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# Dynamic Optimization of the Methylmethacrylate Cell-Cast Process for Plastic Sheet Production

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*Traditionally, the methylmethacrylate (MMA) polymerization reaction process for plastic sheet production has been carried out using warming baths. However, it has been observed that the manufactured polymer tends to feature poor homogeneity characteristics measured in terms of properties like molecular weight distribution. Nonhomogeneous polymer properties should be avoided because they give rise to a product with undesired wide quality characteristics. To improve homogeneity properties force-circulated warm air reactors have been proposed, such reactors are normally operated under isothermal air temperature conditions. However, we demonstrate that dynamic optimal warming temperature profiles lead to a polymer sheet with better homogeneity characteristics, especially when compared against simple isothermal operating policies. In this work, the dynamic optimization of a heating and polymerization reaction process for plastic sheet production in a force-circulated warm air reactor is addressed. The optimization formulation is based on the dynamic representation of the two-directional heating and reaction process taking place within the system, and includes kinetic equations for the bulk free radical polymerization reactions of MMA. The mathematical model is cast as a time dependent partial differential equation (PDE) system, the optimal heating profile calculation turns out to be a dynamic optimization problem embedded in a distributed parameter system. A simultaneous optimization approach is selected to solve the dynamic optimization problem. Trough full discretization of all decision variables, a nonlinear programming (NLP) model is obtained and solved by using the IPOPT optimization solver. The results are presented about the dynamic optimization for two plastic sheets of different thickness and compared them against simple operating policies.* © 2009 American Institute of Chemical Engineers *AIChE J,* 55: 1464–1486, 2009

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## Introduction

Process optimization has a strategic role in polymer plant operability and economics. The importance of global