A Better Way to Make Medical Instruments Come Clean

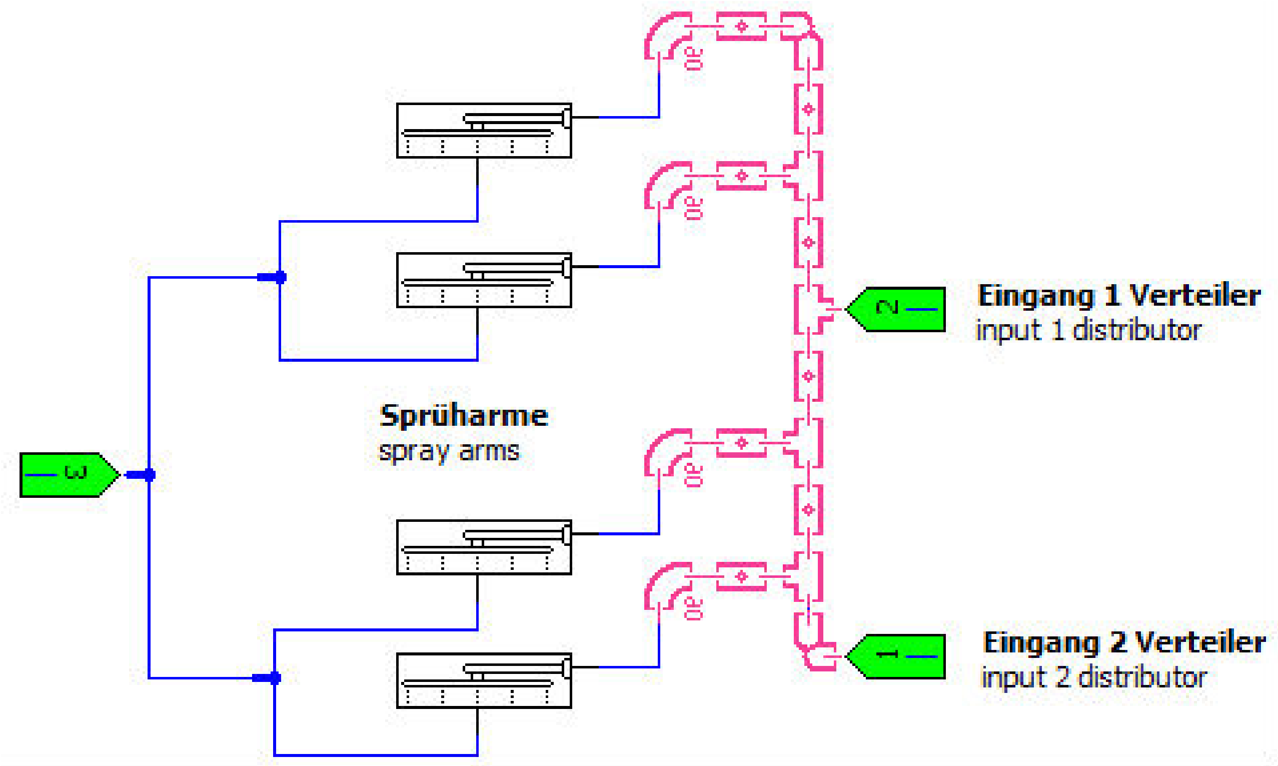
LMS

Founded in 1899, Miele is a world leader in premium domestic products such as cooking, baking, and steam-cooking appliances; refrigeration products; coffee makers; dishwashers; laundry; and floor-care products. Miele also produces specialized dishwashers, washer-extractors, and tumble dryers for commercial use as well as washer-disinfectors and sterilizers used in medical and laboratory settings.

In efforts to continuously improve its product lines, the company was particularly interested in improving the development of its washer-disinfector machines. “The major development challenge with washer-disinfector machines is the variety of items that need to be cleaned,” says Tobias Malec, development engineer at Miele. “Each piece of every medical instrument has different cleaning requirements. Some things only need cleaning on the surface. Other items, such as hollow instruments, need to be cleaned both inside and out. Different water pressures are needed in each case.”

Working with Special Racks
Due to these requirements, a special rack is tailored to every item that needs cleaning to enable the best possible handling and hydraulic performance. Each rack secures the items being cleaned, and includes the hydraulic connections between the circulating pump and the nozzles through which water sprays.

The variety of racks makes it difficult to harmonize the entire production system. It is essential to adapt the frequently changing hydraulic conditions of the rack, and to understand the cleaning pressure required during the operating state inside each rack. The cleaning pressure results from the intersection point of the hydraulic resistance curve of the rack and the characteristic of the circulating pump.



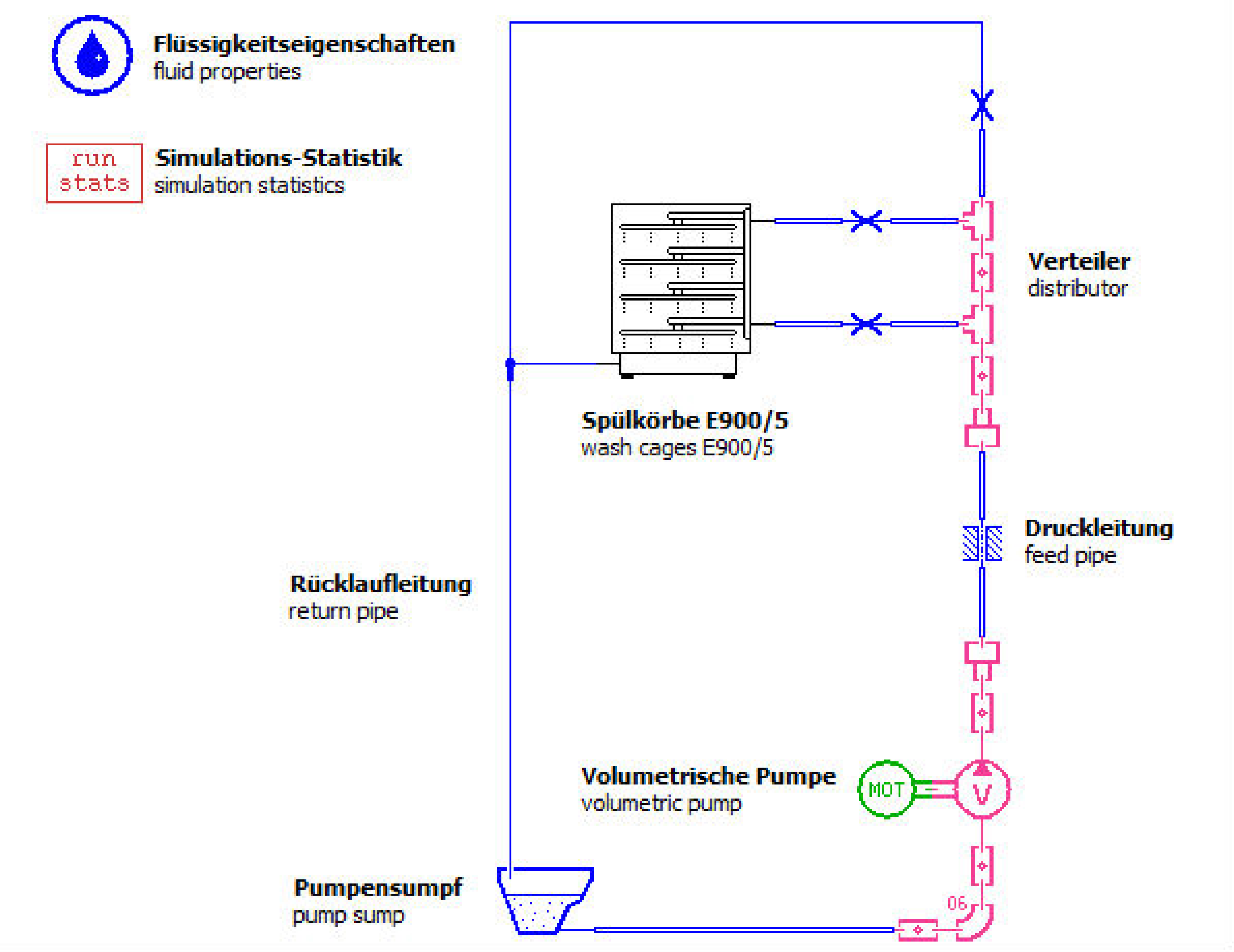
For this engineering challenge, Miele uses the mechatronic system simulation software LMS [1] Imagine.Lab AMESim. This solution from Siemens PLM Software helps Miele engineers simulate the operational characteristics of new products early in the design stage, revealing ways to improve functionality while reducing the need for physical prototypes. “Using LMS Imagine.Lab AMESim enables us to model the racks as super- components, with the circulating pump operating as a characteristic and the washing machine itself as a system boundary,” says Malec. “Thanks to the system simulation, we can evaluate future operating points by changing the geometries of the cleaning nozzle or the water lines.”

He notes, “Using this software, we are now much more effective in the pre-development phase. Before, without the support of LMS Imagine.Lab AMESim, we had to build a real prototype of the washing machine and perform multiple pressure measurements. Afterwards, based on the pressure results, we needed several redesign loops in the prototype phase to reach the required specifications. This was very time-consuming and costly.”

A typical model prepared using AMESim includes hydraulic and hydraulic-resistance components. The machine is modeled, including its water lines and the circulating pump. The water lines include back-pressure valves and a coupling with the rack models. Some nonstandard valves have been customized and are represented by generic elements, such as orifices or t-junctions, which are validated by internal measurements.

A cleaning rack consists of a network of jets and pipelines connected with two coupling points of the machine. To ensure that compatibility and clarity are quickly achieved, the rack is integrated into the model as a super-component and is represented with an icon.

Mechatronic System Simulation Is the Key
The various pumping rotation speeds are then tested virtually. This allows Miele to investigate the pressure evolution on predefined sensor positions to validate the simulation model. The machine operating state is quasi-static, so dynamic examinations are negligible for those types of investigations. The simulated pressure values provide the basis to make adjustments in rack design.



“System simulation enables us to easily study the impact and interactions of cross-section changes,” says Malec. “Changeovers can be optimized or nozzle parameters varied to achieve a more constant pressure distribution. Constant pressure distribution enables good cleaning capacity in all parts of the machine.”

The Design Exploration capability also helps establish consistency for the spray arms. By setting targeted boundary conditions and defining degrees of freedom, the optimal nozzle configuration can be found quickly using AMESim.

“System simulation is an extension of the common 3D computational fluid dynamics (CFD) simulation on a subsystem level,” says Malec. “Correlations become clear very rapidly. Without system simulation, these correlations can only be realized using measurements on expensive prototypes.”

Malec concludes, “The longevity and high quality of our products address the sustainability issue. Our customers don’t have to buy a new machine every few years, but can rely on our consistent quality. That doesn’t just save money, it is also good for the environment. We are also reducing our consumption of resources and using ecologically sound materials for production.”

Links:
[1] http://www.lmsintl.com/