 P.791, 1966.
[19] D. Q. Kern; A.D. Kraus, "Extended Surface Heat Transfer", McGraw-Hill Book Company NewYork, 1972.
[20] R. Sigel; J.R. Howell, "Thermal radiation Heat Transfer 2nd ed, McGraw Hill Book Company New York, 1972.
[21] E. Fried, "Thermal Conductivity", R.P. Tye ed; Vol.2, Academic Press Incorporation New York, 1969.

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[22] I. S. Fletcher, "Recent Developments In Contact Conductionce Heat Transfer", J. Heat Transfer, Vol.110,No.4(B), P.1059, Nov.,1988.

Biography

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