**DESCRIPTION FOR THE GENERAL PUBLIC**

The goal of project will be the investigation whether and in which way the equilibrium density of entanglements is restored in a polymer with lowered density of entanglements. We will determine how the changes in the density of entanglements affect the morphology of a polymer formed during crystallization from melt and its mechanical properties resulting from the morphology. These issues will be investigated on the example of different amorphous (polystyrene) and semicrystalline polymers (polypropylene, poly(lactic acid), poly(ethylene oxide).

Macromolecules of polymers due to their flexibility are able to entangle with other macromolecules. The entanglements of macromolecules are present in the amorphous phase of polymer, in the molten polymer, but are not present in the crystalline structure of polymer. Entanglements are responsible for mechanical, rheological properties, possibilities of processing and crystallization processes. Studies of entanglements typically involve observations of the changes in properties caused by their presence. It is possible to decrease the equilibrium density of entanglements by diluting the polymer and freezing the disentangled state by gelation. The reduced density of entanglements is retained in solid state, while in the polymer melt density of entanglements increases with time and tends to restore the equilibrium density. The incomplete research does not allow for a deeper understanding of the entangling processes, for example whether the entanglements density is restored in full, or how the dynamics of re-entangling depends on temperature. There is also no systematic analysis based on different polymers, how the reduction of entanglements makes easier the crystallization of a polymer and how it influences the properties, in particular mechanical.

The plan of studies includes: a) preparation of polymers with reduced density of macromolecular entanglements and their characterization; b) determination how the entanglements are restored in molten materials and interpretation of results using existing models of thermal motion of macromolecules; c) determination of the influence of density of entanglements on the polymer properties; d) additional experiments, justified by the results of previous studies. Significant results will be described and published on each step of the project.

Materials for studies, having controlled entanglements density, will be obtained by partial disentangling of polymer in dilute solutions. These polymer species will be used in rheological studies for the determination of the density of entanglement and rate of entangling. We will study how the molten, partially disentangled polymer crystallizes, whether there is a change in crystal growth rate and how significant are the differences in crystallinity and crystal’s size. The solidified materials will be used for mechanical tests in compression, to link the degree of entanglements with strain-hardening during deformation. The studies during stretching will show whether a polymer with reduced number of entanglements cavitate and how it modifies the ability for large deformation.

It is known that most of commodity polymers exhibit equilibrium density of entanglements. Only PTFE shows low density of entanglements. The planned experiments will create real possibilities of modification of entanglement density. It would enable to obtain new materials with new properties and new applications, similarly as it happened with disentangled PTFE. We are confident that the accomplishment of the project will broaden and systematize the existing, highly incomplete state of knowledge on chemically identical but physically different materials. and as a result a significant advance in the current state of knowledge will be achieved. Observations for the selected polymers will be representative for the large group of polymers, those which are widely used in industry.