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ADVISIM
Virtual Cleaning Simulation

WHITEPAPER

Cleanability is decided in design. Not in production.

Why CIP systems often clean differently than planned once they are built, what this means for production, QA and food safety, and how this risk can be reduced as early as the design phase.

For process and design engineers in the food, beverage, pharmaceutical and chemical industries

The volume flow application method used for the simulation was scientifically reviewed by TU Dresden (Dresden University of Technology) in December 2025.

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At a glance

- Cleanability is decided in design, but rarely verified there. If flaws only show up months after commissioning, fixing them can be expensive.
- Experience and auxiliary CAD geometries reach their limits with complex plants and vessels. CFD is precise, but too costly and time-consuming for everyday design work.
- The virtual cleaning simulation ADVISIM3D closes this gap: spray shadows become visible on the 3D model before anything is built.
- In 2025, TU Dresden confirmed that ADVISIM3D delivers results that come very close to CFD accuracy, in seconds instead of weeks and on a standard PC instead of a high-performance computer.

Who is this relevant for: Process and design engineers who design, validate or approve CIP systems

What is this whitepaper for?

In hygienic design, cleaning simulation is not a niche topic. It removes one of the most persistent blind spots in plant and vessel engineering: the uncertainty as to whether a CIP system really reaches every surface, before the plant has been built, accepted and put into production.

This whitepaper makes the case for verifying cleanability during the design process, because practical tools for doing so are now available.

Plant and vessel manufacturers who back up their designs with simulation offer their customers in the food and pharmaceutical industries significant added value, along with greater **confidence and documented evidence that the plant will stand up to a hygiene audit.**

Who wrote this whitepaper?

The author is ADVITEC Informatik GmbH. Some background: the Fraunhofer Institute for Process Engineering and Packaging (IVV) in Dresden has been working on the cleaning of process plants for many years and is regularly consulted on complex spray cleaning systems. To support this advice empirically, a powerful visualization tool was needed.

In 2014, the SIMKOR research project, funded by the German Federal Ministry of Education and Research (BMBF), was launched with ADVITEC Informatik GmbH as consortium leader, together with Fraunhofer IVV and Innovations- und Simulationsservice Festenberg. The shared goal was to develop

a software-based simulation that provides realistic predictions of cleanability as early as the design phase. From 2017 to 2020, SIMKOR was tested under real conditions by alpha and beta customers from industry.

Once its functionality and potential had been confirmed, ADVITEC Informatik GmbH worked with practitioners, researchers and manufacturers to develop the software into ADVISEM3D, a highly efficient digital tool. It has been in productive use with customers in the food, beverage, pharmaceutical and chemical industries since 2020.

10 million m³

According to the SIMKOR consortium, optimized cleaning design could save an estimated 10 million m³ of fresh water and wastewater per year in the German food industry alone. On top of that come considerable savings in energy, cleaning agents, time and personnel.

1 The foundation: three visible factors and one invisible one

CIP, short for Cleaning in Place, cleans tanks, vessels and process plants without disassembly: cleaning fluid is delivered to all surfaces through permanently installed nozzles. The principle has been established for decades. So why do so many CIP systems fail unnoticed months after commissioning? The answer lies in physics.

Cleaning technology refers to the TACT parameters: Time, Action, Concentration, Temperature. Time, chemical concentration and temperature can be measured, controlled and continuously monitored via process control systems. This does not apply to the fourth factor, mechanical action, i.e. the cleaning effect generated mainly by the liquid impinging on the vessel wall. It depends on the nozzle type, the nozzle's operating pressure, the flow rate and the exact geometry of the vessel.

"If the liquid jet does not hit the tank wall with sufficient mechanical force, the other three factors (temperature, concentration and time) can no longer make up for it."

In the words of an experienced CIP trainer and EHEDG member with more than 35 years of hands-on experience at international manufacturers

Without sufficient mechanical action on the wall, all other measures fall flat: more chemistry, longer contact times or higher temperatures cannot compensate for a nozzle that fails to reach a surface, or reaches it insufficiently. Mechanical action is a *conditio sine qua non*, not one of several equally

important adjustment levers. And it is determined by decisions made months before the first cleaning cycle: in the design process, without any direct feedback on whether they work.

The core of the problem: cleanability is created in design, but flaws only become visible later. When the riboflavin test or the ATP swab test fails on the finished tank, or after months of production, it is too late for simple solutions.

2 How CIP systems are designed today

When designing CIP systems, the industry often relies on experience, design guidelines and physical tests. At the same time, requirements are rising due to more complex vessel geometries, more process connections, stricter hygiene regulations and shorter validation cycles. The consequences range from higher resource consumption and costly rework to audit findings whose root cause lay in the design.

On top of this comes a systemic pattern: because reliable predictions are lacking, cleaning processes are oversized for safety reasons, with more chemicals, more pressure and longer run times. Not because it is necessary, but because nobody can say for certain that less would also work. This systematic oversizing on the principle of “more is better” costs the industry more water, energy and cleaning agents than necessary every single day.

Experience: a foundation with blind spots

Anyone who has spent years designing and operating CIP systems develops a feel for critical geometries, typical spray shadow patterns and proven nozzle concepts. This knowledge is real, hard-earned and saves processes every day.

But personal expertise has a structural limit: it is tied to individuals, transfers poorly to new geometries and new colleagues, and by its very nature only covers what has already gone wrong in the past. Whatever is lurking in the next design as an undetected grey zone or spray shadow, waiting for the first production run, is terra incognita, even for the expert.

Auxiliary CAD geometries: good practice with a built-in limitation

Without more precise tools, engineers draw auxiliary cones and angle geometries in CAD to estimate spray angles and theoretical coverage. This is not bad practice. Nor does its limitation lie in CAD software being restricted to two dimensions. Modern CAD systems are, of course, fully 3D-capable.

Its limited validity stems from the fact that a handful of drawn auxiliary cones cannot systematically capture the actual three-dimensional interaction with a complex geometry. Spray shadows and grey areas form behind internals, in ports and at undercuts, often in combinations that can no longer be

worked out easily. What looks fully covered in a single view may still lie in a cleaning shadow in three-dimensional reality. Engineers know this. What they have lacked so far is a practical tool that checks their experience in general, and coverage in particular, quickly, systematically and cost-effectively.

Nozzle manufacturer consulting: helpful, but structurally limited

Some nozzle manufacturers offer their own simulation tools as part of their consulting services. This is a step forward in principle, but it comes with four known limitations:

- **Standard geometries:** Complex vessels with multiple internals or special shapes often cannot be modeled.
- **Tied to one product range:** Only nozzles from the manufacturer's own portfolio are shown, so a vendor-independent comparison is usually not possible.
- **External dependency:** The request goes out, and the answer comes back at some point. Independent, iterative work in the design process is not possible this way.
- **Costs:** Every request costs money again. Across several projects and iterations, this adds up noticeably.

The engineer receives a recommendation, but has no way of making their own comparison. They cannot compare and try out options themselves and have to rely on the service provider's result. The final decision is still theirs, but without an independent tool, they make it on the basis of a preselection they cannot verify.

The missing link between design and operation

As a rule, the design engineer who lays out a CIP system has never seen first-hand what months of real production soiling look like inside a tank. They have no direct access to the grey areas that keep showing up in ATP tests.

Conversely, QA and production gather these insights every day through swab tests, ATP measurements and deviation reports, but rarely have any influence on the next design project. The knowledge stays on one side, while the design engineer works on the other. The result: similar mistakes are repeated in new projects. Not because engineers are not good enough, but because there is no standardized feedback loop.

Why this is changing

Four developments suggest that simulation-based validation in the design process will become standard practice in the coming years:

- **Pressure from standardization:** EHEDG is continuously developing standards for hygienic design and CIP validation. In these discussions, cleaning simulation is gaining increasing recognition and relevance as the current state of the art.
- **Operator requirements:** Food and pharmaceutical manufacturers are under growing audit and regulatory pressure. It is foreseeable that tenders will soon require simulation-based proof of

cleanability.

- **Reputational risk:** A product recall costs not only money, but trust, and in the worst case human lives. Those who can demonstrate a simulation-validated CIP design are in a stronger position in an emergency than those who can only point to experience.
- **Generational change:** The next generation of process and design engineers is growing up with digital tools. For them, simulation is not an experiment, but an indispensable standard.

The question is no longer whether things will change, but which plant and vessel manufacturers will be the last to respond.

3 Validation in the wrong place: when the test comes too late

5,250

In 2024, the EU Rapid Alert System for Food and Feed (RASFF) recorded 5,250 notifications, an average of more than 14 per day, including cases involving Salmonella, Listeria and E. coli.

Not every one of these cases can be traced back to cleaning. But surfaces that were never adequately cleaned are a well-known contributing factor, and the root cause often lies long before production, in a design that could have been checked at the time.

Hygiene deficiencies must not first come to light in the end product or in the consumer; they must be revealed directly in the CIP design. Cleaning that is optimized reactively rather than preventively fails in its role as the most important line of defense.

Acceptance tests: indispensable, but at the wrong point in the timeline

The industry has developed good validation methods:

- **Riboflavin test (UV fluorescence):** Vitamin B2 on the inner wall glows under UV light; residues reveal areas insufficiently wetted by the cleaning fluid.
- **ATP swab test:** Biological or organic residues on surfaces become visible within 20 seconds.
- **UV inspection:** Visual inspection under black light detects organic residues.

These tests are valuable and belong in acceptance testing and routine operational monitoring. The problem is not the tests themselves, but the fact that they take place on the finished object, after design, fabrication and installation.

**Fig. 1**

Riboflavin test inside a vessel: under UV light, the fluorescent residues show where the cleaning fluid did not reach sufficiently.

Photo: Pharmatec GmbH, provided as part of the SIMKOR research project (2015–2018)

The time horizon: how late is too late?

A FAMILIAR PATTERN FROM PRACTICE

A CIP system is designed based on experience, and the plant is built, installed and accepted. The riboflavin test is passed because soiling is still minimal at acceptance. The plant goes into production. After a few months, the first microbiological anomalies appear. The cause: a port in a spray shadow that had been there from the start but was never visible.

It can take several months of production before a plant is demonstrably contaminated under real conditions. Only then does it become clear whether the design really holds up. This is often followed by a series of fixes that only make things worse: more cleaning iterations, more chemicals, higher operating pressure. This is not a solution, but the only lever left. The actual cause lies in the design, which has long since been turned into physical reality.

The costs nobody budgets for

More cleaning cycles, higher chemical concentrations, longer CIP run times, service calls and, in the worst case, rebuilding plants in operation, production stoppages, negative audit findings or product recalls.

None of these costs are part of the project budget. They are not attributed to the design process, even though they would never have arisen if someone had checked during the design phase:

Does the cleaning medium really reach all surfaces to be cleaned with sufficient volume flow impact?

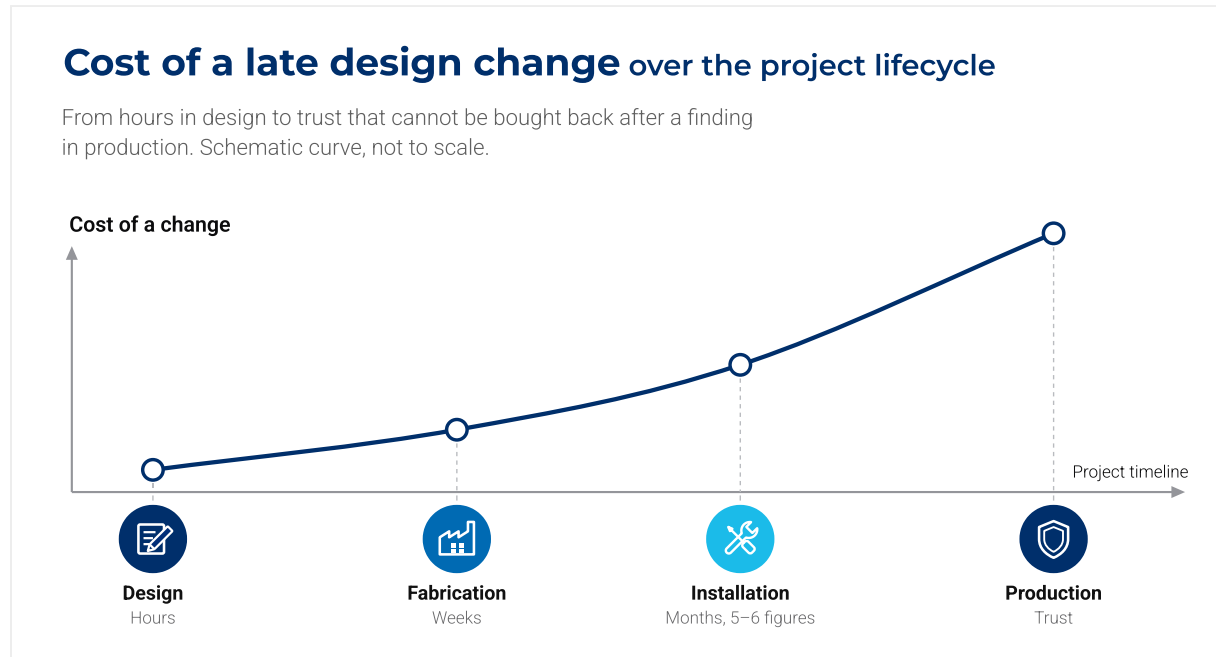


Fig. 2 Schematic cost of a design change, depending on when in the project it is made.

4 Cleaning simulation: the tools already exist

If an engineer can see in CAD what a vessel looks like, why can't they also see whether it will be cleaned properly? Virtual cleaning simulation makes coverage and blind spots in the flow geometry visible as early as the design stage. But how, and at what cost?

CFD: the most precise tool is not always the right one

Computational Fluid Dynamics (CFD) is the mathematical gold standard. Software such as ANSYS Fluent calculates nozzle discharge, droplet flight, wall impact and film formation in a physically correct, time- and space-resolved manner.

Even so, CFD is often the wrong tool for everyday design work. Why? Because it delivers more physical detail than the actual design question requires, and the tool therefore generates a computational effort that is hard to justify in day-to-day project work. A study by PMTC at the University of Limerick (2025) shows what this means in practice: simulating a single 27-liter tank on the EuroHPC supercomputer MeluXina, using 480 cores across four nodes, took around a month of computation. What it modeled: just 1.25 seconds of real process time.

CFD is an excellent tool for research or highly complex problems. For fast, iterative testing in the design process, it is oversized and too slow.

Computation time compared: CFD simulation vs. measurement-based simulation

Same vessel geometry, same nozzle, same question. Logarithmic scale.

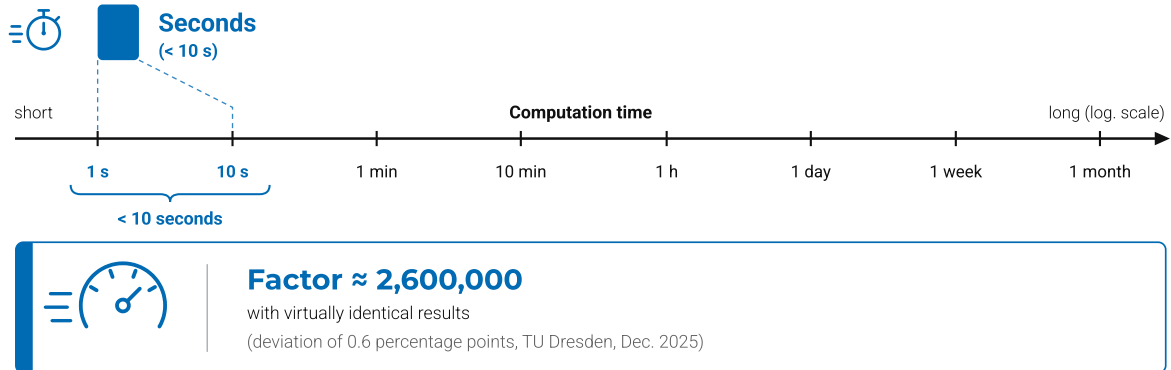
CFD simulation

Supercomputer, 480 cores, 4 nodes (Limerick study 2025)

≈ 1 month

Measurement-based simulation

e.g. ADVISIM3D, on a standard workstation



Note: The times shown refer to the geometry and configuration used in the study.

Fig. 3 Computation time compared: CFD simulation (supercomputer, 480 cores) vs. measurement-based simulation (standard PC, e.g. ADVISIM3D). Logarithmic scale, values rounded.

What the design process really needs

A virtual cleaning simulation should combine three properties that have rarely been available together until now:

- Simulate specific, real CAD geometries instead of standard catalog vessels
- Deliver results in seconds instead of months, enabling iterative work in the design process
- Allow independent use, without CFD expertise, external service providers or waiting times

Method	Speed	Cost	Limitation
Experience + CAD	Immediate	None	Limited 3D insight into spray shadows
Nozzle manufacturer consulting	Weeks	Per request	Mostly standard geometries, manufacturer's own nozzles only
CFD (e.g. ANSYS Fluent)	Months	From at least EUR 8,000 p.a.	High-performance computer required
ADVISEM3D	Seconds	Project license from EUR 1,500	Individual geometry, vendor-neutral catalog, standard PC

Information on nozzle manufacturer tools refers to typical characteristics, not to an assessment of any individual provider.

5 ADVISIM3D: an option for the design phase

One software solution that combines these three properties is ADVISIM3D. It was developed by ADVITEC Informatik GmbH in Dresden in many years of collaboration with Fraunhofer IVV and has been in industrial use in the food, beverage, pharmaceutical and chemical industries since 2020.

The principle: the experimentally measured spray distribution of real nozzles is mathematically transferred onto any three-dimensional vessel surface. The method is based on physical measurement data rather than numerical flow calculation. The result: a reliable statement in seconds on a standard PC workstation, with no supercomputer, no CFD expertise and no waiting.

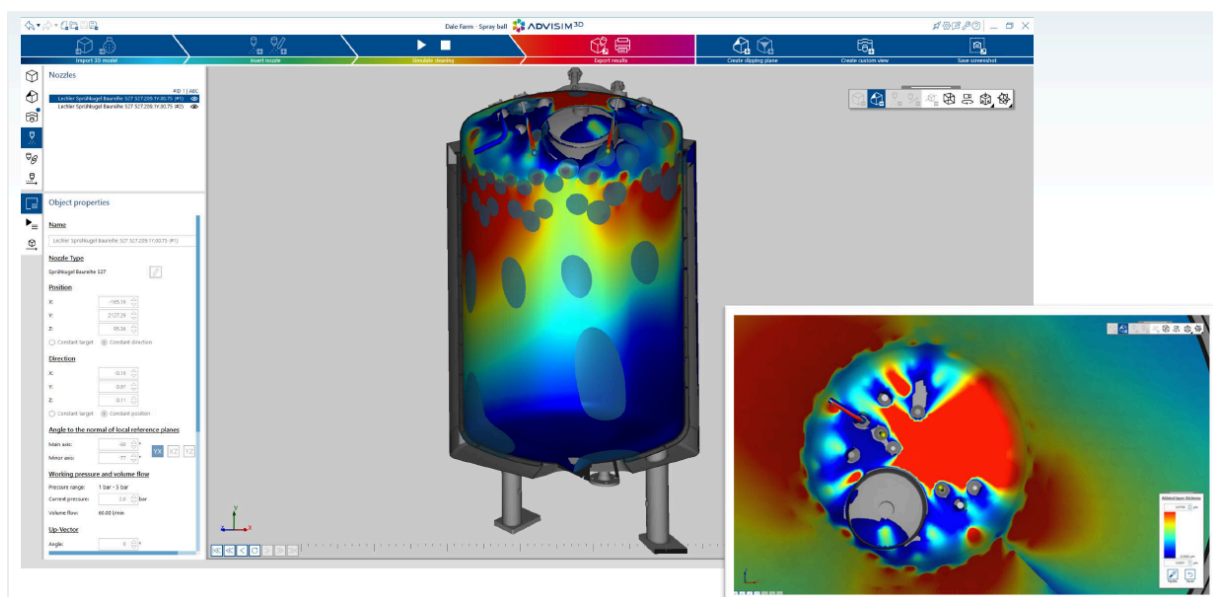


Fig. 4 Simulation with a spray ball

What the software does

- **STEP import:** Any vessel geometry directly from CAD, without remodeling or meshing
- **Nozzle catalog:** Around 125 experimentally measured nozzles from various manufacturers. Additional nozzles can be scientifically measured on request or created with the integrated nozzle designer.
- **Real-time visualization:** Spray shadows become visible immediately as soon as nozzle positions are changed.
- **Quantitative evaluation:** Liquid volume per surface section and comparison of variants, providing an objective basis for decisions
- **Conservative design:** The simulation is based on a type of soiling that is harder to remove than riboflavin. A design that passes the simulation therefore has a conservative safety margin with respect to the later acceptance test.

What ADVISIM3D deliberately simplifies for the sake of usability

ADVISIM3D uses a statistical, measurement-based approach: unlike CFD, the sum of all influences is not calculated as a physical simulation of individual particles in space, but aggregated on the model surface. As a result, falling films along wall surfaces and wall shear stresses are represented in simplified form rather than with full physical accuracy. CFD can do this more precisely, but at the price of weeks to months of computation time.

For the question that matters in the design process (where is the spray shadow, and which areas are critical?), this difference in performance is practically irrelevant. TU Dresden demonstrated a deviation of just 0.6 percentage points compared with a high-resolution CFD reference simulation (see Chapter 6).

What the design covers, and what it doesn't

ADVISIM3D models the design state of a plant based on the specified nozzles, their manufacturer data and the real geometry. The design remains valid as long as the plant is operated in accordance with the intended maintenance intervals (e.g. nozzle cleaning, seal replacement, descaling). Wear or fouling effects outside of this maintenance are the responsibility of plant operation and, as with any CAD tool, cannot be compensated for by the design. For continuous condition monitoring during operation, the simulation-based design can be supplemented by sensors if required.

In industrial use

Since 2020, ADVISIM3D has been used by companies responsible for CIP cleaning under strict hygiene and GMP requirements, including plant builders, machine manufacturers and pharmaceutical process technology suppliers such as ZETA Holding, SIG, Bausch + Ströbel and Pharmatec (Syntegon). The software plays to its strengths especially in custom systems where cleanability is made more difficult by spray coverage, spray shadows or complex geometries.

Typical ADVISIM3D applications include tanks, mixing and reaction vessels, fermenters and bioreactors with complex internals, aseptic filling machines and pharmaceutical machines with narrow connections. In several cases, testing effort and water consumption were noticeably reduced because nozzle configurations were optimized virtually rather than on the real component.

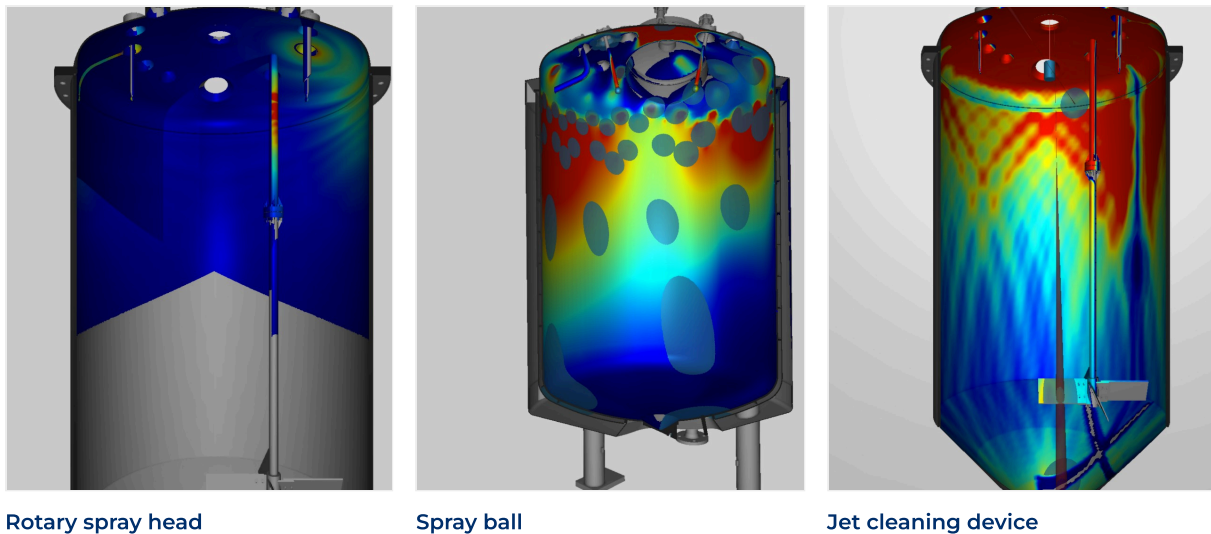


Fig. 5 Different cleaning devices simulated in ADVISIM3D. Spray shadows and volume flow distribution become visible directly on the vessel geometry.

Detailed user stories can be found in the appendix and at www.advisim3d.com/user-stories.html.

An argument you can verify

Integrating cleaning simulation into the design process delivers not only a better cleaning result, but also documented evidence that the CIP design was engineered for the specific geometry and verified before construction. And not on the basis of experience alone, but through a geometry-specific, realistic simulation.

For plant manufacturers, this can be a decisive differentiator from their competitors. For operators and QA departments, it means more transparency and confidence when preparing for audits. Why not take advantage of early adoption instead of waiting until not adopting it has become a competitive disadvantage?

6

Scientific validation in comparison

Claims about simulation accuracy are easy to make. TU Dresden put them to the test in an independent comparative study (Köhler, December 2025, summary report freely available, full report on request): the Chair of Processing Machines/Processing Technology (Dr.-Ing. Hannes Köhler) compared ADVISIM3D directly with the PMTC study by the University of Limerick, a physically high-resolution CFD simulation on the EuroHPC supercomputer MeluXina with 480 cores and around one month of computation time for 1.25 seconds of process time. In both cases, exactly the same vessel configuration and the same nozzle were simulated.

THE RESULT

Supercomputer (480 cores, around 1 month)

3.8 %

ADVISEM3D (standard PC, seconds)

3.2 %

Unwetted area

Deviation: 0.6 percentage points (within the measurement uncertainty)

Both simulations identified the same critical areas, the same spray shadows and the same recommendations for nozzle positioning, with computation times differing by a factor of 2,600,000.

“The unwetted areas were identified in the same way by both simulation approaches. ADVISEM3D offers the decisive advantage for engineering applications of near real-time capability, and the validity of this simulation method is further strengthened significantly by the comparison with a physically high-resolution simulation.”

Dr.-Ing. Hannes Köhler, TU Dresden, December 2025

7**Conclusion: experience and simulation make the strongest team**

Experience remains the indispensable foundation. No tool can replace the intuition that comes from years of CIP practice, and that is not the intention either.

What simulation can do, and experience alone cannot: look inside a geometry before it goes into production. Only a simulation can detect the spray shadow in a critical area before a single liter of water has flowed.

ADVISEM3D bridges the gap between design and operation. It gives design engineers who have never experienced months of production soiling themselves a tool that translates insights from operational practice into the design process. It is not a substitute for intuition, but an extension of it and a proof of concept in real time.

Want to see this on your own geometry? A STEP export of your CAD design is all it takes for an initial evaluation. Visit www.advisim3d.com for contact details and trial options.

References

1. Köhler, H. (TU Dresden, Chair of Processing Machines/Processing Technology): Comparative study on tank cleaning simulation: ADVISIM3D. December 2025. Summary report freely available at www.advisim3d.com; full report available on request.
2. Moghimi, M.H.; Karimi-Jafari, M.; Shardt, O. (PMTIC, University of Limerick): Simulations of sprays in vessels and the effects of key variables for understanding cleaning processes. Chemical Engineering Research and Design, Vol. 217, 2025, pp. 128–151. doi.org/10.1016/j.cherd.2025.03.027
3. Goode, K.R.; Asteriadou, K.; Robbins, P.T.; Fryer, P.J.: Fouling and Cleaning Studies in the Food and Beverage Industry Classified by Cleaning Type. Comprehensive Reviews in Food Science and Food Safety, 12: 121–143, 2013.
4. Fryer, P.J.; Asteriadou, K.: A Prototype Cleaning Map: A Classification of Industrial Cleaning Processes. Trends in Food Science & Technology, Vol. 20, No. 6–7, pp. 255–262, 2009.
5. Palabiyik, I.; Yilmaz, M.T.; Fryer, P.J.; Robbins, P.T.; Toker, O.S.: Minimising the environmental footprint of industrial scaled cleaning processes by optimisation of a novel clean-in-place system protocol. Journal of Cleaner Production, Vol. 108, pp. 1009–1018, 2015.
6. European Commission: Alert and Cooperation Network: 2024 Annual Report. Luxembourg: Publications Office of the European Union, 2025.
7. EHEDG (European Hygienic Engineering and Design Group): Doc. 50: Hygienic Design Requirements for CIP Installations. First edition, July 2019. www.ehedg.org
8. Fraunhofer Institute for Process Engineering and Packaging IVV: Virtual testing of cleaning efficiency: software for simulating spray cleaning systems (SIMKOR research project). www.ivv.fraunhofer.de
9. ZETA Holding GmbH, SIG, Bausch + Ströbel, Pharmatec GmbH (Syntegon): ADVISIM3D user stories. www.advisim3d.com/user-stories.html

APPENDIX

The following content supplements the whitepaper but is not required to understand the core topic: detailed user stories, in-depth cost considerations and frequently asked questions.

A. Full user stories

ZETA Holding GmbH, biotech and pharmaceutical plant engineering

ZETA uses ADVISIM3D in the design phase of CIP cleaning systems, particularly for projects with especially complex requirements: difficult soiling, vessels with many internals, and geometries where the CAD view alone does not allow a reliable statement about spray shadows.

Specific use case: the cleaning design of a fermenter. ADVISIM3D delivered precise advance planning, and the simulation results also became an objective basis for discussions with vessel manufacturers and clients. The result: fewer disputes over interpretation, greater planning certainty.

ZETA's conclusion: "Simulation does not replace engineering knowledge. It makes it productive."

SIG, aseptic filling technology for food and beverages

SIG (around 9,000 employees, EUR 3.2 billion annual revenue) has been using ADVISIM3D as standard software in machine development since 2021. The starting point was the complete redevelopment of an aseptic filling machine with a highly complex sterile chamber containing many internals, undercuts and spray shadows.

ADVISIM3D enabled the engineers to compare different nozzle types and arrangements virtually and to find the optimal configuration before the machine was physically built. The result: fewer modifications to real equipment, fewer nozzles for the same cleaning performance, and shorter development cycles.

Particular context: SIG machines operate worldwide, including at sites where service calls mean long journeys. A cleaning problem that could have been prevented in the design costs many times more there.

Bausch + Ströbel, pharmaceutical machinery in a GMP environment

Bausch + Ströbel, a leading manufacturer of filling and closing machines for the pharmaceutical industry, used ADVISIM3D to optimize the cleaning of a pharmaceutical bottle.

Instead of adding nozzles, increasing pressure or oversizing the system, the engineers loaded the geometry into ADVISIM3D, moved clamps virtually and watched the spray shadows disappear. The result: validation runs were cut in half and around 250 liters of WFI per hour were saved.

Pharmatec GmbH (a Syntegon Company), pharmaceutical process technology

Pharmatec, based in Dresden and part of the Syntegon Group, develops complete solutions for the production, distribution and storage of high-purity media, as well as formulation systems for parenterals under GMP conditions.

The particular challenge: large-volume vessels with complicated internals, where automated CIP systems have to remove production residues under strict pharmaceutical quality requirements. ADVISIM3D was used to validate the cleaning design as early as the design phase and to identify critical spray shadows at an early stage.

All user stories are also available in detail online: www.advisim3d.com/user-stories.html

B. Costs in detail: what an unvalidated design costs

Changes in the design process cost hours. After fabrication: weeks. After installation: months and five- to six-figure sums. After a microbiological finding: trust that cannot be bought back.

TYPICAL FOLLOW-UP COSTS OF AN UNVALIDATED DESIGN

- Modifying or repositioning nozzles on installed components (e.g. re-welding, reassembly)
- Repeating acceptance tests, possibly several times
- Project delays: typically 2 to 8 weeks
- Direct additional costs: often EUR 10,000 to 100,000 per plant
- Higher long-term resource consumption due to oversizing (more chemicals, more water, longer cycles)
- In the worst case: microbiological findings, product recalls, audit findings after months of production

Sustainability

Oversized CIP processes consume water, energy and cleaning agents that would not have been needed with a correct design. The SIMKOR research consortium puts the annual savings potential for the German food industry alone at around 10 million cubic meters of fresh water and wastewater, in addition to savings in energy, cleaning agents, time and personnel.

What 10 million cubic meters of water a year means

Estimated annual savings potential in fresh water and wastewater from optimized CIP design, German food industry (SIMKOR consortium)

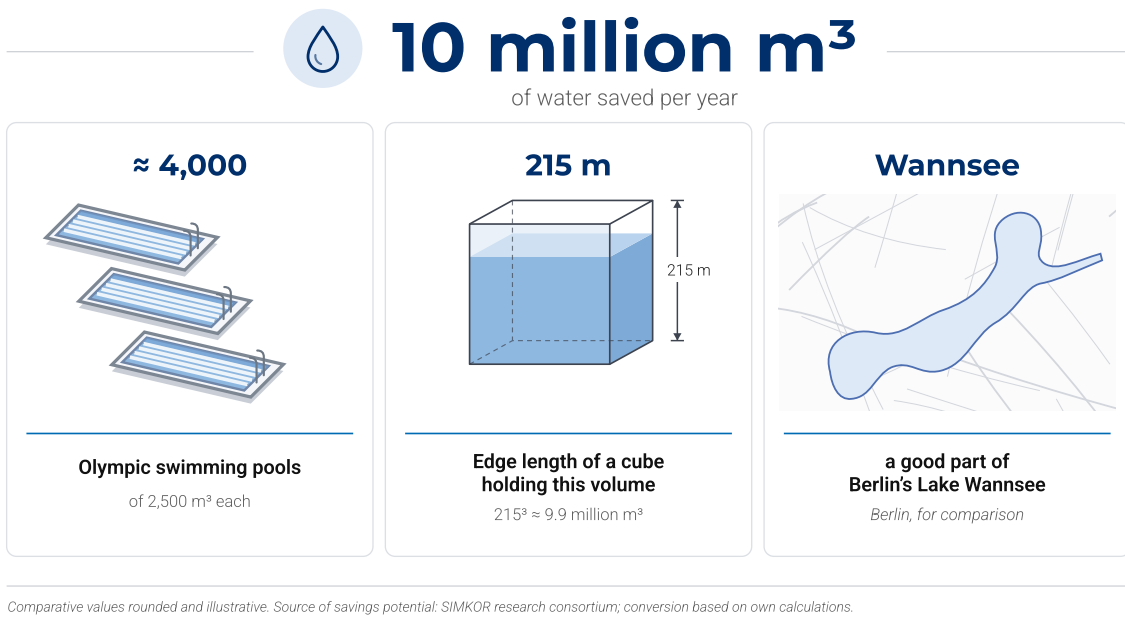


Fig. 6 The estimated annual savings potential for the German food industry, put into perspective.

C. Questions we often hear

“Our experience has always been enough so far. Why change now?”

Experience is the backbone of good design, and that will not change. Simulation does not replace it. It adds a virtual look into a geometry that nobody has cleaned yet. The first time a spray shadow becomes visible doesn't have to be during the riboflavin test; it can happen on the CAD model.

“We have passed every riboflavin test so far.”

That speaks for your experience. However, the riboflavin test takes place under acceptance conditions with minimal soiling. What it does not reflect is months of real production soiling. The test confirms a design, but it does not guarantee that the design will remain sufficient under production conditions in the long run.

“We already use CFD. Do we need anything else?”

CFD is excellent for research questions, but often too time-consuming for the everyday design process: the University of Limerick study (2025) needed a month on a supercomputer to simulate 1.25 seconds of real process time. ADVISEM3D delivers design-relevant results in seconds, according to TU Dresden with a deviation of just 0.6 percentage points. For iterative day-to-day work, that is the difference between theoretically possible and practically feasible.

“Is the simulation accurate enough for regulatory approval?”

ADVISIM3D is a design tool, not an approval document. Formal validation is still carried out using riboflavin tests, ATP swab tests and UV inspection. The difference: the design is already pre-validated, and the test then confirms what the simulation predicted.

“Our geometries are very complex. Does this really work?”

ADVISIM3D was developed for complex geometries, not for standard catalog vessels. Fermenters, aseptic filling systems and pharmaceutical machines with narrow connections and multiple internals can be imported as STEP files from all common CAD systems. The simulation delivers its greatest benefit precisely where experience reaches its limits.

“What about nozzles that clog or wear during operation?”

That is a maintenance issue, not a design issue, and therefore outside what design software can or should solve. ADVISIM3D ensures that a nozzle configuration fully covers the plant, provided it is operated properly and maintained at regular intervals. If a nozzle orifice becomes blocked by scale, product residues or foreign matter, no design tool in the world can help. That is a matter of maintenance, supported where appropriate by condition-monitoring sensors and/or visual inspections. What ADVISIM3D reduces instead is a different risk that is widespread among operators: a spray shadow that was designed in from the very beginning and that no amount of good maintenance can fix.

“What does it really cost, and is it worth it?”

Licensing details can be found on the last page of this whitepaper. In practice, one avoided rebuild or half a day less validation effort usually covers the cost.

“We don’t have the internal capacity for a new tool.”

ADVISIM3D can be operated in a CAD-like environment without CFD expertise. Anyone who can export a STEP file and select a nozzle from a catalog can use ADVISIM3D. Getting started usually takes hours, not weeks, and training and support are included with every license.



A brand of the ADVITEC Informatik GmbH

ADVISIM
Virtual Cleaning Simulation

Get started

Your geometry, your nozzle, your answer in seconds

Load a STEP file of your CAD design and see whether your CIP concept wets all surfaces reliably. We are happy to run an initial evaluation on one of your geometries or show you the software in a live demo.



YOUR CONTACT

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Licensing

ADVISIM3D is available as a project license from EUR 1,500 net, including updates, training and support. One-year and multi-year licenses are also available.

System requirements

- 64-bit Windows, Windows 10 or later
- Graphics card and driver with OpenGL 4.0 or higher
- 32 GB RAM, internet connection
- CAD files in STEP format

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