

## Opel and BASF develop a novel plastic part to protect pedestrians: Lower bumper stiffener made from Ultramid®

### Case Study

During the development of motor vehicles with improved passive protection for pedestrians, Adam Opel GmbH in Rüsselsheim, Germany, entered into a cooperative effort with BASF and created a new plastic part that is instrumental in meeting pedestrian protection requirements in the vehicles of the future. The so-called lower bumper stiffener (LBS) is a functional part made of Ultramid® B3WG6 CR, the glass fibre reinforced polyamide 6 developed by BASF for crash applications. The LBS weighs about one kilogram, is one meter long and is installed behind the front bumper so as to diminish the risk of serious knee injury in the event of a collision with a pedestrian. En route to developing the LBS, BASF deployed its new method of integrative simulation.

Statutory regulations have been an integral part of the type-approval certification in Europe since October 1, 2005 (Directive 2003/102/EC), and consumer protection organizations such as EuroNCAP (European New Car Assessment Programme) also conduct pedestrian protection analyses of new vehicles. Moreover, the stipulations made in the rating tests of underwriters (the Research Council for Automobile Repairs – RCAR, the German Insurance Association – GDV) also have to be met. In the quest to fulfil all of these conditions, the entire design concept of the front end of the vehicle is put to the test.

When designing the LBS on the computer BASF turned to its newly developed numerical material model which not only takes into consideration the non-linear viscoplastic behaviour, but also the anisotropic, that is to say, directionally dependent, behaviour of glass fibre reinforced thermoplastics. Along with the material parameters of the pure plastic, the content, geometry and orientation distribution density of the fibres in the finished part all enter into the computation. This method, which is referred to as integrative simulation, is fed, on the one hand, with

the findings from a classic mould-fill simulation and, on the other hand, with the experimental data obtained from a special high-speed measuring device made by BASF. This yields the part shape that complies with the requirements as well as the optimum mould design.

Without having to perform all too many costly tests, this refined simulation method succeeded in designing the LBS in such a way that it fulfils the requirements made by the pedestrian protection directive. At the same time, if the vehicle crashes against a stationary obstacle where the load is much higher than in the case of impact against a leg, damage to other parts in the front end of the vehicle is prevented in that the LBS systematically fails. This lowers repair costs and translates into more favourable insurance ratings. The method of integrative simulation can image short glassfibre-reinforced plastic parts much more realistically than all other known methods. The integrative description of the material behaviour considerably improves virtual vehicle development.

