Case Study

Oil module in Durethan® AKV 35 H2.0 SR1

Fig. 1 Oil module

Grade: Durethan AKV 35 H2.0 SR1

Manufacturer: MANN+HUMMEL

OEM: Volvo

System supplier MANN+HUMMEL has been producing oil modules in Durethan® AKV 35 H2.0 SR1, a polyamide 66 with 35 percent by weight glass fiber, since 2003. The substitution of aluminum led not only to weight savings but also to cost advantages in production, finishing work and assembly.

The module for Volvo shown in Fig. 1 is made up of four plastic components: the filter cap, filter body, oil separator and base plate.

The assembly has to meet considerable demands on its stiffness and strength. The module must pass a test in which it is subjected to a pulsating internal pressure of more than 10 bar over hundreds of thousands of cycles at 150 °C. To achieve this, it was necessary to establish the optimum part design at an early stage of the project. LANXESS employed state-of-the art CAE methods to this end, including topology and design optimization, as well as “integrative simulation”.

One of the areas to be optimized in co-operation with MANN+HUMMEL was the flange joining the filter body and the oil separator (Fig. 2).

Fig. 2 Flange

To ensure a tight connection, an elastomer seal located in a groove on the filter body flange is compacted during assembly. To prevent any leaks, a sufficient contact pressure must be guaranteed at all temperatures and oil pressures. The flange region was successfully stiffened with the aid of topology optimization, making allowance for the particular demolding direction of the part.

At the side of the filter body is an oil line which joins the cylindrical wall below the thread, thus forming an opening there.

Fig. 3 Filter body (CAD model and part)

This opening was originally meant to be rectangular in shape. In the simulation, however, it was seen that excessively high stress peaks developed in the corners, which would have caused the part to fail. The contour of the opening and the lip-shaped thick sections were thus modified in a design optimization step. The best contour that was finally established in the simulation (see Fig. 3) is reminiscent of a window in a passenger aircraft. Here again, it was possible to considerably enhance the mechanical strength of the structure long before the first parts were injection molded and tested.

The following properties of Durethan® AKV 35 H2.0 SR1 are particularly important for the use of this material in oil modules:

- high stiffness and toughness
- high temperature resistance
- good weld line strength
- excellent chemical resistance
- low warpage and high dimensional stability
- very good surface finish, particularly in the region of the sealing grooves