

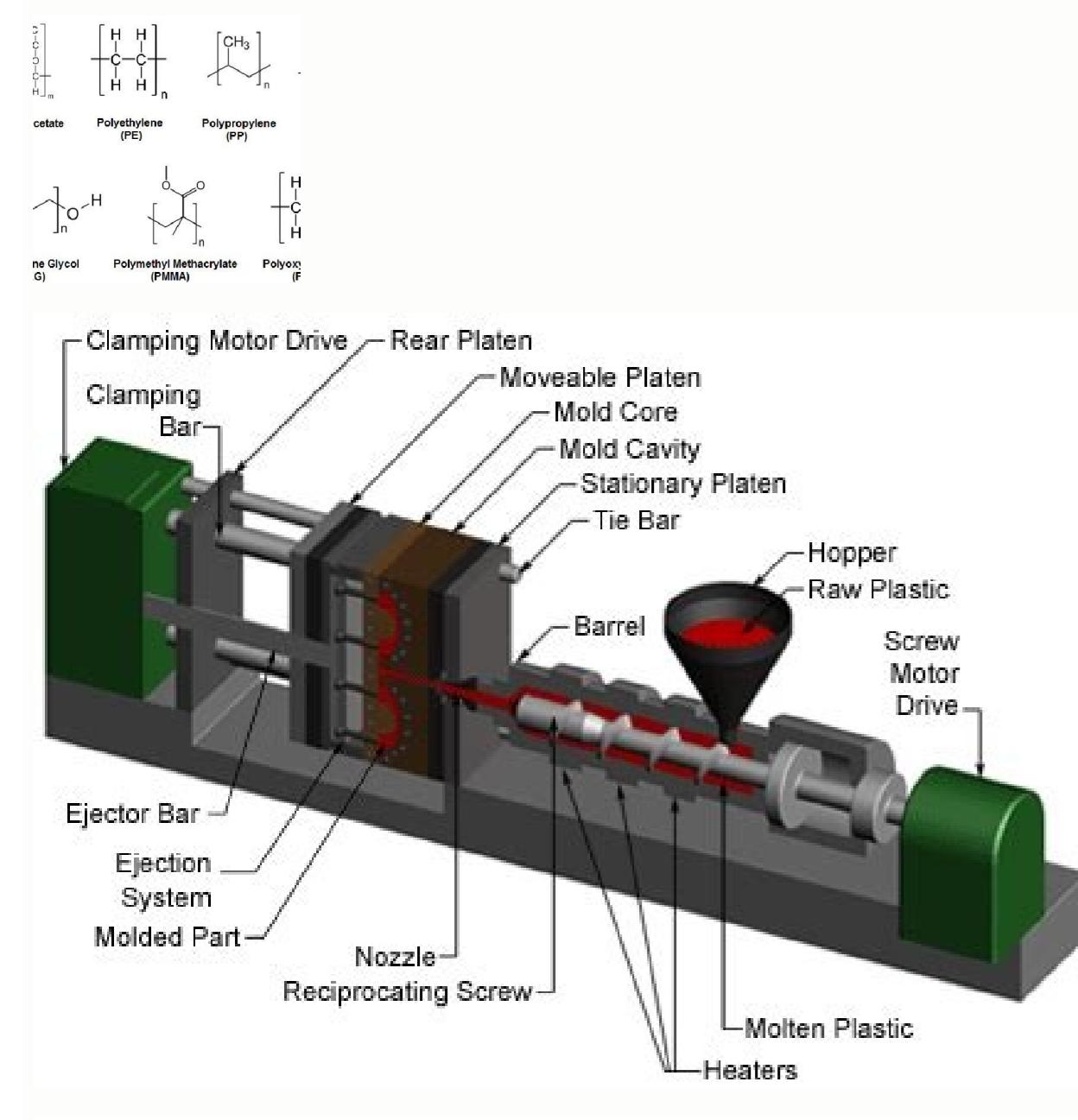


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ELSEVIER Physics Procedia 87 (2016) 61 – 71

44th Annual Symposium of the Ultrasonic Industry Association, UIA 44th Symposium, 20-22 April 2015, Washington, DC, USA and of the 45th Annual Symposium of the Ultrasonic Industry Association, UIA 45th Symposium, 4-6 April 2016, Seattle, WA, USA

### Ultrasonically-assisted polymer molding: an evaluation

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#### Abstract

Energy reduction in extrusion and injection molding processes can be achieved by the introduction of ultrasonic energy. Polymer flow can be enhanced on application of ultrasonic vibration, which can reduce the thermal and pressure input requirements to produce the same output. This study also investigated the effect of a transverse ultrasonic wave on a mold cavity. A 1.5 MHz transverse wave and sonotrode designed to resonate close to 20 kHz with up to 100 µm vibration amplitude. The design was evaluated with modal and thermal analysis using finite-element analysis software. The use of numerical techniques, including computational fluid dynamics, fluid-structure interaction and coupled Lagrangian-Eulerian method, to predict the effect of ultrasound on polymer flow was considered. A sonotrode design utilizing ceramic to enhance thermal isolation was also explored.

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Peer-review under responsibility of the Ultrasonic Industry Association.

Keywords: ultrasound; polymer; melt; processing; finite element; thermal isolation

#### 1. Introduction

Polymer processing is an important and diverse field in the manufacturing industry. By applying vibration to a polymer flow, for example as reviewed in Ibar (1998), its effective flow rate may be enhanced. It is generally believed that the observed improvements are due to one, or a combination, of three possible modes: (1) high shear rate imposed by the vibrating surface that reduces the viscosity of the polymer melt; (2) shearing of polymer chains

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Peer-review under responsibility of the Ultrasonic Industry Association.  
doi:10.1016/j.phpro.2016.12.011

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