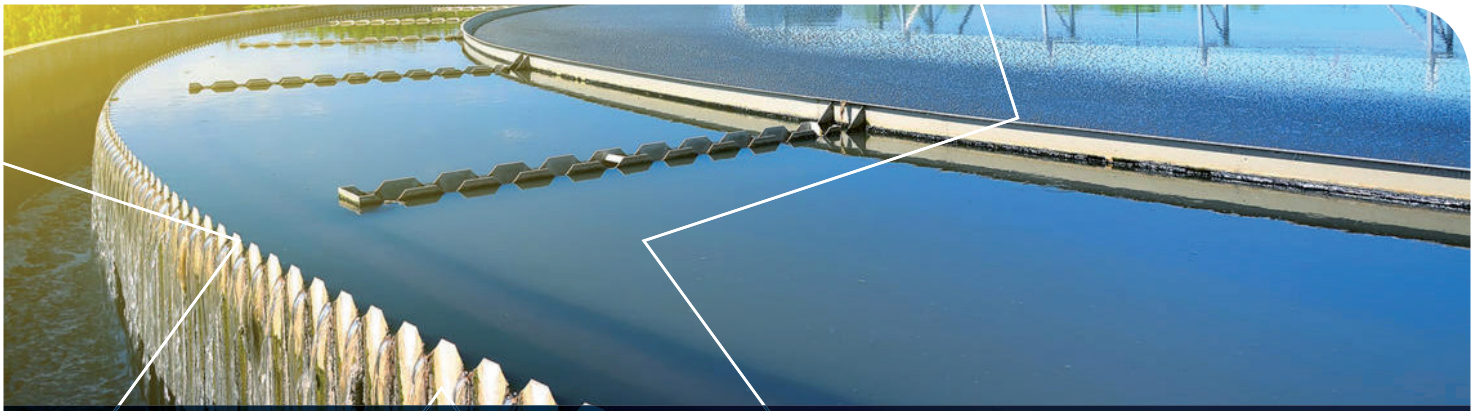
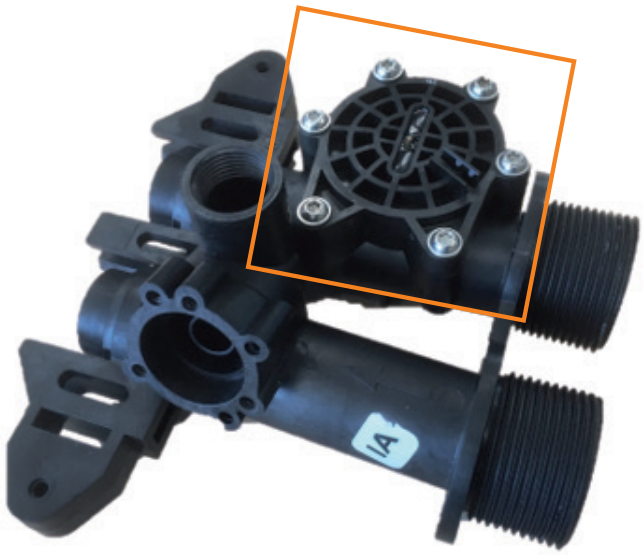


Water meter cover product optimisation

The project

Over the years water management systems like water meters, filters, housings, valves etc. are increasingly made of plastics through injection molding. Plastics offer many advantages over traditional metal systems like corrosion resistance, light weighting, measurement accuracy, design freedom and obviously lowers costs. Code Product Solutions in collaboration with the material supplier Sabic further optimised an existing water meter cover which is part of a soft water system in order to fulfil more stringent requirements for a new market.



The challenge

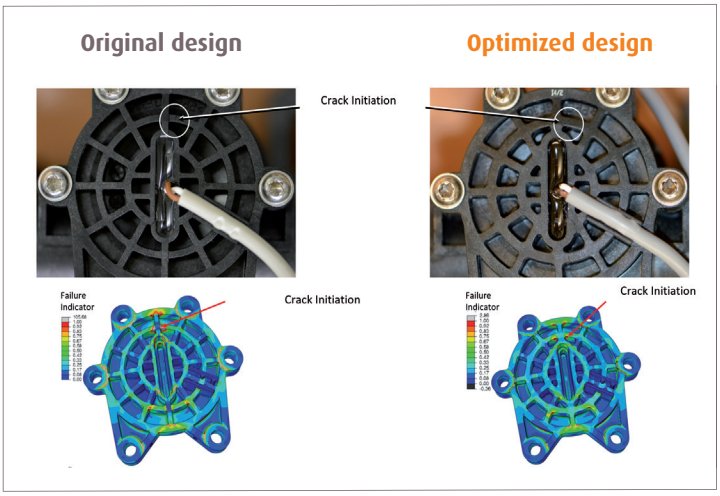
The water meter shown in the above figure is part of a water softener assembly and it is made of NORYL™ (short glass fiber reinforced PPO™/ PS). The original design was developed to fulfil the requirements of DIN for the European market. But, a foray into other markets required that the water meter cover had to meet a higher burst pressure requirement.

The challenge was to find a cost-effective solution to adapt to the changed requirements with the lowest possible change to the existing design that could be implemented in the existing tool.

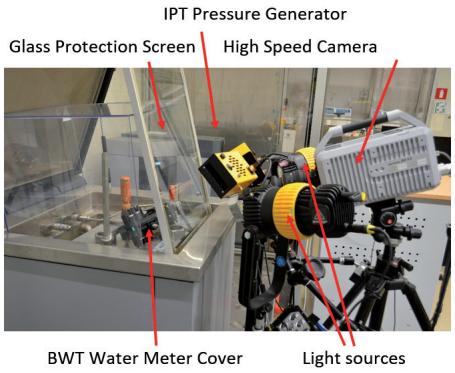
Our solution

To seek a solution the application experts from BWT, Sabic and Code Product Solutions worked together in a CAE- driven development process. The original design was analysed using integrative simulations that allow anisotropic description of the material behaviour enabling accurate prediction of the parts strength and failure characteristics locally like the location of the crack and the instant of load at which the crack was initiated.

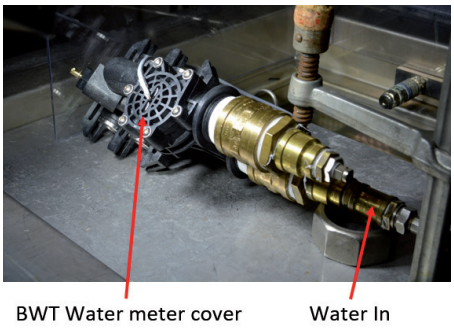
The part was optimized with minimal design changes to match the higher requirements. In the optimized design the location of the failure remains unchanged but the time to failure was delayed to higher pressures as shown below.



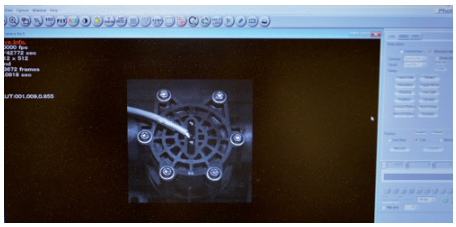
The simulation was validated by an actual burst pressure test of the part. At 23°C, the pressure was increased at a rate of 0.5 bar/s till failure of the part. The high-speed camera with a frame rate of 80,000 fps records the crack propagation in slow motion and hence accurate insights into the failure development and progression. It was observed that the CAE led optimisation process has increased the burst strength of the part by 30%.



1) Experimental setup of the burst pressure test



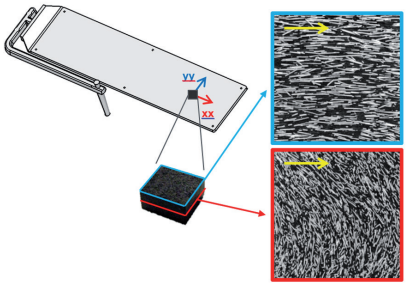
2) Test part with water inlet



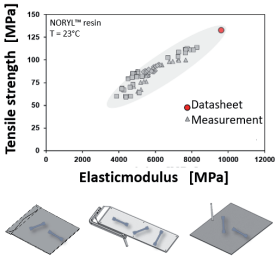
3) Test evaluation on the computer

Accounting Anisotropy

Plastics offer multiple benefits in water management applications. However, during product development with plastics there are aspects which may be trivial with respect to metals but here may have a huge influence and need to be considered. These aspects can be material specific properties or manufacturing induced influences. In Water management fiber reinforced thermoplastics (FRTP) are used to obtain maximum mechanical performance. During injection molding, due to the flow process complex fiber orientations and varying fiber lengths are induced which alter the mechanical properties varyingly in different locations.



1) CT scans show Fiber orientation distribution in the skin (marked as blue) and in the core (marked as red) (yellow arrows are flow direction)



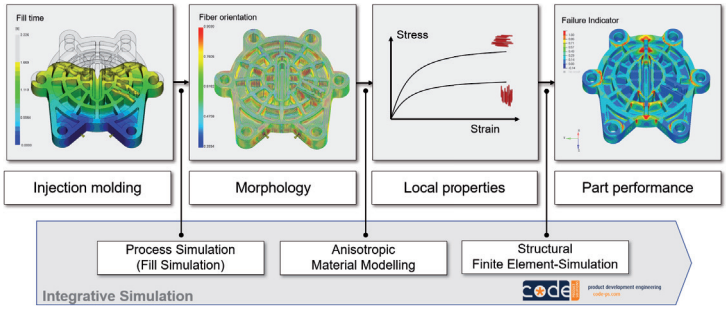
Factor **2x** in stiffness/strength

2) Effect of different fiber orientation on the mechanical properties

In addition, injection molding causes weld lines, which is undesirable in a highly stressed area. Therefore, the application engineer cannot rely solely on the isotropic traditional development approach but also consider the above factors leading to an increased complexity in the design and optimisation of the injection molded part.

Integrative simulations

In order to predict the part behaviour arising from morphology, the combination of process simulations and structural analysis simulations has proven to be effective. Using state of the art tools the anisotropic property of the material based on the fiber orientations predicted in the filling simulations is described by a special material model. Therefore, the local material properties are accurately mapped at each node of the component. This means the quality of results is more accurate and validation experiments confirmed it in this case.



Conclusion

Integrative simulations are an integral part of the services provided by Code Product Solutions to support customers in the development of Water management applications. These integrative simulations have also largely improved the accuracy of fatigue and creep prediction. Integrative simulations therefore are not limited only to optimization of existing components but can be an effective partner in evaluation and optimization in the design stage itself. The benefits are many for example reduction in time and costs due to minimal design changes on prototypes in existing tooling.

Our achievements

- Minimal design changes which can be accommodated in existing tool
- Optimization leading to 30% increase in burst strength
- Validation of simulation models with lab tests
- Cost savings as no tool change was required