Abstract

Long fiber reinforced plastics with thermoplastic resin were steadily growing with an ongoing success over many industries mainly automotive. Even during economically difficult periods, they increased their output and their market share.

In addition to flow compression molding, semi-finished LFRT in form of granules were introduced to new processes like injection molding.

This work covers two major topics to enlarge the performance of LFRTs. Firstly, it shows a material development, which leads to flame retarded LFRT. Secondly, it presents a new process method to improve especially dynamic mechanical properties by laminating two compression molded sheets with no additional equipment.

One major restriction for further applications is represented by flammability of thermoplastics. This thesis gains for a new potential. Encountering future legislative restrictions a combination of halogen-free flame retardant and LFRT based on polypropylene has been developed. Test results match the requirements in accordance to flammability test UL 94 V0 (2.6 mm). Furthermore the mechanical properties achieved a similar performance as standard-LFRTs. The polymer flow in compression molding provokes a fiber orientation parallel to the direction of the flow front development. A x-ray analysis in combination with a fiber orientation analysis show, that rheology has a strong influence on the flow front development, fiber orientation and compression work needed.

One advantage of flow compression molding is the free option in placing the polymer melts in the cavity. The common mold design with male and female mold without slides allows changing part thickness by different polymer melt volumes charged in the cavity. This allows to proceed the compression molding process twice without demolding the first part. On a flat panel, the process of laminating two sheets by compression molding is demonstrated. A first panel gets over molded by a second polymer melt. This laminate provides a better performance than a singular molded panel of the same thickness.

The higher substrate’s temperature the better is the adhesion of the first to the second layer. Additionally, the best adhesion is achieved in the area of the second polymer melt cavity placement. Furthermore an optimum in mechanical properties can be obtained utilizing the same resin for the first and the second layer. A more advanced material is shown with the combination of a standard-LFRT layer and a flame retarded layer.

Calculations show, that the flame retardancy of LFRT on polypropylene can be economically advantageous in comparison to the utilization of higher flame resistant polymer for large parts. Nevertheless for each specific geometry as well as for certain mechanical demands an evaluation on the best material to fit has to be carried out.

This work shows economically reasonable options either to improve the mechanical performance and to enlarge materials properties by flame retardancy or to combine both.