MULTIPHYSICS SIMULATION FOR PACKAGING

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ABSTRACT

Fluid Structure Interaction (FSI) problems involve the coupling of moveable or deformable structures with fluid. It is a common, yet still complex, type of multiphysics problem.

This presentation will focus on how FSI techniques are being applied in packaging to study, improve, and optimize packaging designs. Common packaging FSI applications include filling, conveying, and dropping. In these scenarios, structural loading due to fluid behaviors such as sloshing and water hammer cannot be easily and accurately simplified; thus, FSI approaches must be employed to accurately simulate the package and ensure that it meets performance requirements. In recent years, the rapid growth of e-commerce has placed higher demands on package requirements. Additionally, sustainability considerations have led many manufacturers to light-weight their packages, reducing material costs and subsequently weakening packages. Simulation is being used to develop better packages that are strong enough to survive their lifecycle and maintain their contents without breaking or leaking.

Various approaches, including the Arbitrary Lagrangian-Eulerian (ALE) and Smooth Particle Hydrodynamics (SPH) methods, have been used to model these types of FSI problems. FSI models can be very computationally expensive due to the large number of elements needed to adequately model the fluid within the structure; they often require extensive effort to debug due to issues with properly coupling the fluid to the structure; and they can be difficult to validate. FSI problems also require a broad skillset, as the analyst must be familiar with details relating to both structures and fluids.

This presentation will discuss modeling limitations, scalability, results fidelity, and the types of physics that can be modeled. It will also showcase example FSI models for packaging and how FSI simulation is being used to solve real-world challenges in the packaging industry. While the discussion will speak in general terms about FSI problems, most examples presented will be models run using LS-DYNA.

And finally, three actionable takeaways from this presentation will include:

- knowing when to employ the FSI approach
- understanding FSI capabilities, challenges, and limitations
- learning basic checks to verify model accuracy.