HEAT AND MASS TRANSFER IN A SEMI-INFINITE POROUS MEDIUM IN CONTACT WITH WELL-STIRRED FLUID

H. N. Narang

Defence Science Laboratory, Delhi

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Unsteady transfer of heat and mass in a semi-infinite capillary-porous medium in contact with well-stirred fluid has been considered in this paper. At the interface, we have assumed the continuity of temperature and of heat flux while for mass transfer convective law has been assumed. It is also assumed that a quantity of heat, proportional to the moisture transferred at the interface, is produced within the fluid. Some numerical results have been graphically depicted.

NOMENCLATURE

t = temperature

θ = mass transfer potential

τ = time

x = co-ordinate in the x-direction

$a_m = \dfrac{\lambda_m}{C_m \gamma_\theta}$, moisture diffusivity coefficient

$a_q = \dfrac{\lambda_q}{C_q \gamma_\theta}$, heat diffusivity coefficient

λ_m, = moisture conductivity coefficient

λ_q = heat conductivity coefficient

C_m = specific mass capacity

C_q = specific heat capacity

γ_θ = density of porous skeleton

ρ = specific heat of evaporation

ϵ = coefficient of moisture (internal evaporation)

δ_s = Soret coefficient

α_m = mass transfer coefficient

h = heat produced per unit area per unit mass at the interface due to chemical reaction

L = width of the well-stirred fluid in contact with the porous medium

$X = \dfrac{x}{L}$, non-dimensional x-coordinate

$T_i = \dfrac{t_i - t_{20}}{t_{10} - t_{20}}$, non-dimensional temperature $(i = 1, 2)$

$\Theta = \dfrac{\theta_{20} - \theta_i}{\theta_{20} - \theta_{10}}$, non-dimensional mass transfer potential $(i = 1, 2)$

$Lu = \dfrac{a_m}{a_q}$, Luikov Number

$K_\theta = \dfrac{\rho C_m}{C_q} \dfrac{(\theta_{20} - \theta_{10})}{(t_{10} - t_{20})}$, Kossowich Number

$Pn = \dfrac{\delta_s (t_{10} - t_{20})}{(\theta_{20} - \theta_{10})}$, Posnov Number

$Fo = \dfrac{a_q \tau}{L^2}$, Fourier number for heat transfer

$Bi_m = \dfrac{\alpha_m L}{\lambda_m}$, Biot number for mass transfer

H = as defined in equation (19)

N = as defined in equation (20)

Ko_1 = as defined in equation (21)

The subscripts q, m, 0, 1 and 2 stand respectively for heat transfer, mass transfer the initial state, the well-stirred fluid and the porous medium.

Luikov & Mikhailov[1] have discussed a number of problems of heat and mass transfer under variety of boundary and initial conditions. In almost all the cases which they considered, the surrounding atmosphere has been taken to be at a constant temperature and mass transfer potential or at a temperature and mass transfer potential which are some known functions of time. However the problems, where the surrounding medium is such that its temperature and mass transfer potential no longer remain constant but vary by way of their dependence on the interface conditions, need consideration. The motivation for studying such problems is found in their applicability in adsorption and dehydration problems in chemical technology. These applications suggest a new type of boundary condition at the interface with which the solution of coupled equations of heat and mass transfer is presented here.

Although in the context of transpiration cooling and the drying problems, Kumar & Narang[2] in an earlier work solved the system of heat and mass transfer equations along with the equations of flow and energy of the fluid, the present problem of dehydration, where the moisture removing fluid is considered so well-stirred that the temperature in it appears only as a function of time, has not been formulated so far. In simple heat conduction, however, a number of problems regarding well-stirred fluids have been solved[3].

Kumar[4] discussed the case of finite hollow cylinder in contact with mass M of a well-stirred fluid at its outer surface, while the inner surface was assumed to be absorbing heat flux which is sinusoidal along the length of the cylinder. Many other cases concerning well-stirred fluids have been reviewed by Kumar[5] in his thesis on "Some Boundary Value

Problems in Heat Flow". Recently Ahuja[6] has discussed the case of heat transfer in semi-infinite slab in contact with mass M of the well-stirred fluid per unit area of the solid, the heat capacity of which varies linearly with temperature.

In the problem considered here, a unit area of the plane end of the capillary porous body ($x > 0$) remains in contact with a mass M of the well-stirred fluid for all times and a quantity of heat h per unit area per unit time is assumed to be produced at the interface for every unit quantity of moisture transferred to it from within the porous body. As for the interface conditions, the continuity of temperature and of heat flux has been assumed while the mass transfer obeys a convective law. The solution of the problem has been obtained by the use of Laplace Transform and some numerical results have been presented graphically.

STATEMENT OF THE PROBLEM

Consider a semi-infinite moist capillary-porous solid ($x > 0$) in contact with mass M per unit area of the well-stirred fluid. Initially, the porous solid is at a constant temperature t_{20} and moisture transfer potential θ_{20}. The fluid is also at a constant temperature and mass transfer potential given by t_{10} and θ_{10} respectively. At the interface ($x = 0$) the temperature and heat flux are assumed to be continuous, whereas the mass transfer follows the convective law. The fluid is assumed to be so well-stirred that at any time the whole fluid is at a temperature equal to that of the interface. A quantity of heat h per unit area per unit time due to chemical reaction is assumed to be produced at the interface for every unit quantity of moisture transferred from within the porous medium to the interface. Assuming further that the mass transfer potential of the fluid remains constant for all times, let us determine the distributions of temperature and mass transfer potential in the porous solid at any time τ.

The differential equations governing the process together with initial and boundary conditions can be written as follows :

$$\frac{\partial t_2}{\partial \tau} = a_{q2} \frac{\partial^2 t_2}{\partial_x{}^2} + \frac{\epsilon \rho}{C_{q2}} C_{m2} \frac{\partial \theta_2}{\partial \tau} \tag{1}$$

$$\frac{\partial \theta_2}{\partial \tau} = a_{m2} \frac{\partial^2 \theta_2}{\partial_x{}^2} + a_{m2} \delta_s \frac{\partial^2 t_2}{\partial_x{}^2} \tag{2}$$

$$(x > 0 \, , \; \tau > 0)$$

$$\left.\begin{aligned} t_2 &= t_{20} \quad (3) \\ \theta_2 &= \theta_{20} \quad (4) \end{aligned}\right\} x > 0 \, , \quad \tau = 0$$

$$\left.\begin{aligned} t_1 &= t_{10} \quad (5) \\ \theta_1 &= \theta_{10} \quad (6) \end{aligned}\right\} \tau = 0$$

$$M C_{q1} \frac{\partial t_1}{\partial \tau} = \lambda_{q2} \frac{\partial t_2}{\partial x} + h \, \alpha_{m2} \, (\theta_2 - \theta_{10}) \tag{7}$$

$$\lambda_{m2} \frac{\partial \theta_2}{\partial x} + \lambda_{m2} \, \delta_s \frac{\partial t_2}{\partial x} + \alpha_{m2} \, (\theta_{10} - \theta_2) = 0 \tag{8}$$

$$t_1 = t_2 \tag{9}$$

$$(x = 0 \, , \quad \tau > 0)$$

The boundary condition (7) represents the heat balance at the interface. The first term on the left represents the change in heat content of the fluid column per unit area per unit time. The first term on the right is the heat flux into the porous body whereas the second term represents the quantity of heat produced at the interface due to the chemical reaction of the moisture, transferred to the interface from within the porous medium, with the surrounding fluid. As pointed out in the introduction this boundary condition is valid only in the case when the fluid is well-mixed so that its temperature is a function of time only. If the fluid is not well-mixed then one has to consider the variation in temperature with respect to space variable also. In such a case the problem becomes quite complicated and an analytical solution is difficult to obtain. It is with this idea that the above assumption of well-mixing has been introduced, which leads to a restriction on the number Bi_q namely $Bi_q >> 1$.

The boundary condition (8) is the moisture balance at the interface. The first term represents the moisture flux out of the porous medium due to the gradient of moisture transfer potential while the second term is the moisture flux induced by the temperature gradient. The third term represents the convective moisture exchange due to the difference of moisture transfer potentials between the interface and surrounding fluid. Lastly, the boundary condition (9) is the temperature continuity condition at the interface.

The equations (1)–(9) can be written in the non-dimensional form, as

$$\frac{\partial T_2}{\partial Fo} = \frac{\partial^2 T_2}{\partial x^2} - \epsilon Ko \frac{\partial \Theta_2}{\partial Fo} \tag{10}$$

$$\frac{\partial \Theta_2}{\partial Fo} = Lu \frac{\partial^2 \Theta_2}{\partial X^2} - Lu\ Pn \frac{\partial^2 T_2}{\partial X^2} \tag{11}$$

$$(X > 0\ ,\ Fo > 0)$$

$$\left.\begin{aligned} T_2 &= 0 \quad (12) \\ \Theta_2 &= 0 \quad (13) \end{aligned}\right\}\ X > 0\ ,\ Fo = 0$$

$$\left.\begin{aligned} T_1 &= 1 \quad (14) \\ \Theta_1 &= 1 \quad (15) \end{aligned}\right\}\ Fo = 0$$

$$\frac{\partial T_1}{\partial Fo} = H \frac{\partial T_2}{\partial X} + NH\ (1 - \Theta_2) \tag{16}$$

$$-\frac{\partial \Theta_2}{\partial X} + Pn \frac{\partial T_2}{\partial X} = Bi_m\ (1 - \Theta_2) \tag{17}$$

$$T_1 = T_2 \tag{18}$$

$$(X = 0\ ,\ Fo > 0)$$

where the non-dimensional quantities like Lu, ϵ, Ko, Pn etc. have been defined in the nomenclature. In the above equations we have, also

$$H = \frac{\lambda_{q2}\ L}{MC_{q1}\ a_{q2}} \tag{19}$$

$$\begin{aligned} N &= \frac{h\alpha_{m2}\ (\theta_{20} - \theta_{10})\ L}{\lambda_{q2}\ (t_{10} - t_{20})} \\ &= Lu\ Bi_m\ Ko_1 \end{aligned} \tag{20}$$

where
$$Ko_1 = \frac{h\, C_{m2}}{C_{q2}} \frac{(\theta_{20} - \theta_{10})}{(t_{10} - t_{20})} \tag{21}$$

SOLUTION OF THE PROBLEM

Defining the Laplace transform with respect to the variable Fo as

$$\bar{\varphi} = \bar{\varphi}\ (X, p) = \int_0^\infty \varphi\ (X, Fo)\ e^{-p\,Fo}\, dFo \tag{22}$$

and applying it to equations (10) and (11), taking into account the initial conditions (12) and (13), we obtain

$$p\bar{T}_2 = \frac{d^2 \bar{T}_2}{dX^2} - \epsilon Ko\ p\ \bar{\Theta}_2 \tag{23}$$

$$p\ \bar{\Theta}_2 = Lu\ \frac{d^2 \bar{\Theta}_2}{dX^2} - Lu\, Pn\ \frac{d^2 \bar{T}_2}{dX^2} \tag{24}$$

Eliminating $\bar{\Theta}_2$ from the equations (23) and (24), we obtain a fourth order differential equation in $\bar{T}_2$ as

$$\frac{d^4 \bar{T}_2}{dX^4} - p\left(1 + \frac{1}{Lu} + \epsilon KoP_n\right)\frac{d^2 \bar{T}_2}{dX^2} + \frac{p^2}{Lu}\bar{T}_2 = 0 \tag{25}$$

The solution of (25) admissible to our problem is

$$\bar{T}_2 = A_1\, e^{-\sqrt{p}\,\nu_1 X} + A_2\, e^{-\sqrt{p}\,\nu_2 X} \qquad (X > 0) \tag{26}$$

Substituting for $\bar{T}_2$ in (23) we obtain the transformed mass transfer potential $\bar{\Theta}_2$ as

$$\bar{\Theta}_2 = -\frac{1}{\epsilon Ko}\left\{ A_1\left(1 - \nu_1^2\right) e^{-\sqrt{p}\,\nu_1 X} + A_2\left(1 - \nu_2^2\right) e^{-\sqrt{p}\,\nu_2 X}\right\} \qquad (X > 0) \tag{27}$$

where ν_1 and ν_2 are given by the following expressions :

$$\nu_1^2 = \tfrac{1}{2}\left[\left(1 + \frac{1}{Lu} + \epsilon KoPn\right) - \sqrt{\left(1 + \frac{1}{Lu} + \epsilon KoPn\right)^2 - \frac{4}{Lu}}\right] \tag{28}$$

$$\nu_2^2 = \tfrac{1}{2}\left[\left(1 + \frac{1}{Lu} + \epsilon KoPn\right) + \sqrt{\left(1 + \frac{1}{Lu} + \epsilon KoPn\right)^2 - \frac{1}{Lu}}\right] \tag{29}$$

The arbitrary constants A_1 and A_2 may be determined from the boundary conditions (16)–(18). These conditions in terms of the transforms become

$$p\bar{T}_1 - 1 = H\ \frac{d\bar{T}_2}{dX} + NH\left(\frac{1}{p} - \bar{\Theta}_2\right) \tag{30}$$

$$-\frac{d\ \bar{\Theta}_2}{dX} + Pn\ \frac{d\bar{T}_2}{dX} = Bi_m\left(\frac{1}{p} - \bar{\Theta}_2\right) \tag{31}$$

$$\bar{T}_1 = \bar{T}_2 \tag{32}$$

The transformed solution (26) and (27) may now be combined with boundary conditions (30)–(32) to give a set of equations for the determination of the arbitrary constants A_1 and A_2 ; which on solution gives:

$$A_1 = \frac{1}{b_1}\left\{ \begin{aligned} & r_{11}\frac{1}{\sqrt{p}\,(\sqrt{p}+\alpha)\,(\sqrt{p}+\beta)} \\ & + r_{21}\frac{1}{p\,(\sqrt{p}+\alpha)\,(\sqrt{p}+\beta)} \\ & + r_{31}\frac{1}{(\sqrt{p}+\alpha)\,(\sqrt{p}+\beta)} \end{aligned} \right\} \tag{33}$$

$$A_2 = \frac{1}{b_1}\left\{ \begin{aligned} & r_{12}\frac{1}{\sqrt{p}\,(\sqrt{p}+\alpha)\,(\sqrt{p}+\beta)} \\ & + r_{22}\frac{1}{p\,(\sqrt{p}+\alpha)\,(\sqrt{p}+\beta)} \\ & + r_{32}\frac{1}{(\sqrt{p}+\alpha)\,(\sqrt{p}+\beta)} \end{aligned} \right\} \tag{34}$$

where

$$\alpha = \frac{1}{2}\left[\frac{b_2}{b_1} + \sqrt{\left(\frac{b_2}{b_1}\right)^2 - \frac{4b_3}{b_1}} \right] \tag{35}$$

$$\beta = \frac{1}{2}\left[\frac{b_2}{b_1} - \sqrt{\left(\frac{b_2}{b_1}\right)^2 - \frac{4b_3}{b_1}} \right] \tag{36}$$

The quantities r_{11}, r_{12} etc. and b_1, b_2 etc. occurring in equations (33)–(36) are given by the following expressions :

$$r_{11} = \frac{Bi_m}{\epsilon Ko}(1 - \nu_2^2) + Bi_m \tag{37}$$

$$r_{21} = NH\left\{ \frac{\nu_2\,(1 - \nu_2^2)}{\epsilon Ko} + \nu_2\, Pn \right\} + H\nu_2\, Bi_m \tag{38}$$

$$r_{31} = \frac{\nu_2\,(1 - \nu^2_2)}{\epsilon Ko} + \nu_2\, Pn \tag{39}$$

$$r_{12} = -\left\{ \frac{Bi_m}{\epsilon Ko}\left(1 - \nu_1^2\right) + Bi_m \right\} \tag{40}$$

$$r_{22} = -\left[NH\left\{ \frac{\nu_1\,(1 - \nu_1^2)}{\epsilon Ko} + \nu_1\, Pn \right\} + H\nu_1\, Bi_m \right] \tag{41}$$

$$r_{32} = -\left\{ \frac{\nu_1\,(1 - \nu_1^2)}{\epsilon Ko} + \nu_1\, P_n \right\} \tag{42}$$

$$b_1 = \frac{\nu_2\,(1 - \nu_2^2) - \nu_1\,(1 - \nu_1^2)}{\epsilon Ko} + (\nu_2 - \nu_1)\, P_n \tag{43}$$

$$b_2 = H\,\nu_1\,\nu_2\,\frac{(\nu_1^2 - \nu_2^2)}{\epsilon Ko} + \frac{Bi_m}{\epsilon Ko}\,(\nu_1^2 - \nu_2^2) \tag{44}$$

$$b_3 = H \frac{Bi_m}{\epsilon Ko} \left\{ \nu_1 (1 - \nu_2^2) - \nu_2 (1 - \nu_1^2) \right\}$$

$$+ NH \left[\frac{(1 - \nu_1^2)(1 - \nu_2^2)(\nu_1 - \nu_2)}{\epsilon Ko} + Pn \left\{ \nu_1 (1 - \nu_2^2) - \nu_2 (1 - \nu_1^2) \right\} \right] \tag{45}$$

With the values of A_1, A_2 found above, $\bar{T}_2$ and $\bar{\Theta}_2$ can be written as

$$\bar{T}_2 (X, p) = \frac{1}{b_1 (\alpha - \beta)} \left[\frac{1}{\sqrt{p}\,(\sqrt{p} + \beta)} - \frac{1}{\sqrt{p}\,(\sqrt{p} + \alpha)} \right] \times \sum_{j=1}^{2} r_{1j}\, e^{-\sqrt{p}\, \nu_j X}$$

$$+ \frac{1}{b_1 (\alpha - \beta)} \left[\frac{1}{p\,(\sqrt{p} + \beta)} - \frac{1}{p\,(\sqrt{p} + \alpha)} \right] \times \sum_{j=1}^{2} r_{2j}\, e^{-\sqrt{p}\, \nu_j X}$$

$$+ \frac{1}{b_1 (\alpha - \beta)} \left[\frac{1}{\sqrt{p} + \beta} - \frac{1}{\sqrt{p} + \alpha} \right] \times \sum_{j=1}^{2} r_{3j}\, e^{-\sqrt{p}\, \nu_j X}$$

$$(X > 0) \tag{46}$$

$$\bar{\Theta}_2 (X, p) = - \frac{1}{\epsilon Ko} \frac{1}{b_1 (\alpha - \beta)} \left[\frac{1}{\sqrt{p}\,(\sqrt{p} + \beta)} - \frac{1}{\sqrt{p}\,(\sqrt{p} + \alpha)} \right] \times \sum_{j=1}^{2} r_{1j} (1 - \nu_j^2)\, e^{-\sqrt{p}\, \nu_j X}$$

$$- \frac{1}{\epsilon Ko} \frac{1}{b_1 (\alpha - \beta)} \left[\frac{1}{p\,(\sqrt{p} + \beta)} - \frac{1}{p\,(\sqrt{p} + \alpha)} \right] \times \sum_{j=1}^{2} r_{2j} (1 - \nu_j^2)\, e^{-\sqrt{p}\, \nu_j X}$$

$$- \frac{1}{\epsilon Ko} \cdot \frac{1}{b_1 (\alpha - \beta)} \left[\frac{1}{\sqrt{p} + \beta} - \frac{1}{\sqrt{p} + \alpha} \right] \times \sum_{j=1}^{2} r_{3j} (1 - \nu_j^2)\, e^{-\sqrt{p}\, \nu_j X}$$

$$(X > 0) \tag{47}$$

Applying the inversion theorem for Laplace transform defined by

$$\phi (X, Fo) = \frac{1}{2 \pi i} \int_{\gamma - i\infty}^{\gamma + i\infty} \bar{\phi} (X, p)\, e^{pFo}\, dp \tag{48}$$

to the above expressions for $\overline{T}_2\,(X,p)$ and $\overline{\Theta}_2\,(X,p)$ we obtain the final distributions for the temperature T_2 and mass transfer potential Θ_2 as

$$\begin{aligned}
T_2\,(X, Fo) = {} & \frac{1}{b_1\,(\alpha-\beta)} \sum_{j=1}^{2} r_{1j} \Bigg[e^{\nu_j \beta X + \beta^2 Fo} \operatorname{erfc}\left(\frac{\nu_j X}{2\sqrt{Fo}} + \beta\sqrt{Fo} \right) \\
& - e^{\nu_j \alpha X + \alpha^2 Fo} \operatorname{erfc}\left(\frac{\nu_j X}{2\sqrt{Fo}} + \alpha\sqrt{Fo} \right) \Bigg] \\
& + \frac{1}{b_1\,(\alpha-\beta)} \sum_{j=1}^{2} r_{2j} \Bigg[\operatorname{erfc}\left(\frac{\nu_j X}{2\sqrt{Fo}} \right) \left(\frac{1}{\beta} - \frac{1}{\alpha} \right) \\
& + \frac{1}{\alpha}\, e^{\nu_j \alpha X + \alpha^2 Fo} \operatorname{erfc}\left(\frac{\nu_j X}{2\sqrt{Fo}} + \alpha\sqrt{Fo} \right) \\
& - \frac{1}{\beta}\, e^{\nu_j \beta X + \beta^2 Fo} \operatorname{erfc}\left(\frac{\nu_j X}{2\sqrt{Fo}} + \beta\sqrt{Fo} \right) \Bigg] \\
& + \frac{1}{b_1\,(\alpha-\beta)} \sum_{j=1}^{2} r_{3j} \Bigg[\alpha\, e^{\nu_j \alpha X + \alpha^2 Fo} \operatorname{erfc}\left(\frac{\nu_j X}{2\sqrt{Fo}} + \alpha\sqrt{Fo} \right) \\
& - \beta\, e^{\nu_j \beta X + \beta^2 Fo} \operatorname{erfc}\left(\frac{\nu_j X}{2\sqrt{Fo}} + \beta\sqrt{Fo} \right) \Bigg] \\
& \qquad (X > 0) \qquad\qquad (49)
\end{aligned}$$

$$\begin{aligned}
\Theta_2\,(X, Fo) = {} & - \frac{1}{\epsilon Ko}\; \frac{1}{b_1\,(\alpha-\beta)} \sum_{j=1}^{2} r_{1j} \left(1 - \nu_j^2 \right) \times \\
& \Bigg[e^{\nu_j \beta X + \beta^2 Fo} \operatorname{erfc}\left(\frac{\nu_j X}{2\sqrt{Fo}} + \beta\sqrt{Fo} \right) - e^{\nu_j \alpha X + \alpha^2 Fo} \operatorname{erfc}\left(\frac{\nu_j X}{2\sqrt{Fo}} + \alpha\sqrt{Fo} \right) \Bigg] \\
& - \frac{1}{\epsilon Ko}\; \frac{1}{b_1\,(\alpha-\beta)} \sum_{j=1}^{2} r_{2j} \left(1 - \nu_j^2 \right) \Bigg[\left(\frac{1}{\beta} - \frac{1}{\alpha} \right) \operatorname{erfc}\left(\frac{\nu_j X}{2\sqrt{Fo}} \right) \\
& + \frac{1}{\alpha}\, e^{\nu_j \alpha X + \alpha^2 Fo} \operatorname{erfc}\left(\frac{\nu_j X}{2\sqrt{Fo}} + \alpha\sqrt{Fo} \right) \\
& - \frac{1}{\beta}\, e^{\nu_j \beta X + \beta^2 Fo} \operatorname{erfc}\left(\frac{\nu_j X}{2\sqrt{Fo}} + \beta\sqrt{Fo} \right) \Bigg]
\end{aligned}$$

$$-\frac{1}{\epsilon Ko}\;\frac{1}{b_1(\alpha-\beta)}\sum_{j=1}^{2} r_{2j}\left(1-\nu_j^2\right)\left[\alpha\, e^{\nu_j \alpha X+\alpha^2 Fo}\operatorname{erfc}\left(\frac{\nu_j X}{2\sqrt{Fo}}+\alpha\sqrt{Fo}\right)\right.$$

$$\left.-\beta\, e^{\nu_j \beta X+\beta^2 Fo}\operatorname{erfc}\left(\frac{\nu_j X}{2\sqrt{Fo}}+\beta\sqrt{Fo}\right)\right] \qquad (X>0) \qquad (50)$$

The distribution for the temperature T_1 in the fluid can be obtained from (49) by substituting $X=0$.

NUMERCIAL RESULTS AND DISCUSSION

The values of the parameters chosen for the numerical work of the above problem were

$$Lu = 0\cdot 3 \;,\quad \epsilon = 0\cdot 5 \;,\quad Ko = 1\cdot 2$$

$$Pn = 0\cdot 5 \;,\quad Bi_m = 10\cdot 0$$

The corresponding values of temperature T_2 have been plotted in Fig. 1 and 2.

In Fig. 1 we have plotted the temperature T_2 at the surface of the porous solid(i. e at $X=0$) against non-dimensional time Fo for four different values of the number H ($H=0\cdot 25$, $H=0\cdot 5$, $H=0\cdot 75$ and $H=1$). At any time Fo, it is seen that the surface temperature decreases with the increase in H. This may be explained on account of the fact that, for a fixed value of heat content in a unit volume of the porous solid the increase in H results in a decrease in the heat content of the fluid in the column at unit area at the surface and hence the temperature at the interface decreases.

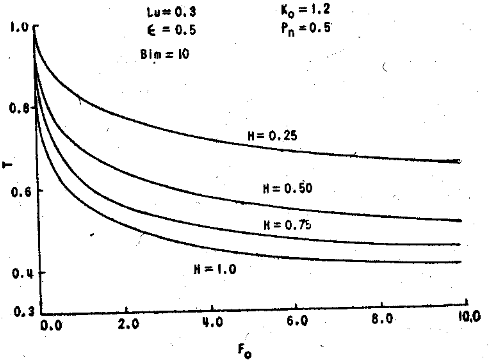

Fig. 1—Variation of non-dimensional temperature at the porous body surface for different values of H.

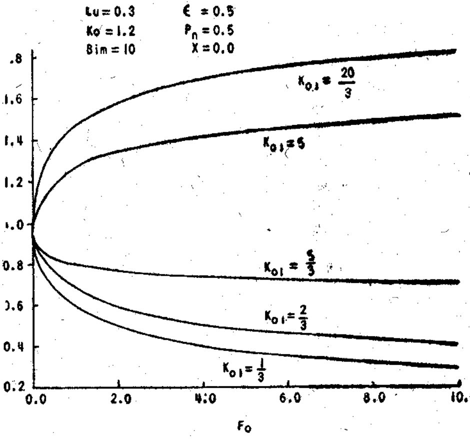

Fig. 2—Effect of Ko_1 on non-dimensional temperature at the porous body surface.

Fig. 2 exhibits the effect of non-dimensional number Ko_1, on the temperature T_2 at the porous body surface. It appears that with the increase in Ko_1, the surface temperature goes on increasing. This is readily explained by the fact that Ko_1, being a non-dimensional heat source at the interface, the increase in the value of this number would naturally raise the surface temperature of the porous body.

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