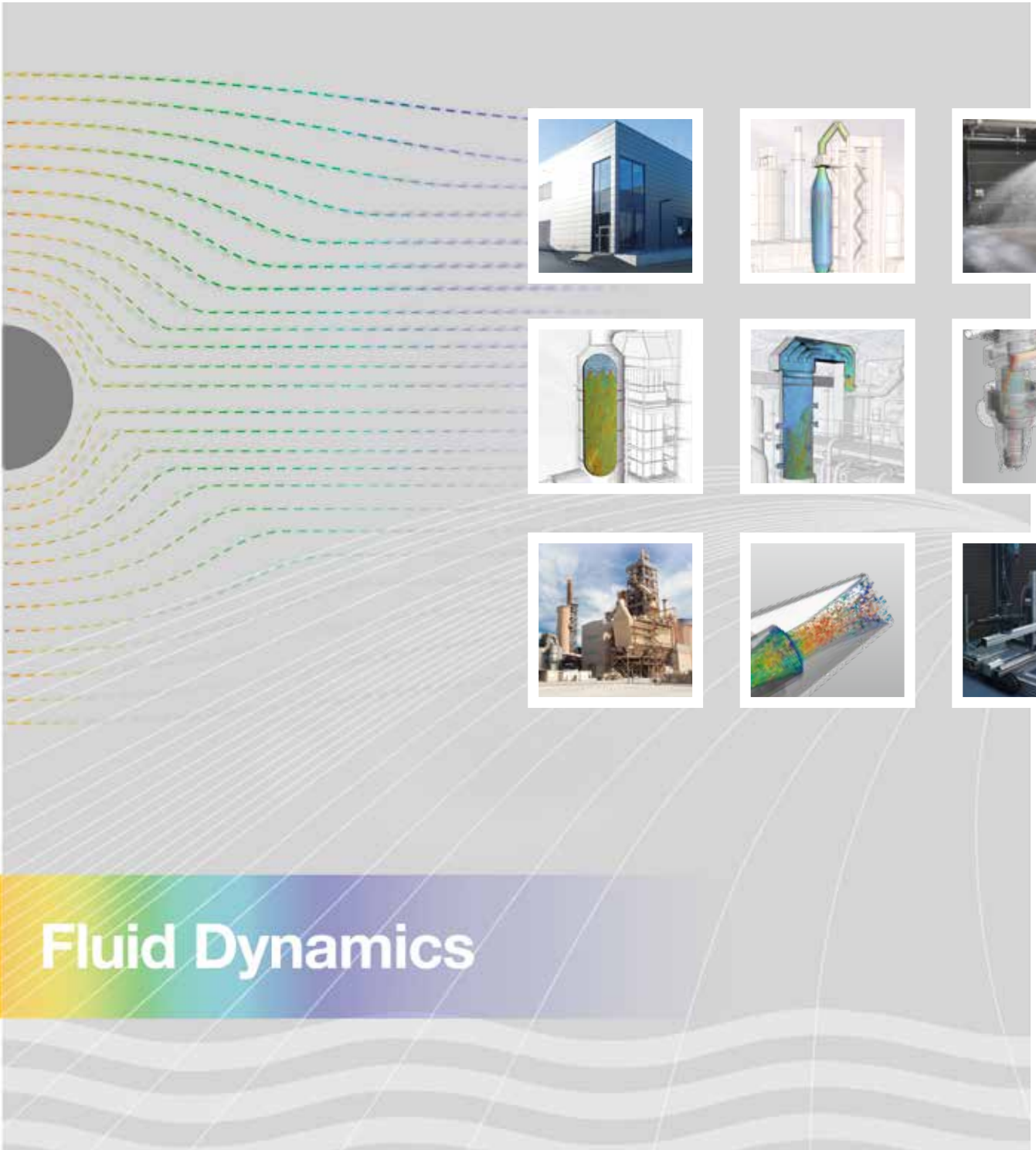


**ENGINEERING  
YOUR SPRAY SOLUTION**



## **Fluid Dynamics**

The intelligent way to achieve optimum nozzle use



**Fluid Dynamics**

# 135 YEARS OF NOZZLE KNOW-HOW

For well over a century, Lechler has been developing and manufacturing nozzles and nozzle systems for a very wide range of applications. Over the years, the company has acquired a unique understanding of spray and atomization processes in various applications under conditions with varying pressures, temperatures and atmospheres. With over 680 employees worldwide, we continuously strive to improve precision and efficiency and develop new application areas.

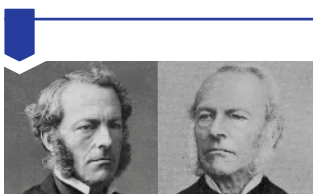
For simple geometries such as a straight pipe section, the flow conditions can still be calculated relatively easily with paper, pencil and a calculator.



However, this is no longer possible as soon as there is even a slight bend. This is where Computational Fluid Dynamics – or CFD – comes into play.



1845



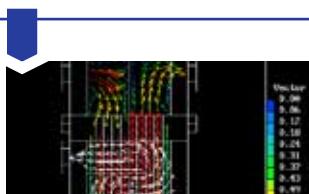
First formulation of Navier-Stokes equations

1879



Company founded by Paul Lechler

1981



First commercial CFD code "PHOENICS" is published

1994



Start of the "Beowulf" project. Affordable HPC clusters for industrial use

# WE DO NOT PROMISE PERFECTION IT IS WHAT WE EXPECT

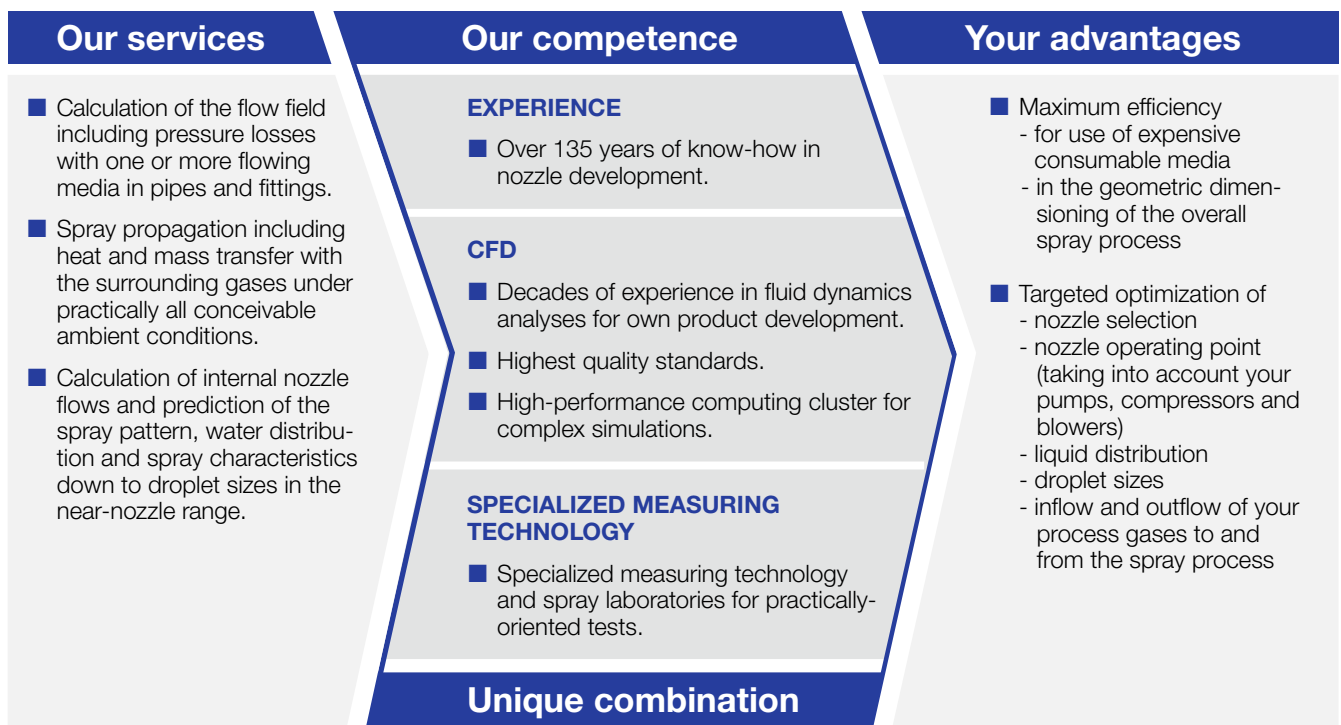
No matter what the spray application, the goal is always to achieve the maximum effect with minimal use of material, spray media and energy. Therefore it is essential to have a detailed understanding of how spray mist is formed and propagated.

This is made possible by computer-aided simulation of the flow processes of one or more substances in static or dynamic environments taking into account heat and mass transfer.

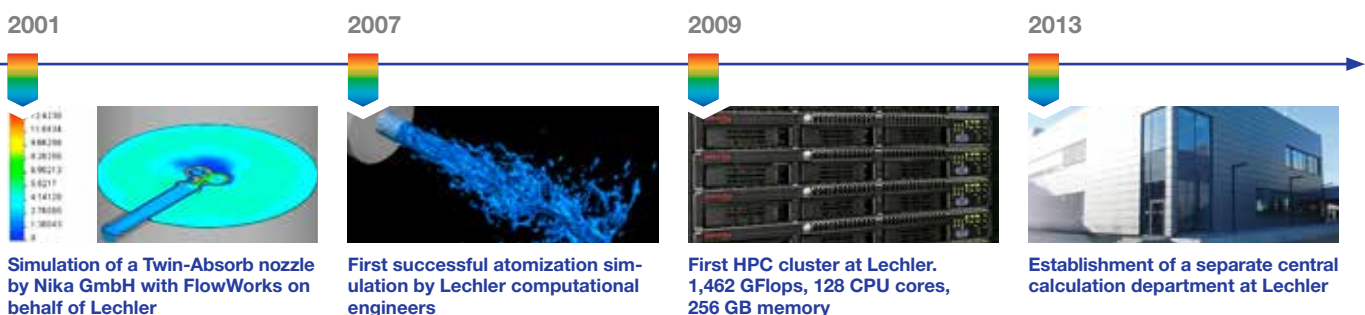
These simulations incorporate decades of know-how from the field of nozzle development. Initially, CFD was only an internal tool which helped us to develop a desired nozzle more quickly and precisely. The completion of our high-performance cluster with a processing power of around 8,500 GFlops means that we can now offer our knowledge as a service.

We simulate nozzle applications and processes individually for your environment and requirements, so that your processes also run perfectly in real situations.

## TURN OUR SECRET OF SUCCESS INTO YOURS: CFD-ASSISTED PRODUCT DEVELOPMENT AND PROCESS OPTIMIZATION



When it comes to flows, turbulences and highly complex spray processes, no-one has better knowledge of the available possibilities than us. Just like no-one knows your requirements better than yourself. So let's talk to each other and find out how to exploit your full potential.



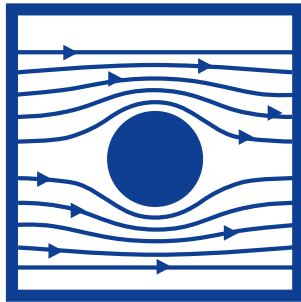
PRODUCT DEVELOPMENT

PROCESS OPTIMIZATION

# FLUID DYNAMICS IN PRACTICAL USE

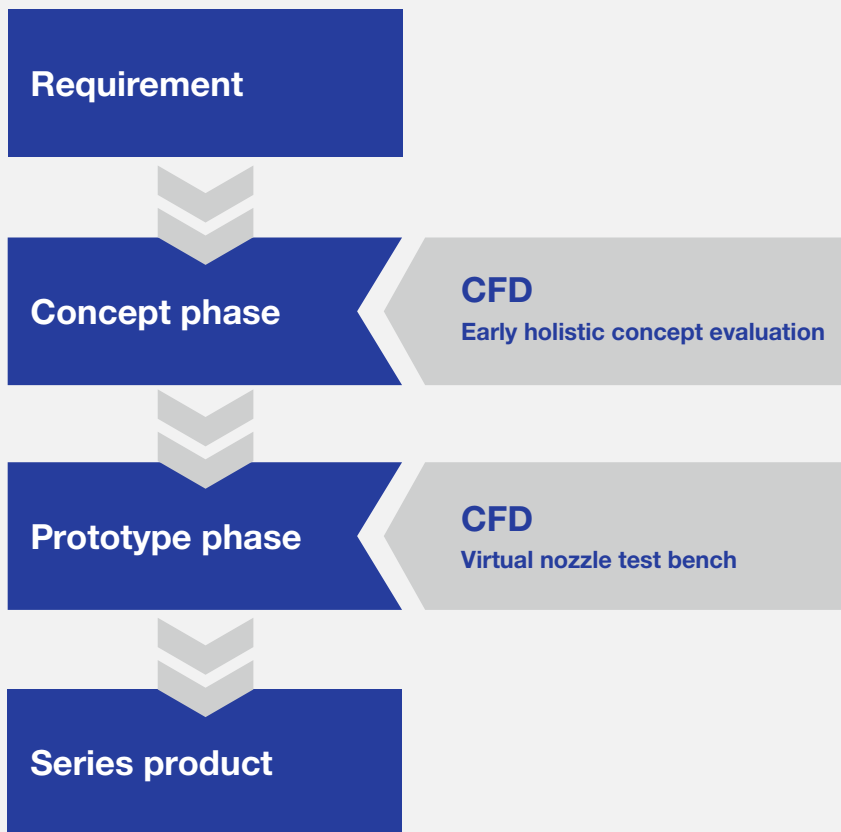
## SMART SOFTWARE FOR DEVELOPING YOUR NOZZLE

PRODUCT DEVELOPMENT



In order to achieve maximum efficiency of a nozzle application, the right nozzle must spray the right quantity of fluid at the right place and with the right pressure – and possibly also first mix the fluid with the right quantity of gas/air.

No-one, including us, can quickly come up with a finished product when so many different variables have to be taken into account. However, we can perform simulations based on empirical values and assumptions. A clearly defined procedure guarantees that we do not just move towards our goal step-by-step, but also reach it in the shortest possible way. We gladly offer this service as part of customer-specific nozzle development.



### YOUR ADVANTAGES:

- Time saving
- Cost reduction
- Precise comparisons
- 100% repeatability

Benefit from our engineering experience. We will gladly support you in your specific nozzle development with the know-how we have acquired over the course of many decades. **Talk to us. It will be worth your while.**

# FLUID DYNAMICS NOZZLE AND SPRAY SIMULATIONS IDENTIFYING TARGETED AREAS

## The project

Laval nozzle simulation



### The task

The Laval nozzle from Lechler is a twin-fluid nozzle with an internal mixing chamber that can be used in a large number of different applications. Normally, water is pre-atomized in the mixing chamber by means of compressed air. Significant post-atomization is then achieved further on in the nozzle.

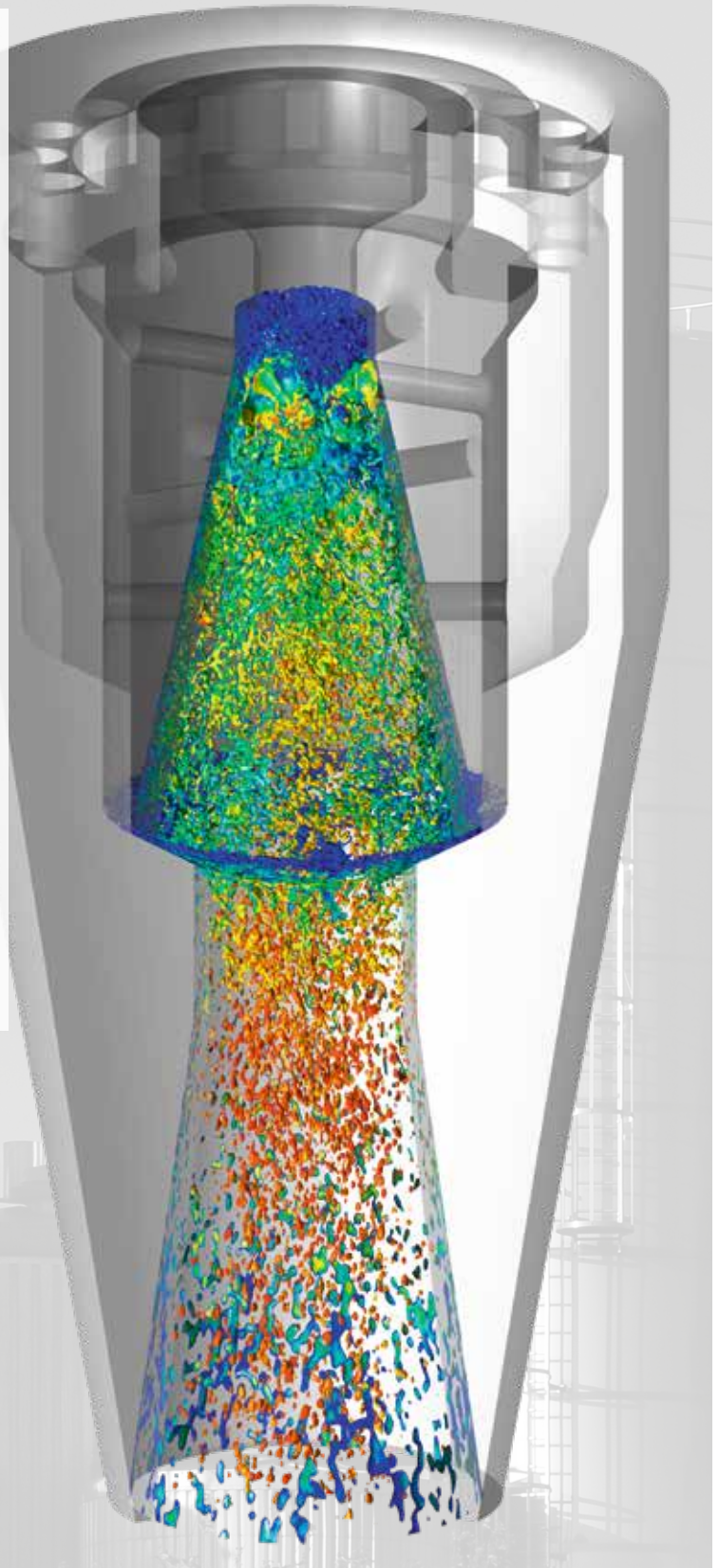
All this takes place in a very small space at extremely high speed, with up to two billion droplets being produced per second.

By performing detailed simulation of this process, we are able to discover inhomogeneities of all kinds and other weaknesses. All flow parameters can be precisely observed in every corner of the nozzle at all times. This allows nozzle optimizations to be initiated and checked in a very targeted manner.



### The result

- Shorter development times
- Simplification of the geometries
- Increase in atomization efficiency
- Reduction in droplet sizes
- Spray homogenization
- Minimization of undesirable pulsation effects
- Reduced consumption of expensive media such as compressed air
- Shorter reaction and process times in the nozzle application
- Longer nozzle service life



# FLUID DYNAMICS NOZZLE AND SPRAY SIMULATIONS IMPROVING NOZZLE DESIGN

PRODUCT DEVELOPMENT

## The project

SCALEMASTER® descaling nozzle simulation



### The task

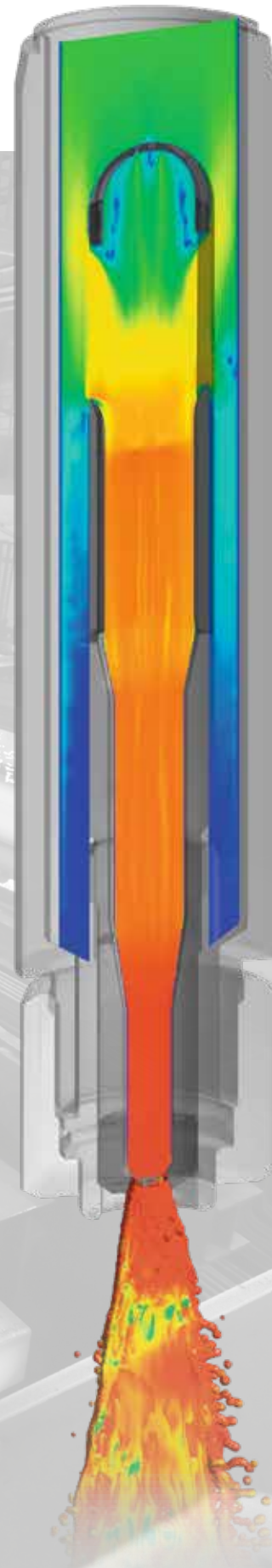
The SCALEMASTER® from Lechler is a high-pressure flat spray nozzle for descaling hot steel prior to rolling. The water passes through a filter and a steel funnel before it is finally delivered in an extremely targeted and non-atomized spray.

Simulation by Computational Fluid Dynamics allows us to eliminate turbulence and pressure losses. This in turn achieves, precise nozzle development and optimization. This also makes it possible to improve the accuracy of the spray width and impact distribution.



### The result

- Shorter development times
- Increased descaling efficiency and quality
- Reduced consumption of high-pressure water in the process
- Eliminate cooling of the steel
- Increased uniform descaling action
- High energy savings in operation of the high-pressure pumps, leading to lower operation costs and CO<sub>2</sub> emissions



# FLUID DYNAMICS NOZZLE AND SPRAY SIMULATIONS OPTIMIZATION IN A TINY SPACE

## The project

Simulation of VarioSelect® valve



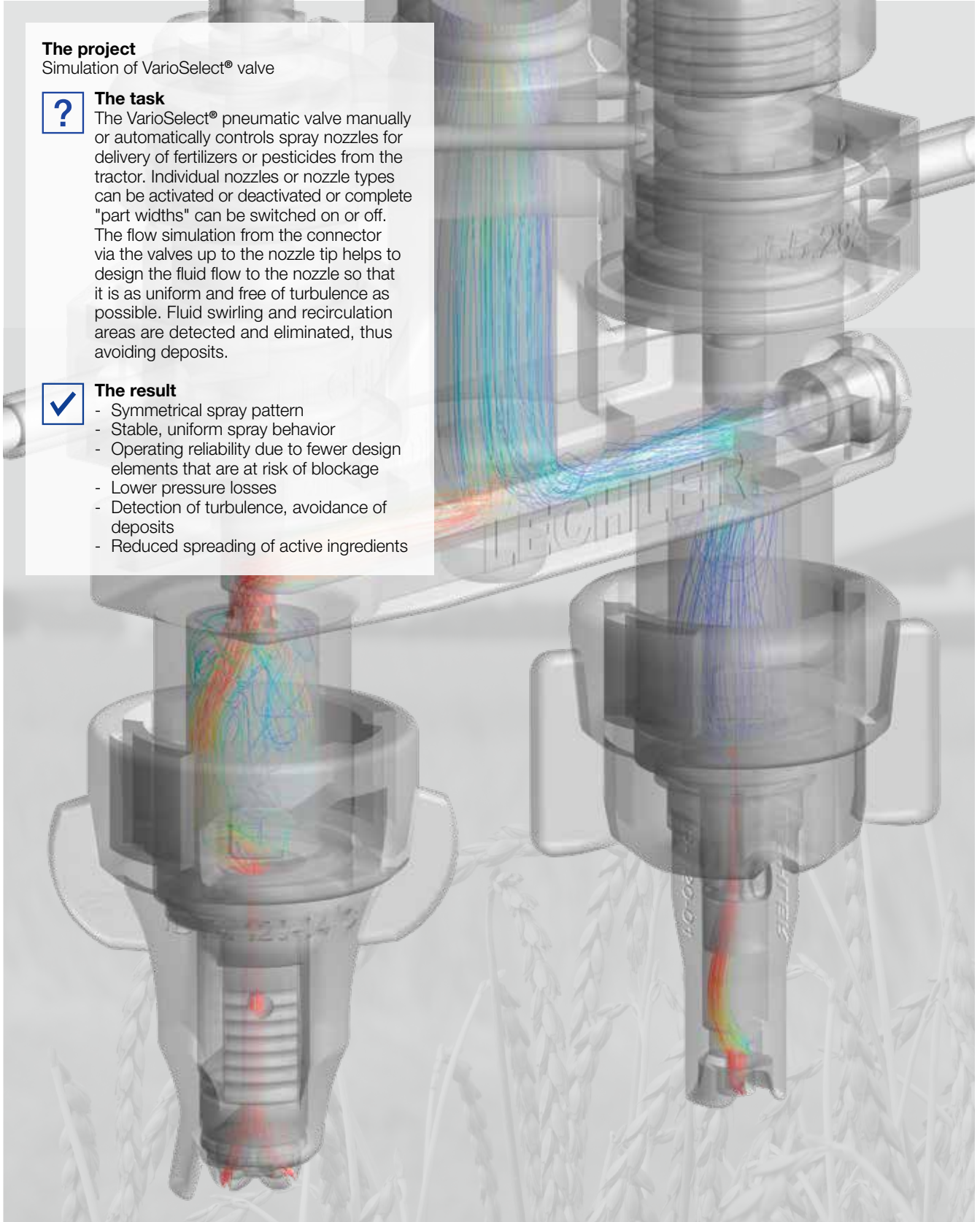
### The task

The VarioSelect® pneumatic valve manually or automatically controls spray nozzles for delivery of fertilizers or pesticides from the tractor. Individual nozzles or nozzle types can be activated or deactivated or complete "part widths" can be switched on or off. The flow simulation from the connector via the valves up to the nozzle tip helps to design the fluid flow to the nozzle so that it is as uniform and free of turbulence as possible. Fluid swirling and recirculation areas are detected and eliminated, thus avoiding deposits.



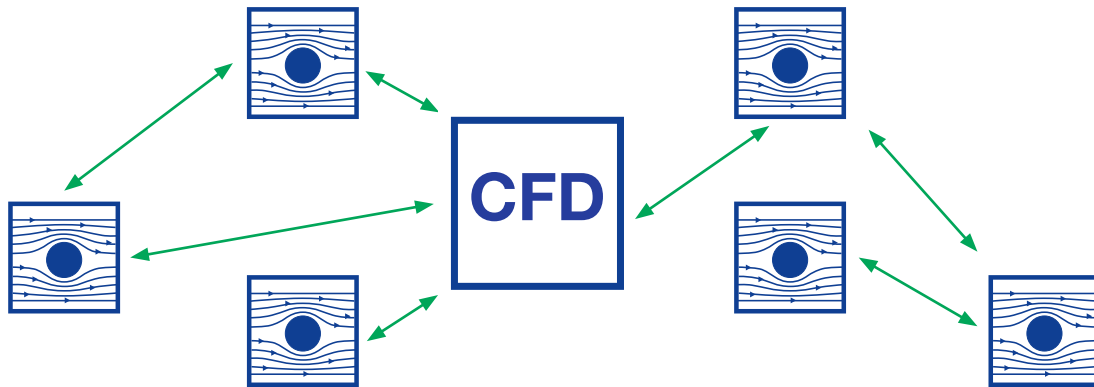
### The result

- Symmetrical spray pattern
- Stable, uniform spray behavior
- Operating reliability due to fewer design elements that are at risk of blockage
- Lower pressure losses
- Detection of turbulence, avoidance of deposits
- Reduced spreading of active ingredients



# FLUID DYNAMICS IN OPERATION

## CUSTOMER-SPECIFIC PROCESS OPTIMIZATION



Even spray processes that have been functioning for years without problems also offer considerable optimization potential. We explore these in our process simulations without intervening in ongoing production. This makes it possible to test different settings and evaluate their effects on the overall result.

Similar to product development, we use a clearly defined workflow here.

Project definition

Analysis of current situation

**CFD**  
Definition of starting situation  
Identification of optimization potentials

Optimization

**CFD**  
Virtual checking and evaluation of individual measures

Implementation

### YOUR ADVANTAGES:

- Identification of optimization potentials
- Virtual evaluation of individual measures
- Risk-free, virtual tests
- Time saving
- Demonstration of saving potentials
- Clear amortization analysis

Benefit from our engineering experience. We will gladly support you in your process optimization with the know-how we have acquired over the course of many decades. **Talk to us. It will be worth your while.**



# FLUID DYNAMICS PROCESS SIMULATIONS

## RELIABLE FLOW CONDITIONS

### The project

Holistic optimization of evaporative coolers



### The task

Due to increasing environmental requirements and changed loads, evaporative coolers are frequently operated well outside their original design parameters. In many cases, this results in inefficient operation, wet floors and walls and/or massive caking, which can negatively affect the entire structural design. Flow simulation of the complete process allows optimization potential to be found and the right steps to be initiated. All physical effects are simulated here, from inflow of the hot flue gas through spray injection including evaporative cooling up to outflow of the cold, moist flue gas. The main results obtained are the pressure loss of the overall cooler as well as the spray trajectories.

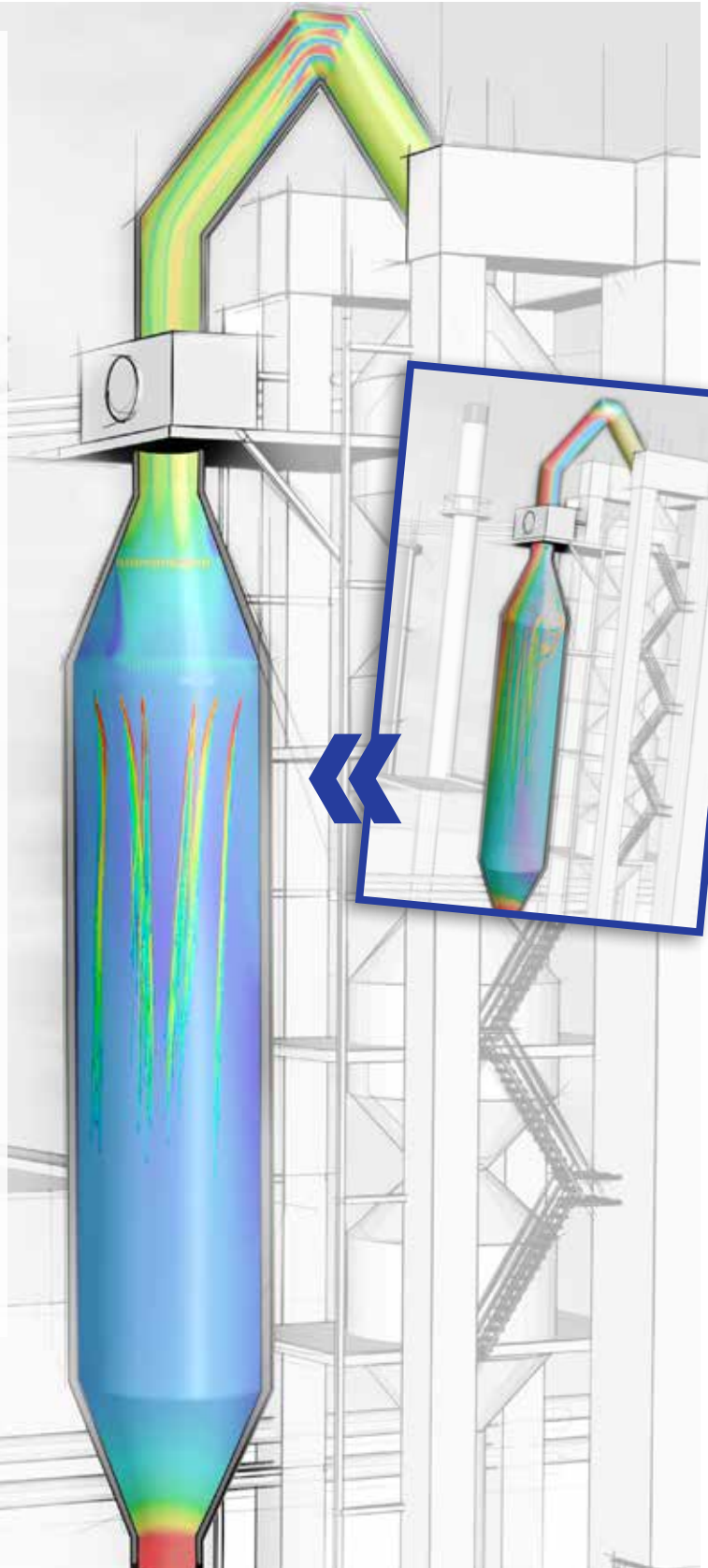
Reliable and efficient operation is possible only when the spray has evaporated on a trajectory parallel to the tower axis before the next deflection. For this purpose, the inflow of the hot flue gas must normally be pacified by fittings such as baffles and perforated plates directly before the injection point.

In addition, it is obligatory to check and if necessary adapt the spray system from the process unit up to the nozzle tip. Lechler is the right partner for holistic optimization of such evaporative coolers.



### The result

- Operating reliability thanks to permanently dry walls and floors
- Operating reliability due to stable flow conditions at all operating points
- Lower energy requirement for the induced draft fan through reduced pressure losses
- Cost reduction through efficient use of consumable media such as compressed air or high-pressure water
- Short amortization period (normally two years or less)



# FLUID DYNAMICS PROCESS SIMULATIONS

## PRECISE CALCULATIONS

PROCESS OPTIMIZATION

### The project

Scrubbing tower for treating process gases



### The task

Flue gas desulfurization is one of the most well known gas scrubbing processes. There are also numerous other scrubbing principles such as denitrification or cleaning particulate-laded gas flows. All scrubbers have one thing in common, however: using spray nozzles, gas treatment must function as efficiently as possible and at the same time offer sufficient flexibility for all load cases. This must be achieved over the shortest distances and in the smallest space possible. Flow simulation helps to determine three important factors here:

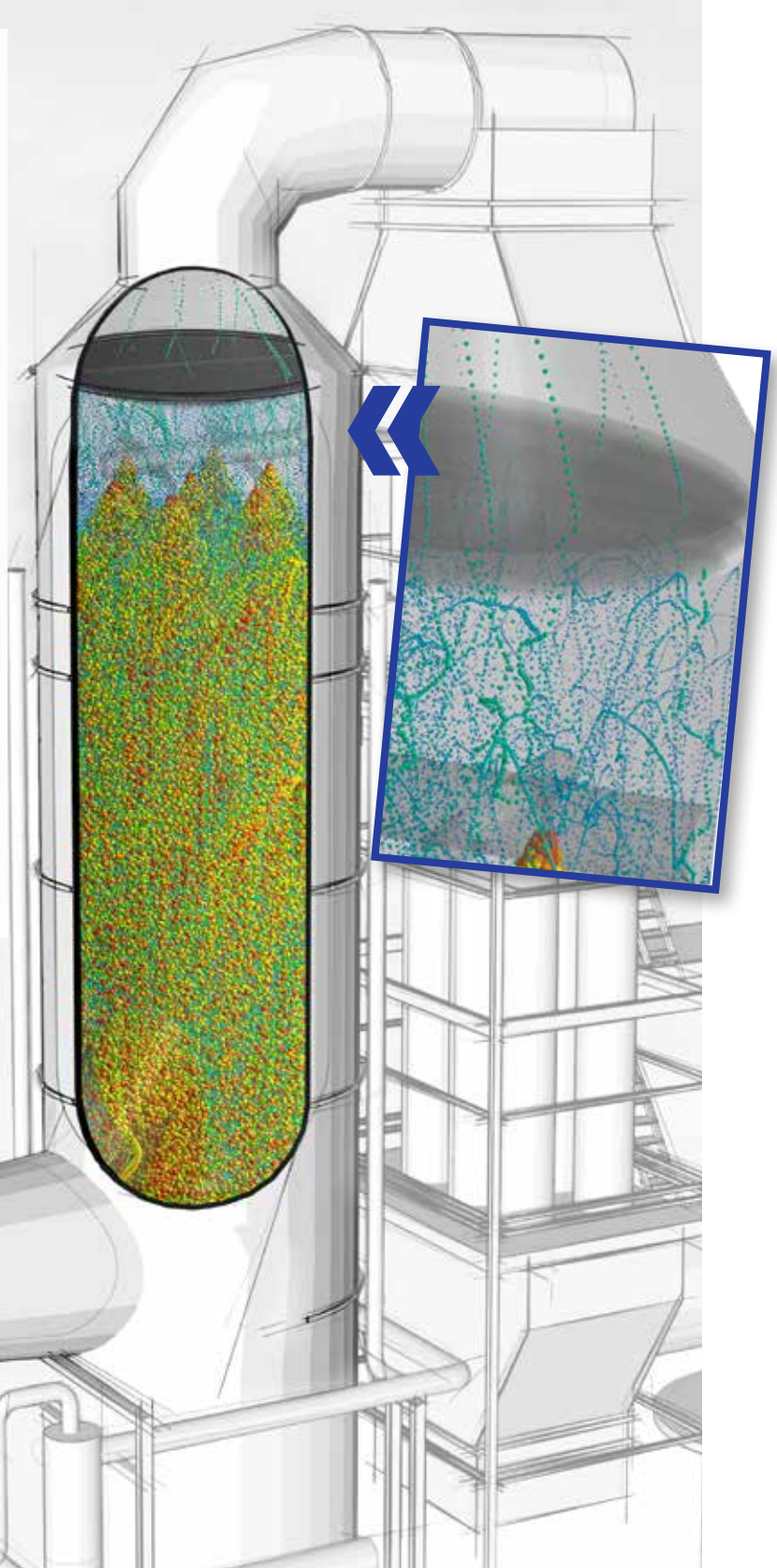
- Nozzle selection
- Nozzle arrangement
- Operating point(s)

This allows us to determine the optimum scrubber configuration for every process taking into account your requirements. A downstream droplet separator is obligatory in most scrubbers. Here too, flow simulation can help in customized design.



### The result

- Optimum utilization of the available space
- Maximum efficiency for use of expensive consumable media
- Energy-efficient use of pumps and blowers
- High operating reliability
- High flexibility



# FLUID DYNAMICS PROCESS SIMULATIONS PREVENTATIVE MEASURES

## The project

Sulfuric acid injection for cleaning and cooling process gases with sulfur trioxide



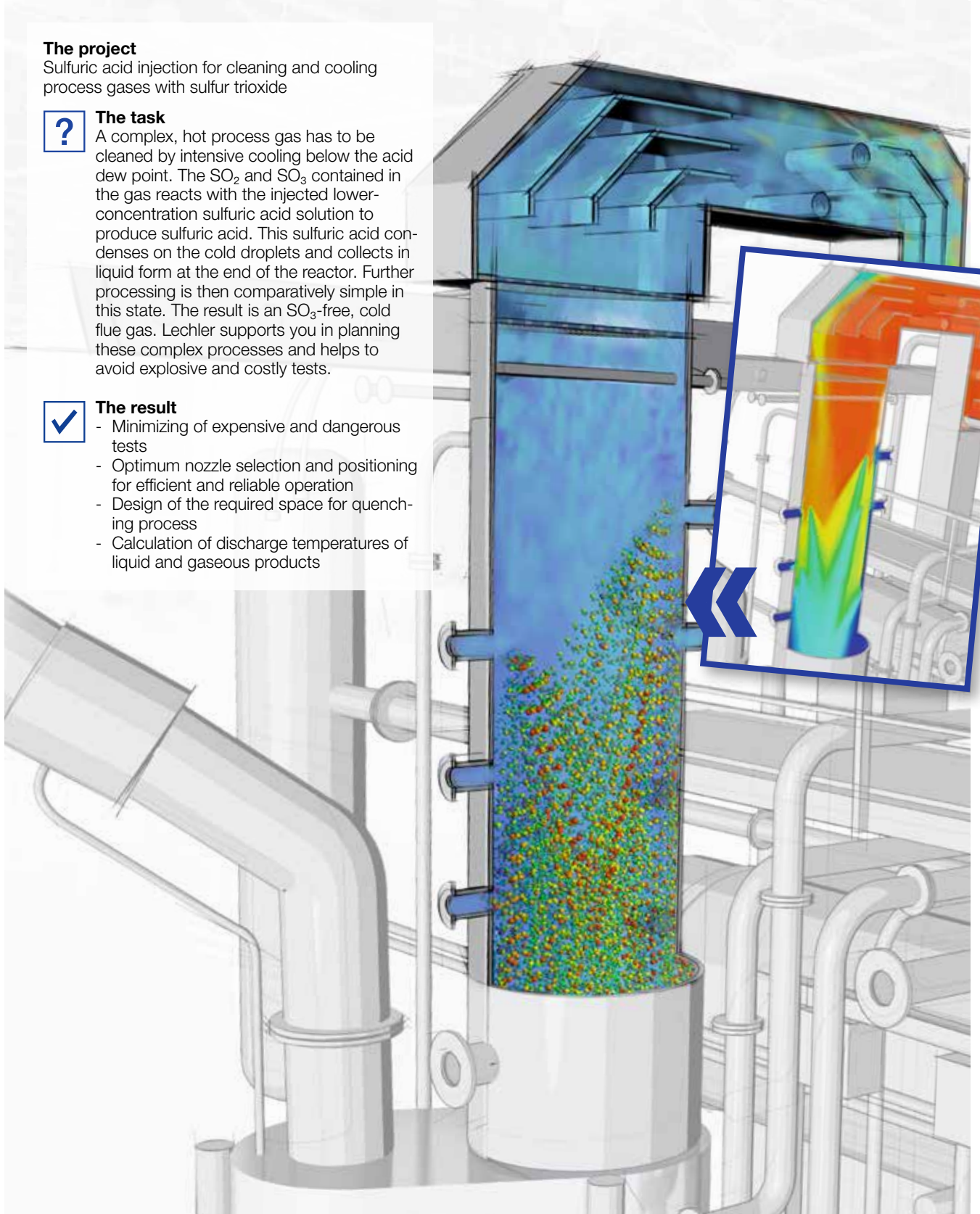
### The task

A complex, hot process gas has to be cleaned by intensive cooling below the acid dew point. The  $\text{SO}_2$  and  $\text{SO}_3$  contained in the gas reacts with the injected lower-concentration sulfuric acid solution to produce sulfuric acid. This sulfuric acid condenses on the cold droplets and collects in liquid form at the end of the reactor. Further processing is then comparatively simple in this state. The result is an  $\text{SO}_3$ -free, cold flue gas. Lechler supports you in planning these complex processes and helps to avoid explosive and costly tests.



### The result

- Minimizing of expensive and dangerous tests
- Optimum nozzle selection and positioning for efficient and reliable operation
- Design of the required space for quenching process
- Calculation of discharge temperatures of liquid and gaseous products



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## FLUID DYNAMICS OUR SERVICES – YOUR ADVANTAGES

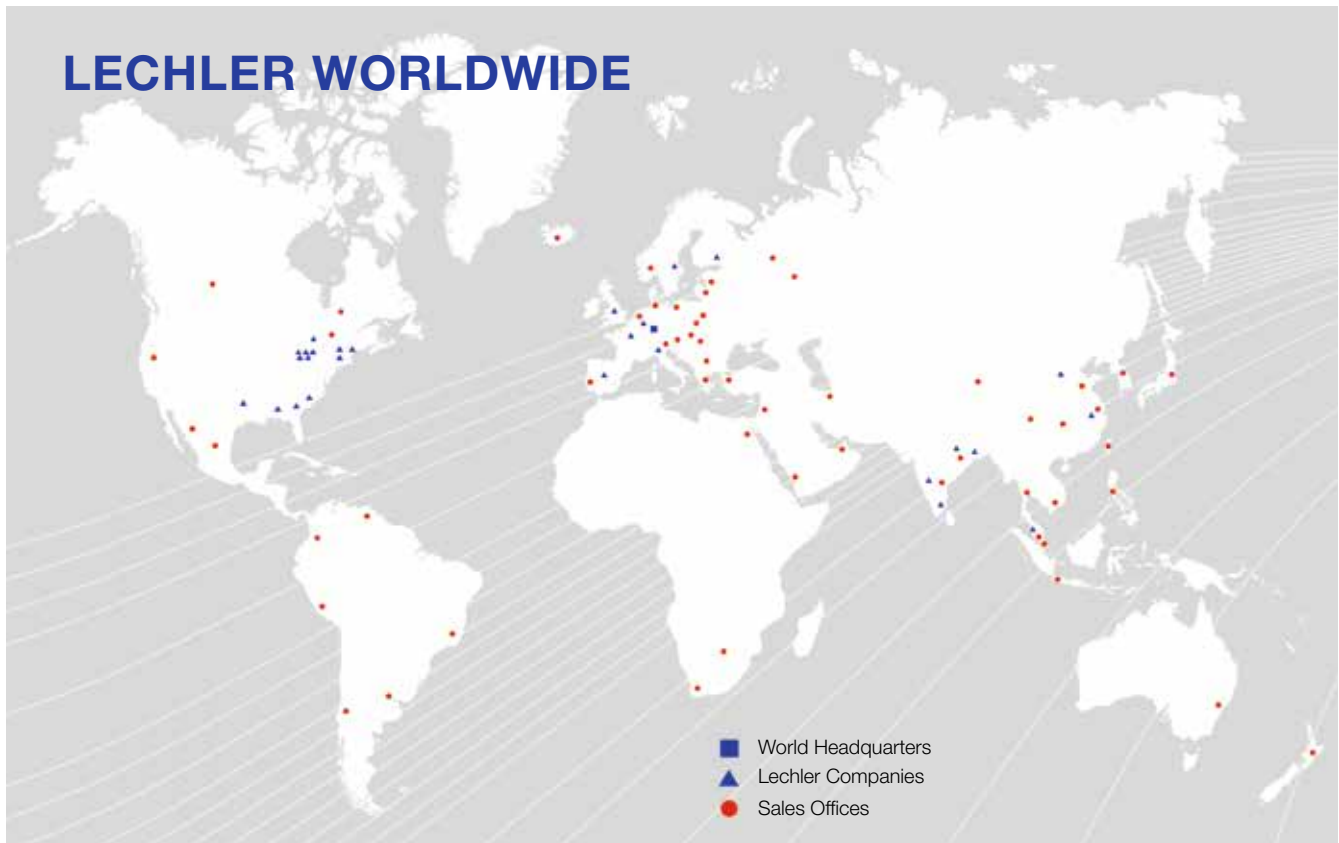
- Over 100 years of experience in nozzle development
- Over 15 years of experience with flow simulations
- Excellent understanding of fluid dynamics
- High-performance computing cluster and state-of-the-art measuring technology



### Talk to us

We offer individual product development for your spray application as well as support in defining or optimizing your overall spray process. We will gladly define the work package together with you and produce a specific offer based on your needs.

## LECHLER WORLDWIDE



### Lechler GmbH · Precision Nozzles · Nozzle Systems

P.O. Box 13 23 · 72544 Metzingen, Germany · Phone: +49 7123 962-0 · Fax: +49 7123 962-301 · info@lechler.de · www.lechler.com

**ASEAN:** Lechler Spray Technology Sdn. Bhd. · No. 23, Jalan Teknologi 3/3A · Taman Sains Selangor 1 · Kota Damansara, PJU 5 · 47810 Petaling Jaya · Malaysia · info@lechler.com.my

**Belgium:** Lechler S.A./N.V. · Avenue Mercatorlaan, 6 · 1300 Wavre · Phone: +32 10 225022 · Fax: +32 10 243901 · info@lechler.be

**China:** Lechler Intl. Trad. Co. Ltd. · Beijing · Rm. 418 Landmark Tower · No. 8 Dong San Huan Bei Lu · Phone: +86 10 84537968, Fax: +86 10 84537458 · info@lechler.com.cn

**Finland:** Lechler Oy · Jäspilänkatu 18 · 04250 Kerava · Phone: +358 207 856880 · Fax: +358 207 856881 · info@lechler.fi

**France:** Lechler France, S.A. · Bât. CAP2 · 66-72, Rue Marceau · 93558 Montreuil cedex · Phone: +33 1 49882600 · Fax: +33 1 49882609 · info@lechler.fr

**Great Britain:** Lechler Ltd. · 1 Fell Street, Newhall · Sheffield, S9 2TP · Phone: +44 114 2492020 · Fax: +44 114 2493600 · info@lechler.com

**India:** Lechler (India) Pvt. Ltd. · Plot B-2 · Main Road · Wagle Industrial Estate · Thane (W) · 400604 · Phone: +91 22 40634444 · Fax: +91 22 40634497 · lechler@lechlerindia.com

**Italy:** Lechler Spray Technology S.r.l. · Via Don Dossetti, 2 · 20080 Carpiano (MI) · Phone: +39 02 98859027 · Fax: +39 02 9815647 · info@lechleritalia.com

**Spain:** Lechler S.A. · Avda. Pirineos 7 · Oficina B7, Edificio Inbisa I · 28700 San Sebastián de los Reyes, Madrid · Phone: +34 91 6586346 · Fax: +34 91 6586347 · info@lechler.es

**Sweden:** Lechler AB · Kungsängsvägen 31 B · 753 23 Uppsala · Phone: +46 54 137030 · Fax: +46 54 137031 · info@lechler.se

**USA:** Lechler Inc. · 445 Kautz Road · St. Charles, IL. 60174 · Phone: +1 630 3776611 · Fax: +1 630 3776657 · info@lechlerUSA.com