Секція «Фізика»

ESTIMATION OF THE SUBSURFACE AFTERBURNING TIME OF MAGNESIUM CONGLOMERATES

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This work continues the cycle of analytical processing of the results of experiments on the combustion of magnesium conglomerates. In particular, to compare the processes of high-temperature combustion of single particles (index 0) and conglomerates (index 1), evaluations of the criterion of Bio: $Bi_{(0)}/Bi_{(1)} = 1.53\cdot10^{-3} << 1$. The estimate indicates that there is practically no temperature gradient along the radius of the particle, in contrast to the conglomerate. At the same time, layer-by-layer melting and evaporation of the initial powder characterize the combustion of conglomerates. Accordingly, the combustion of conglomerates acquires a pronounced staged character: the first, diffusion stage is replaced by subsurface afterburning. The thermokinetics of the second stage of combustion is determined primarily by the change in the diffusion of oxygen through the oxide residue on the surface of the conglomerate. Estimation of the afterburning time was based on the model of oxidant motion in macropores [1], as well as on the assumption of a linear nature of the dependence of the flux density on the ratio of partial pressure to the thickness of the oxide coat. Thus, taking into account the two-stage combustion leads to the equation forburn-up time

$$\tau_a = \beta \nu_1 \left(S_f P_2'\right)^{-1} \left(\rho_c^{0.5} M_S\right)^{2/3}, \qquad (1)$$

where ν_1 -is the stoichiometric coefficient forMgreaction of interaction ofMgwithO_2; $\beta = 0.192$; $P_2^{'}$ - is the partial pressure of O_2in the environment; the S_f coefficient determines the oxygen flux density through the oxide coatings; ρ_c - is the conglomerate density; M_S- is themass of magnesium at the beginning of the second stage of combustion.

The estimates of the time τ_a and the results of experiments on two-stage combustion of conglomerates are in satisfactory agreement.

References

1. D.Zhang, F. Pengand X. Liu.Protection of magnesium alloys: From physical barrier coating to smart self-healing coating. *Journal of Alloys and Compound*, Volume 853, 2021, 157010.