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Theory of Electromagnetic Drying: An Asymptotic Solution of an Initial–Boundary Value Problem for a Cylinder

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Abstract—A long-time asymptotic analytical solution to a system of equations and boundary and initial conditions modeling electromagnetic drying has been constructed for a cylindrical region. The solution determines the temperature and moisture content fields in the during period in which the drying rate is constant. Calculations have been carried out for the maximum drying intensity regime with allowance made for the overeating of the material or its strain-induced breakup.

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INTRODUCTION

The processes taking place in electromagnetic drying are presently analyzed using numerical methods [1–3]. The potential of analytical methods has not been fully understood. Their application needs a number of approximations to be made, which are difficult to choose and substantiate [4–8]. Only the classical problem of drying a plate has been investigated to date. A method of constructing analytical solutions for convective drying was developed in a monograph by Lykov

$$Q(T) = \sigma A\left[(T+T_1)^4 - (T_{air}+T_1)^4\right] + \alpha_w (T - T_{air}); \quad (5)$$

$$J(T) = \alpha_m [P(T) - \varphi P(T_{air})];$$

$$P(T) = 6.03\times 10^{-3} \exp\frac{17.3T}{T+T_2}; \quad (6)$$

$$T(M,0) = T_0; \quad U(M,0) = U_0. \quad (7)$$

In these equations, $T = T(M,\tau)$, $U = U(M,\tau)$ are the temperature and moisture content of the body