OP-13-240

Tuesday, May 10, 2011, 10:50-11:10 am
Room: Karam 5

LIGHTENED POLYAMIDE 6,6 OBTAINED BY A CHEMICAL REACTION BETWEEN POLYMER END-GROUPS AND A SPECIFIC FOAMING AGENT

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Polyamide 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 polyamide and a specific foaming agent in twin screw extrusion. The challenge was to identify a foaming agent stable enough to avoid foaming during the preparation of expandable polyamide pellets that is performed in molten state: the melting temperature of Polyamide 6,6 is 265°C, a te mperature higher than the decomposition temperature of usual chemical blowing agents. This specific agent contains blocked isocyanate moieties.
The 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 reactions of isocyanates with carboxylic acid end-groups of polyamide and water contained in the reaction medium emits CO_2 and other gases which lighten polyamide and modify polyamide structure.
Preliminary injection moulding trials have led to foamed parts exhibiting a density reduced by approximately 20% compared to standard Polyamide 6,6. Two studies have been performed in order to better control the foam structure and the resulting properties: On the one hand, the kinetics of the gases production has been investigated as a function of temperature, shear rate and the amount of chemical blowing agent. Three experimental set-ups have been built in order to study both the overall kinetics, and the kinetics during the first minutes of the reactions which corresponds to the typical residence time in classical transformation processes. On the other hand, the influence of chemical foaming reactions on Polyamide 6,6 molecular structure and crystallization has been studied by Size Exclusion Chromatography, DSC and X-Ray Diffraction. The reactions lead to an increase of the polymer molecular mass but they do not significantly modify its crystalline structure.