

# **Mathematical Model of Mechanical Stretching of Polymeric Films and Sheets with Nonuniform Radial Temperature Profile for Control of Pharmaceutical and Food Packages Quality**

**A. N. Polosin, T. B. Chistyakova, E. V. Tyan**

*Saint-Petersburg State Institute of Technology (Technical University),  
Saint-Petersburg*

**Key words and phrases:** mathematical modeling; mechanical stretching; membrane theory of shells; numerical methods; polymeric materials; rheological models; temperature profile of workpiece; thickness of product.

**Abstract:** Physically based mathematical model of mechanical stretching of polymeric films and sheets with nonuniform radial temperature distribution for manufacturing axially symmetric products used as pharmaceutical and food packages has been developed. It includes equations of membrane theory of revolution shells and rheological model of polymeric material for two-dimensional stress state. The model enables to calculate distribution of thickness along profile of product of given configuration in dependence on geometrical parameters of forming equipment, rheological characteristics and temperature profile of polymeric material, speed of stretching. The model is used to determine radial temperature profile of workpiece (polymeric film, sheet) that ensures thickness distribution guaranteeing required quality (vapor and gas permeability, hardness) of packages of different configurations.