creasing irradiation dose, which is evidence in support of a breakdown process. The values of thermal conductivity λ at the 10 MGy dose are approximately 5-8% overestimated throughout the entire temperature range and correlate with the overestimated (by approximately 10%) initial density of specimens prior to irradiation with the same dose. Lack of data on the radiation stability of individual resins, components of Kriosil, makes it impossible to analyze the results obtained here in greater detail.

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EFFECT OF PARTICLE-SIZE COMPOSITION OF A NICKEL ALLOY POWDER ON ITS REFLECTIVITY

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The effect of the duration of grinding and the most probable radius of the particles of a nickel alloy powder on its optical properties in the infrared region is investigated.

Considerable attention has been paid in recent years to the development of selective paints for use in solar energy converters [1-3]; such paints must have high absorptivity within the solar spectrum (0.2-3.0 μm) and high reflectivity in the infrared (IR) region (3-30 μm). These properties depend greatly on the particle-size composition of the pigments and fillers used. The effect of particle size of a nickel alloy power on its reflectivity in the IR region was investigated in [4]. The powder was subjected to wet grinding in a ball mill for 50, 100, 150, or 200 h and its particle-size composition was determined on a Hitachi (Japan) PSA-2 sedimentograph. Examples of differential particle-size distributions are shown in Fig. 1; the most probable particle radius r_m is determined from the position of the peak on the curve.

The spectral reflectivity of the investigated material was measured at six wavelengths (λ = 2.45, 4.0, 7.95, 10, 12, and 15 μm) by a special apparatus [5]. The integral reflectivity

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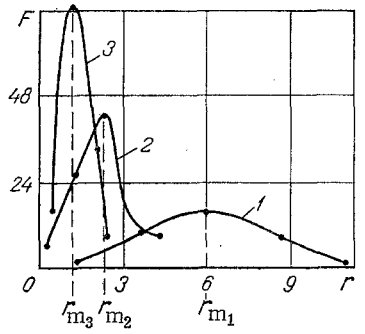

Fig. 1

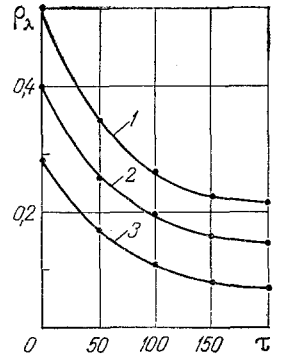

Fig. 2

Fig. 1. Differential particle-size distributions of nickel alloy powder: 1) initial powder; 2) after 50-h grinding; 3) after 100-h grinding. F, %; r, μm.

Fig. 2. Plots of spectral reflectivity ρ_λ (rel. units) of nickel alloy powder against grinding time τ(h) for three wavelengths: 1) λ = 7.95 μm; 2) 15 μm; 3) 2.45 μm.

ρ was calculated from the formula ρ = 1 − ε, where ε is the emissivity, measured on a TIS instrument [6]. We also determined the specific surface S (m^2/g) by the BET method on a Strokhlein area meter, and the oxygen content q (%).

An increase in grinding time led to a reduction of the most probable particle radius, and to an increase in the specific surface and amount of oxygen adsorbed on the surface of the particles; the integral reflectivity was reduced to less than half its initial value. It was characteristic that the shape of the plot of spectral reflectivity ρ_λ of the nickel alloy powder against wavelength in the range λ = 2.45-15 μm was unaltered by an increase in grinding time, but the curve itself was displaced downwards. This indicates a reduction of the spectral reflectivity of nickel alloy powder with increase in grinding time (Fig. 2).

Approximations of the relations $r_m(\tau)$, $\rho(\tau)$, and $\rho_\lambda(\tau)$ for six values of λ were obtained on a computer. We found that these relations were represented very satisfactorily by an equation of the type $y = a_0 + a_1 e^{-a_2 \tau}$, where y is the required quantity, and a_0, a_1, and a_2 are calculated parameters. The parameter a_0 has the physical sense of a limit to which the required quantity (e.g., the integral reflectivity) tends when the grinding time tends to infinity; a_1 is the difference between the initial and limiting values of the particular quantity, while a_2 characterizes its rate of change with increase in grinding time. For instance for $\rho(\tau)$ we have $a_0 = 0.372 \pm 0.003$ (rel. units), $a_1 = 0.213 \pm 0.004$ (rel. units), and $a_2 = 0.0285 \pm 0.0018$ (h^{-1}). The integral reflectivities calculated from the equation with these values of parameters agreed very well with the experimental values; the maximum error of the approximation was smaller than the experimental error.

Thus, we have established that reduction of particle size leads to a considerable reduction of the integral and spectral reflectivities; the shape of the wavelength dependence of the latter characteristic is unaltered. This fact can be used to obtain coatings with the required reflectivity in the IR region. The grinding time required to obtain specified values of $r_m(\tau)$, $\rho(\tau)$, and $\rho_\lambda(\tau)$ can easily be calculated with the aid of approximating equations.

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CALCULATION OF RADIATIVE-CONDUCTIVE HEAT TRANSFER IN A SEMITRANSPARENT PLATE BY THE MONTE CARLO METHOD

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The possibility of applying the Monte Carlo method together with the method of finite differences for calculating radiative–conductive heat transfer is analyzed.

At the present time, a great deal of attention is devoted to the study of radiative–conductive heat transfer. The energy equation in this case is a nonlinear integrodifferential equation. Its solution had not been found in general. A series of papers [1-3] is devoted to the numerical solution of this equation in different particular cases. In the general case, in taking into account the nongray nature of the medium and the temperature dependences of the absorption coefficient and thermophysical parameters, it is difficult to obtain a numerical solution using traditional methods.

In such complex cases, it is expedient to use the Monte Carlo method. The essence of this method consists in constructing for a given problem a random process whose parameters are the quantities sought. They are determined by observing the random process and calculating its statistical characteristics, approximately equal to the parameters sought.

Radiative heat transfer in semitransparent media was studied in [4, 5] using the Monte Carlo method. In this paper, we examine the more general form of heat transfer: radiative–conductive. In so doing, in order to carry out the calculations, we attempt to combine the Monte Carlo method with a finite-difference numerical method. The analysis is based on the scheme for the Monte Carlo method used in [4].

We examined nonstationary radiative–conductive heat transfer in the absence of scattering. Such heat transfer occurs, for example, in processes of glass formation. The problem was to determine the temperature fields for two types of glasses: white and green. We calculated the cooling of an infinite plate taking into account the wavelength dependence of the coefficient of absorption and the temperature dependence of the thermophysical parameters. These dependences were obtained by approximating the data in [6].

The system of equations, describing heat transfer, in this case has the form

$$\frac{\partial I_\lambda}{\partial x} = \beta_\lambda \left[\frac{e_{b\lambda}(x)}{\pi} - I_\lambda \right], \tag{1}$$

$$\frac{\partial}{\partial t}(\rho c_p T) = -4 \int_0^\infty \beta_\lambda e_{b\lambda}(x)\, d\lambda + 2\pi \int_{-1}^{+1} \mu d\mu \int_0^\infty \beta_\lambda I_\lambda d\lambda + \frac{\partial}{\partial x}\left(K \frac{\partial T}{\partial x} \right). \tag{2}$$

In view of the absolute contact between the glass layer and nontransparent surfaces, boundary conditions of the first kind T_s are given. The temperature T_i, identical for the entire glass specimen, is given as an initial condition.

In order to solve the system (1-2), the plate was separated into zones (Fig. 1), while the cooling process was separated into time intervals. In order to determine the intensity

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