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SIMULATION OF THERMAL CONDUCTIVITY AND DIFUSIVITY OF POLYMERICS MATERIALS IN NONSTATIONARY STATE.

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ABSTRACT

The use of polimerics materials has been a great increase in the last years, by this is necessary to determine as the processes implied in the production of such affect the final product, one of the determining factors in this processing is the thermal behavior, for this reason is of great importance the study of this behavior for obtain better results. The objective of this work is to simulate from the temperature profiles the behavior of a cell of cylindrical conductivity in the radial coordinate based on the conductivity and thermal difusividad of a polimeric material, being disturbing the stationary state with a periodic signal, and thus to understand the theoretical behavior of these materials that are of so ample use.

For the development of the mathematical model is necessary make some conditions and suppositions for the boundary of the created problem: a) the extreme effects are despicable, b) exists radial symmetry, c) the power inlet agrees with the axial axis, d) the system reaches the stationary state when applying a gradient of temperature in the radial direction.

When the stationary state is disturbed superposing to a power signal type step to the source, the propagation of the signal based on the time and the position depends on parameters like the conductivity and heat capacity.

In order to simulate the behavior of the described cell the transference equation is solved.

$$\frac{1}{r}\frac{\partial}{\partial r}\left(kr\frac{\partial T}{\partial r}\right)+\frac{1}{r^2}\frac{\partial}{\partial \phi}\left(k\frac{\partial T}{\partial \phi}\right)+\frac{\partial}{\partial z}\left(k\frac{\partial T}{\partial z}\right)+\overset{o}{q}=\rho Cp\frac{\partial T}{\partial t} \qquad (1)$$

Where; r: radio (m), T: temperature of the polymer (k), ϕ: angle, z: height (m), ρ: density of polymer (kg /m^3), Cp: heat capacity of polymer (W kg) and t: time (seg).

Thus, taking into account the exposed restrictions above, regrouping some factors and considering the definition of the thermal difusividad it is left:

$$\frac{1}{r}\frac{\partial}{\partial r}\left(\alpha r\frac{\partial T}{\partial r}\right)=\frac{\partial T}{\partial t} \qquad (2)$$

Then the board conditions for the solution of the model will be: $T(r,0)=T_0$, $T(r_i,t)=T_0+T(t)$ and $T(r_e,t)=T_0$

Where, T_0: initial temperature of the disc (k), $T(t)$: function of study (k), r_i: internal disc radio (m) and r_e: external radio of the disc (m).

For the development of the investigation the programming of a software in Visual BASIC for the simulation of the equation was necessary that represents the processes of heat transference, this was obtained developing a first program that calculates the analytical solution of the model and other one the numerical solution for its later comparison calculates. In addition to this, a sensitivity analysis was made to determine in which values of thermal difusividad obtained better results.

Between the obtained results it is important to emphasize that the simulations by the analytical method and the numerical method display absolute errors around 0.01ºC, the simulation by the software developed in Visual BASIC and the numerical simulation in MatLab displays absolute errors of 0ºC. The rank of application for a fixed time of 33000 seconds is in values of thermal difusividad that from $4*10^{-4}$ cm^2/seg until $2*10^{-3}$ cm^2/seg and that the tolerance of the program for the time before mentioned is of 0,00001 cm^2/seg.