Analysis over the Techniques to Improve the Heat Transfer Rate by Radiation

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Abstract— Generally we have seen that the radiated heat is not transferred properly from one place to another place. Means a large percentage of radiated heat is wasted suddenly. This heat not only reduces the working efficiency of any thermodynamic device but also increases the global warming which is very serious problem. Now here it is required to search such type technique which is helpful to reduce the wastage of heat radiation. Generally the radiated heat is distributed in three parts as heat reflected, heat transmitted and heat absolved. So it is clear that the heat is transmitted perfectly about to 100 % if the parts heat absolved and heat reflected are negligible or zero. In other words we can say that we will have to search such type techniques which may provide the sufficient resistance against the heat reflected and heat absolved. Here it is clear that a closed cell will be required under which the heat generation, heat reflection and heat transmission related activities will be performed. Means a isolated cell will be required in which these activities will be performed.

Keywords: Maximum Radiated Heat Transferred

I. INTRODUCTION

It is very difficult to capture the radiated heat and to transfer it fully from one place to another place. A large amount of radiated heat is destroyed in the atmosphere. If this heat is utilized by any heat absorbing unit then the wastage of heat may be minimized till a big limit. This heat may be utilized to heat the water, to preheat the air, to preheat any metal etc.To avoid the wastage of radiated heat special type ceramic cells are used in which the heat transfer phenomenon is occurred.

A. Methodology or Literature Survey Related To Heat Isolation –

Methodology related to the heat isolation by using ceramic cell – According fig(A) a ceramic cell is good option to perform the heat transfer related activities without loss of heat. For example the Aluminum oxides of ceramic, zirconia, silicon nitride and silicon carbides etc are the good insulators for the heat transfer from one place to another.

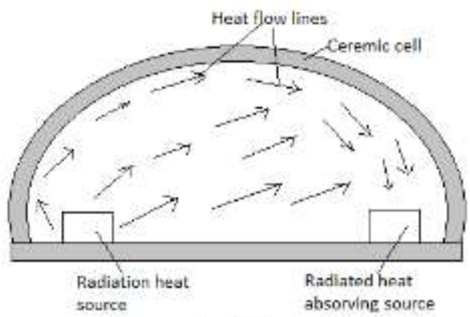

Fig.(A)

The ceramic cells may be used as good insulators for both the heat transfer by radiation and heat transfer by convection.

B. Methodology Related To the Heat Isolation by Using Cotton Cover-

According fig.(B) the heat may be transferred perfectly from one place to another place without any loss if a cotton cover is provided over the whole working system.

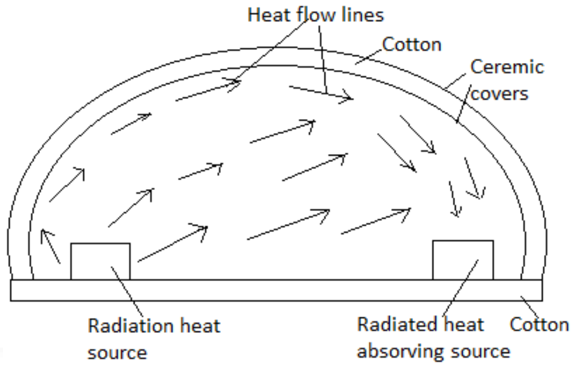

Fig.(B)

Here the thin ceramic covers are also used to capture the cotton and for isolation.

1) Methodology Related To the Heat Isolation by Using Heat Reflection –

According fig.(C) the heat may also be transferred perfectly from one place to another place without any loss if heat transfer phenomenon is occurred in a closed ceramic cell whose inner surface is highly polished in such a way that it may reflect the all heat flowing lines towards the centre.

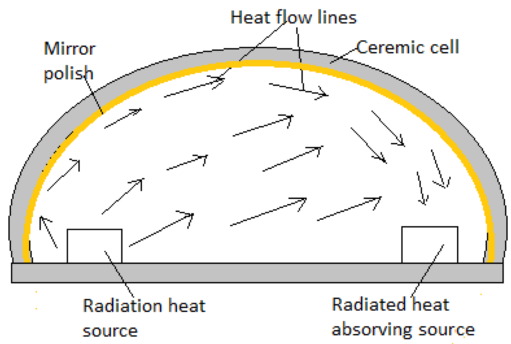

Fig.(C)

Further the heat collected at centre of the cell is absorbed by the source.

C. Methodology Related To the Heat Isolation by Using Pressure Difference –

According fig.(D) the heat may also be transferred perfectly from one place to another place without any loss of heat if heat transfer phenomenon is occurred.

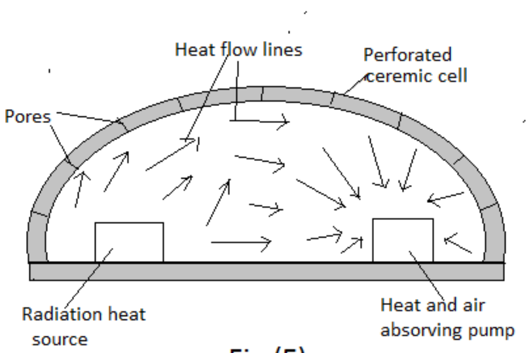

Fig.(E)

Here the heat created in the cell is absorbed by a heavy vacuum pump. For this the cell is made perforated for entry of outer air. By this the total quantity of heat created in the cell is absorbed.

II. ANALYSIS

A. Analysis Related To the Effect of Using Perforated Ceramic Cell for Heat Isolation –

First find the relation between the radiated heat(H), volume of the cell(V), density of air in the cell(ρ), distance travelled by heated air before absorption per sec.(D_s) and heat reflectivity of ceramic per sec.(ε_s).

Then by Buckingham's π theorem →

$f(D_s,V,H,\rho,\varepsilon_s) = 0$ → Equ.(A)

So the number of variables

(n) = 5

Now on putting the dimensions of all variables →

$D_s = (L)$, $V = (L^3)$, $H = (ML^2\,T^{-2})$, $\rho = (ML^{-3})$,

So it is clear that the number of dimensions (m) = 3

So the number of π terms = 5-3 = 2

So we can write as $f_1(\pi_1, \pi_2) = 0$ → Equ.(B), where

$\pi_1 = (D_s^{a1}.V^{b1}.H^{c1}.\rho)$ → Equ.(C)

$\pi_2 = (D_s^{a2}.V^{b2}.H^{c2}.\varepsilon_s)$ →Equ.(D)

Now on putting the all dimensions at both sides of the equation (C) →

$(M^0L^0T^0) = \{(LT^{-1})^{a1}.(L^3)^{.b1}\,(ML^2T^{-2})^{c1}.\,(ML^{-3})\}$

On comparison of dimensions at both sides →

$a_1 + 3b_1 + 2c_1 - 3 = 0$ Equ.(E),

$c_1 + 1 = 0$, or $c_1 = -1$,

$-a_1 - 2\,c_1 = 0$ or $a_1 = 2$

Then from equation(E)→$b_1 = 0$

Then again from equation(C) –

$\pi_1 = (D_s^2.V^0.H^{-1}.\rho)$

$\pi_1 = \{\rho D_s^2/H\}$ → Equ.(F)

Now on putting the all dimensions at both sides of the equation (D) →

$(M^0L^0T^0) = \{(LT^{-1})^{a2}.(L^3)^{.b2}\,(ML^2T^{-2})^{c2}.(T^{-1})\}$

On comparison of dimensions at both sides →

$a_2 + 3b_2 - 2c_2 = 0$ Equ.(G), $c_2 = 0$, $-a_2 - 2\,c_2 - 1 = 0$ or $a_2 = -1$

Then from equation (G)→

$b_2 = 1/3$

Then again from equation(D) –

$\pi_2 = (D_s^{-1}.V^{1/3}.H^0.\,\varepsilon_s)$

$\pi_2 = \{V^{1/3}\varepsilon_s/D_s\}$ → Equ.(H)

Then from equation (B) →

$f_1\,(\rho D_s^2/H,\ V^{1/3}\varepsilon_s/D_s) = 0$

or $\rho D_s^2/H = \phi\,(V^{1/3}\varepsilon_s/D_s)$

$\rho D_s^2 = H\,\phi\,(V^{1/3}\varepsilon_s/D_s)$

$H\ \alpha\ \rho D_s^2$

{If $\phi\,(V^{1/3}\varepsilon_s/D_s)$ is constant}

Hence here it is clear that the heat absorbed (H) depends on the density of the air(ρ) and distance travelled by air before absorption of radiated heat (D_s).

B. Analysis Related To the Effect of Cotton Layer over the Heat Isolation –

First find the relation between the radiated heat(H), volume of air in the cell(V), thickness of cotton cover over the cell(t) density of air in the cell(ρ), and heat reflectivity of ceramic per sec.(ε_c).

Then by Buckingham's π theorem →

$f(t,V,H,\rho,\varepsilon_c) = 0$ → Equ.(A)

So the number of variables

(n) = 5

Now on putting the dimensions of all variables →

$t = (L)$, $V = (L^3)$, $H = (ML^2\,T^{-2})$, $\rho = (ML^{-3})$,

So it is clear that the number of dimensions (m) = 3

So the number of π terms = 5-3 = 2

So we can write as $f_1(\pi_1, \pi_2) = 0$ → Equ.(B), where

$\pi_1 = (t^{a1}.V^{b1}.H^{c1}.\rho)$ → Equ.(C)

$\pi_2 = (t^{a2}.V^{b2}.H^{c2}.\varepsilon_s)$ →Equ.(D)

Now on putting the all dimensions at both sides of the equation (C) →

$(M^0L^0T^0) = \{(L)^{a1}.(L^3T^{-1})^{.b1}\,(ML^2T^{-2})^{c1}.\,(ML^{-3})\}$

On comparison of dimensions at both sides →

$a_1 + 3b_1 + 2c_1 - 3 = 0$ Equ.(E),

$c_1 + 1 = 0$, or $c_1 = -1$,

$-b_1 - 2\,c_1 = 0$ or $b_1 = 2$

Then from equation(E)→$a_1 = -5$

Then again from equation(C) –

$\pi_1 = (t^{-5}.V^2.H^{-1}.\rho)$

$\pi_1 = \{\rho V^2/Ht^5\}$ → Equ.(F)

Now on putting the all dimensions at both sides of the equation (D) →

$(M^0L^0T^0) = \{(L)^{a2}.(L^3T^{-1})^{.b2}\,(ML^2T^{-2})^{c2}.\,(T^{-1})\}$

On comparison of dimensions at both sides →

$a_2 + 3b_2 + 2c_2 = 0$ Equ.(G), $c_2 = 0$, $-b_2 - 2\,c_2 - 1 = 0$ or $b_2 = -1$

Then from equation (G)→

$a_2 = 3$

Then again from equation(D) –

$\pi_2 = (t^3.V^{-1}.H^0.\,\varepsilon_c)$

$\pi_2 = \{t^3\varepsilon_c/V\}$ → Equ.(H)

Then from equation (B) →

$f_1\,(\rho V^2/Ht^5,\ t^3\varepsilon_c/V) = 0$

or $\rho V^2/Ht^5 = \phi\,(V^{1/3}\varepsilon_s/D_s)$

$H\ \alpha\ \rho V^3$

{If $t^5\phi(\varepsilon_s t^3)$ is constant}

Hence here it is clear that the heat radiated (H) depends on the density of the air(ρ) and volume of air present in the cell(V).

III. CONCLUSION

Here it is clear that the radiated heat may be transferred or absorbed maximum by using some methods given as above.

Note - By using all above methods together a perfect cell is developed which may transfer or absorb the maximum radiated heat.

REFERENCE

[1] Thermal Engineering by R S Khurmi
[2] Buckingham's π theorem