

PRESS RELEASE

Low-loss bottle filling

Keeping it calm

- Beverage sloshing at high filling capacities causes loss and soiling
- KHS analyzes bottle and machine parameters using simulation
- Around 850 CFD calculations for optimization performed to date

Bad Kreuznach, September 4, 2025 – If, at high filling capacities, beverages slosh out of the bottle, levels of efficiency and hygiene suffer. KHS prevents this by drawing up extensive calculations.

If beverage filling is to be safe with little loss, physics comes into play: given the rotation speed and change in direction, especially at the transition from the transfer star to the closure system, high levels of centrifugal force act on the content of the containers. This can cause liquid to slosh out of the bottle. This may only comprise a few drops of spillage at a time – but with up to 90,000 fills an hour, the amount of product lost soon mounts up. Another aspect is hygiene. It's not hard to imagine that on the one hand, sloshed sugary beverages soil container necks and closures, with mold even being formed in some cases. On the other, the machine is also contaminated. This in turn increases cleaning requirements and takes up valuable production time.

Two groups of parameters

In order to counter this, Dominik Weirich has been drawing up CFD calculations since 2013. "Ever higher filling outputs mean that the technology's reaching its physical limits, so that we also have to take liquid sloshing into account when designing the machine," says the KHS development engineer at the factory in

Bad Kreuznach, Germany. Data collected from the simulations he carries out form the basis here. “First, we take a look at the geometric parameters of the beverage containers themselves: here, we investigate the impact the bottle shape, fill height and neck diameter have. This is done in close consultation with our [Bottles & Shapes](#) experts, especially in conjunction with new line projects, when changes are made to the geometry or the bottle weight is reduced, for example. Second, we have the physical parameters of the machines. These depend on the capacity, machine pitch and diameter of the stars. Adjustments can be made here relatively easily. Adapting the containers, however, is usually an iterative and more extensive process.”

Increasing number of simulations

As a rule, it can be said that the larger the product surface and the closer the beverage is to the bottle mouth, the more likely the liquid is to slosh. This interaction of the various factors requires calculations to be made that are then included in both the design engineering and the offers for the machinery. Weirich has already performed about 850 of these simulations – with this number continuing to rise.

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Pictures and captions

(Source: Frank Reinhold)

Picture captions

High centrifugal forces

Different centrifugal forces act on the product in the bottle as it passes from the filler to the transfer star and capper.

Dominik Weirich

KHS development engineer Dominik Weirich has been carrying out fluid dynamic calculations in Bad Kreuznach, Germany, since 2013.

About the KHS Group

The KHS Group is one of the world's leading manufacturers of filling and packaging systems for the beverage and liquid food industries. Besides the parent company (KHS GmbH) the group includes various subsidiaries outside Germany, with production sites in Ahmedabad (India), Waukesha (USA), Zinacantepec (Mexico), São Paulo (Brazil) and Kunshan (China). It also operates numerous sales and service centers worldwide. KHS manufactures modern filling and packaging systems for the high-capacity range at its headquarters in Dortmund, Germany, and at its factories in Bad Kreuznach, Kleve, Worms and Hamburg. The KHS Group is a wholly owned subsidiary of the SDAX-listed Salzgitter AG corporation. In 2024 the KHS Group and its 5,626 employees achieved a turnover of around €1.654 billion.

PR contact

KHS GmbH
Alisa Altrock
(external PR consultant)
Phone: +49 251 6255 6123
Fax: +49 251 6255 6119
Email: khs@information-presse.de
Website: <https://www.khs.com>

Media contact

KHS GmbH
Eileen Rossmann
(external media consultant)
Phone: +49 711 26877 656
Fax: +49 711 26877 699
Email: eileen.rossmann@mmb-media.de
Website: <https://www.khs.com>