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HOT-COMPACTION OF SELF-REINFORCED POLYCARBONATE FILMS

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Self-reinforced composites completely consist of layered self-reinforced thermoplastic fibres or tapes.Therefore, they require no foreign reinforcement materials, such as carbon, glass or natural fibres. Their principle of macromolecular alignment leads to outstanding mechanical properties, e.g. exceptional strength, high stiffness and impact resistance, low density. These qualities are simultaneously combined with excellent recycling abilities (single-polymer system). The implementation of self-reinforcement is achievable by means of solid phase deformation of the macromolecules. This method is common for semi-crystalline thermoplastics like PP, PE and PET. In polycarbonate the amorphous molecular chains align themselves in the direction of stretching, whereby the original structure is altered. Consequently, the orientation of the molecular structure and the upward gradient of secondary valence forces cause an increase both in stiffness and in the Young's modulus. The challenge is to transfer the enhanced mechanical properties, which were obtained by means of self-reinforcement, onto composite materials. Therefore, the uni-axial oriented PC films will be layered and hot-compacted regarding selected, exact temperature-, pressure- and time-parameters. Thus, it is mandatory to take the interaction of the processing parameters into consideration. During the hot-compaction process it must be ensured that the self-reinforcement of the films previously implemented via stretching be preserved and, accordingly, a loss of the mechanical properties prevented. Paradoxically, an adequate consolidation degree must be attained for the layered film composites, in order to fulfil the requested composite properties. Different types of PC films were layered and thereafter hot-compacted according to an experimental design to achieve comparability between the orientation degree and film thickness. We hereby focused on un-oriented as well as 1:2 and 1:3 mono-axial oriented films in our research. The mechanical properties were characterized quasi-statically to obtain the composite properties needed to examine whether the transfer of the orientation of the films onto self-reinforced PC-composites was successful.