KL 3.1

Kinematics of Stretch Blow Moulding and Plug Assisted Thermoforming of Polymers; Experimental Study

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Besides polymers processing techniques such as injection or extrusion, where the involved material is in its molten state, stretch blow moulding of PET and plug assisted thermoforming of PS blends involve the polymer in solid or intermediate physical state.
In these processes a half-finished product is heated close to a transition at a temperature where the behaviour of the material is a combination of a “rubber-like” elasticity and of some visco-elastic phenomena. Deformation can induce complex microstructural modification, the kinetics of which is controlled by (and controls to some extent) the kinematics of the deformation. As a result of both the complex behaviour of polymer and the complex actual processing conditions, optimisation and understanding of such processes cannot be totally intuitive. Correct knowledge of kinematics is then both necessary and difficult
Due to hyperelasticity interrupted blowing does not allow unambiguous study of the forming. Additionally, technological parameters are not intrinsic characteristics for the mechanical loading and moulds do not allow visualising deformation.
To overcome these difficulties instrumented prototypes are developed in which stretching force and velocity, blowing pressure and temperature are measured while part formation is observed using marked half product.
Typical kinematics for stretch blowing and thermoforming and their dependence upon processing conditions can then be discussed.
In this lecture, particular attention will be paid to the effect of low blow delay in stretch blow moulding that does not exist in thermoforming and to the relative influence of thermal and friction effects under the plug in thermoforming. Heat dissipation during forming will also be addressed.
The two processes will be compared in terms of local loading sequences and strain rate. Importance of difference in rheological behaviour of both materials will be addressed to.