Packaging excellence with MSC Dytran

TOTAL packaging solutions coupled with high service levels, technical support, competitive filling systems and, ultimately, lower costs are the hallmarks of Nampak Liquid.

To maintain its technology leadership positon in the packaging industry, Nampak R&D has invested in advanced simulation technologies from MSC.Software. Using this technology, Nampak R&D recently conducted a study designed to gain an understanding of the behaviour of fluid filled bottles under certain loading conditions. The technology of finite element analysis (FEA) was used to simulate the behaviour of bottles and to correlate the results of the analysis with bottles tested in the laboratory. As this approach of solving a fluid filled bottle simulation is a relatively new FEA method, there was no available data on the percentage difference between the FE prediction results and physical laboratory data. Nampak made use of MSC. Dytran for the simulations as it has the ability to include the fluid, air and the bottle in the simulation.

A generic one-litre PET bottle, with a mass of 35g, was selected for analysis. Top loading of the bottle was performed to the point of bottle failure. In this study, bottle failure was defined as the point at which the resistive load drops with an increase in compression displacement.

Designed for solving dynamic events and enabling the effect of water volume and air volume inside the bottle to be taken into account, the MSC.Dytran simulation used two different top-load speeds, to see if varying speeds had an effect on the accuracy of the solution. As the MSC.Dytran model does not consider the static pressure effect exerted by water on the bottle's side walls, a third model was run taking this hydrostatic pressure into account.

The results

After all the physical tests were conducted it was clear that the point of failure was at the bottle neck. The FE model predicted that failure would occur at the exact same place as the physically tested bottle. The three different MSC.Dytran models all gave correct top-load failure predictions which were within 8% of the tested values. The most accurate model was the one which also included the water hydrostatic pressure in the bottle which had an error of only 3% from the test results. The effect of running the simulation top-load at different speeds did not have any significant effect on the results.

The results of this study suggest a good correlation between the MSC.Dytran filled bottle analysis and physical laboratory test data. As with any FE model there will always be a certain degree of uncertainty in material properties, thickness and geometry. Based on the results of this study it is suggested that an acceptable error of 10% between FE predictions and actual physical testing is reasonable.

Martin Sheen, project manager at Nampak R&D's Customer Solutions Centre, explains how simulation is becoming a key element in designing and manufacturing plastic bottles.

'MSC.Dytran has established itself as a vital component in the design of plastic bottles. We are now able to do a reliable filled bottle analysis on a proposed design prior to costly mould manufacturing. This not only allows our customers to be confident in the initial design but also permits wall thickness optimisation which relates to raw material savings and thus lower production costs,' he says.

T +27 012 9919080
www.msc-africa.co.za
Nampak R&D
T +27 021 5905800
www.nampak.co.za