Rotational Molding

Motivation

Rotational molding is a processing technology capable of producing seamless hollow structures with very low residual stresses (Fig. 1). Complex geometries with a well distributed wall thickness can be manufactured in a broad range of sizes up to more than 100.000 litres in volume (Fig. 2). The technique therefore competes with other processes for the production of large volume components, such as blow-molding or thermoforming and excels due to its low-cost mold- and system-technology, which makes it the preferred method especially for small series production.

Application

Well known product representatives are water and fuel tanks as well as sporting goods such as kayaks and boats. Rotationally molded components can also be found in product categories such as machine housings, transport- and safety-containers, toy parts and furniture. The most commonly used materials are thermoplastic powders. Polyethylene accounts for over 80 % of the materials used in this processing technology (Fig. 3). In addition to thermoplastics, reactive systems and plastisoles are common base materials for rotational molding.

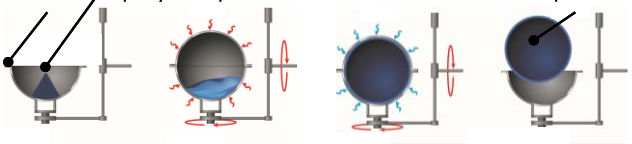

Fig. 1: *Process steps of rotational molding*

Fig. 2: *Rotational molding machine at LKT*

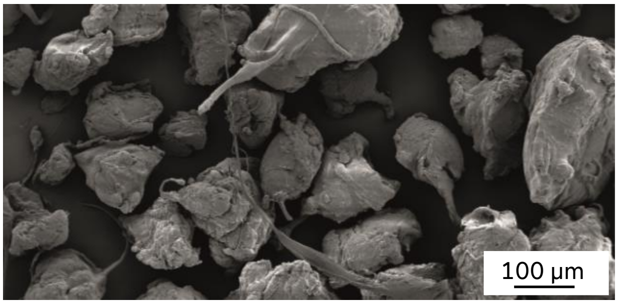

Fig. 3: *Polyethylene powder for rotational molding application*

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Research focus

Due to an increased awareness of sustainability among the population a new process has been developed for foaming without blowing agents in rotational molding. Process related air inclusions in the polymer melt are exploited and act as nuclei for cell growth by means of vacuum application. This approach takes advantage of the fact that the air in the enclosures will expand when the pressure is reduced, in accordance with the ideal gas law. The use of cost-intensive chemical blowing agents with a potentially harmful effect on the environment and human operators is made obsolet. Furthermore, the use of microgranulate as a starting material instead of powder is being investigated. Expensive grinding processes would no longer be necessary if successful results were achieved. A major research focus lies on investigating the influence of particle shape, size and size distribution with particular regard to the resulting air inclusions and, based on this, the foam structure that arises in the vacuum assisted rotational foam molding process.

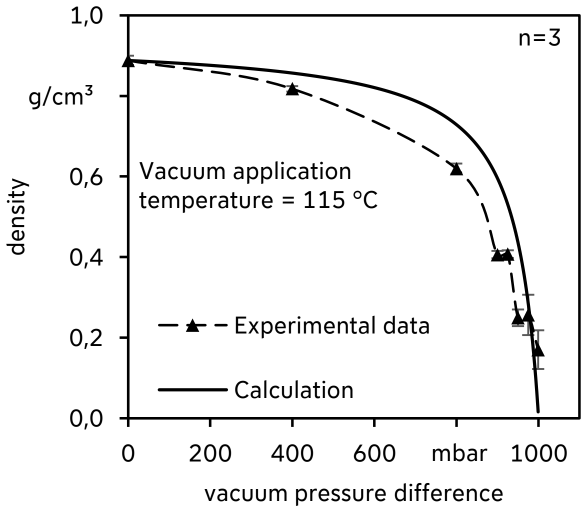

Fig. 4: Density profile as a function of the differential pressure between vacuum and atmospheric pressure

Main research results

The new process approach does allow the generation of foamed structures in rotational molding without the addition of chemical blowing agents. The foam density showed a dependence on the process variables, pressure and temperature (Fig. 4). Possible density reduction by a factor of five represents another major potential compared to competing foam processes. Furthermore, it could be proven, that the initial bubble concentration in the melt is significantly influenced by the particle format and particle size and has a corresponding effect on foam formation (Fig. 5).

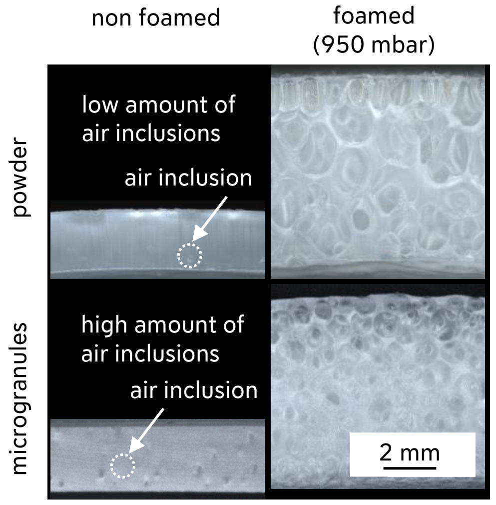

Fig. 5: Influence of particle format on air inclusions and corresponding foam structure

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