Melt-mixing of immiscible polymer blends can form a broad range of heterogeneous structures [1]. Polymer blend morphology depends on various processing factors and affects their resulting physical properties [2]. The aim of this study was: 1) to describe development of the phase structure in high-density polyethylene/cycloolefin copolymer (HDPE/COC) blend, 2) to investigate the impact of phase structure on selected mechanical properties and compare them with predictive theories [2,3].

**Phase structure and its development.** The specimens of HDPE/COC systems (composition: 100/0, 90/10, 80/20...0/100 wt.%) were obtained by melt mixing followed by extrusion, compression or injection molding. Scanning electron microscope (SEM) Vega Plus TS 5135 (Tescan, Czech Republic) was used for observing the phase morphology. The samples were cut from the center of test specimens, smoothed under liquid nitrogen [3], etched with toluene (5 min, room temperature) and observed in SEM (30 kV, SE imaging). The SEM micrographs were processed with image analysis software (NIS-Elements) to calculate the average size of particles (Fig. 1; morphological descriptor Equivalent Diameter [4]) and the average length of segments of the two phases (Fig. 2; descriptor MeanChord [4], appropriate also for co-continuous morphologies). Tensile tests were carried out by using an Instron tester 5800R (Instron, United States) (dumb-bell-shaped specimens, room temperature, 50.0 mm/min).

**Phase structure and mechanical properties.** The impact of phase structure on selected mechanical properties (such as yield strength; Fig. 3) was experimentally determined and theoretically predicted using equivalent box model (EBM) and linear rule of mixtures (RoM). HDPE/COC morphology analysis showed the fibrous structure at compositions 70/30 and 60/40. The fibrous morphology which is a rare type of structure in the polymer blends occurred in this case due to careful selection of initial polymers and processing conditions. Moreover the resulting structure had a positive impact on mechanical properties: they proved positive deviations from EBM predictions, as indicated in our previous study [2].

**References**

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Fig. 1: SEM micrograph of smoothed and etched surface of injection molded HDPE/COC=70/30 blend with fibrous morphology perpendicular to the injection direction.

Fig. 2: SEM micrograph of smoothed and etched surface of injection molded HDPE/COC=70/30 blend with fibrous morphology parallel to the injection direction.

Fig. 3: Yield stress of HDPE/COC blends as a function of COC content and their theoretical predictions: rule of mixtures (RoM), equivalent box model (EBM).