RHEOLOGICAL STUDY OF MOLTEN POLYAMIDE 66 CONTAINING DISSOLVED GAS GENERATED IN SITU BY A CHEMICAL REACTION BETWEEN THE POLYMER END GROUPS AND A SPECIFIC FOAMING AGENT

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Polyamide (PA) foam was obtained directly from expandable polyamide pellets by using classical transformation processes, like injection moulding or extrusion, without any additional equipment.

Expandable pellets were prepared by mixing PA and a specific foaming agent in twin screw extrusion. The challenge was to identify a foaming agent stable enough to avoid foaming during preparation of expandable PA pellets that is performed in molten state: melting temperature of PA6,6 is 265°C, a temperature higher than the decomposition temperature of usual chemical blowing agents. This specific agent contains blocked isocyanate moieties.

Foaming takes place in a second step at a temperature higher than the temperature of preparation of the expandable pellets: a temperature high enough to release isocyanate moieties. The chemical reaction of isocyanates with carboxylic acid end groups of PA and water contained in the medium emits CO_2 and other gases which lighten PA and modify polyamide structure.

Kinetics of gases production and structural modifications of PA66 were firstly investigated as a function of temperature, shear rate and amount of chemical blowing agent. It was then possible to study the effect of gases and of the structural modification of PA66 on the melt viscosity by using a standard and an in-line capillary rheometers. To prevent premature nucleation of gas bubbles during viscosity measurements, rheometers were equipped with a counter-pressure device. The challenge was to measure viscosity while the chemical reaction is running, generating gases and modifying the chemical structure of PA.

Influence of pressure on shear viscosity of neat PA66 was firstly investigated. Expandable PA66 was then studied: Chemical foaming agent content, reaction time, temperature and shear rate were modified in order to reach various amounts of gas dissolved in molten PA66. Influence of pressure on shear viscosity of these reactive systems containing dissolved gases was then determined. These data allowed to tune process parameters in order to obtain the right foam structure.