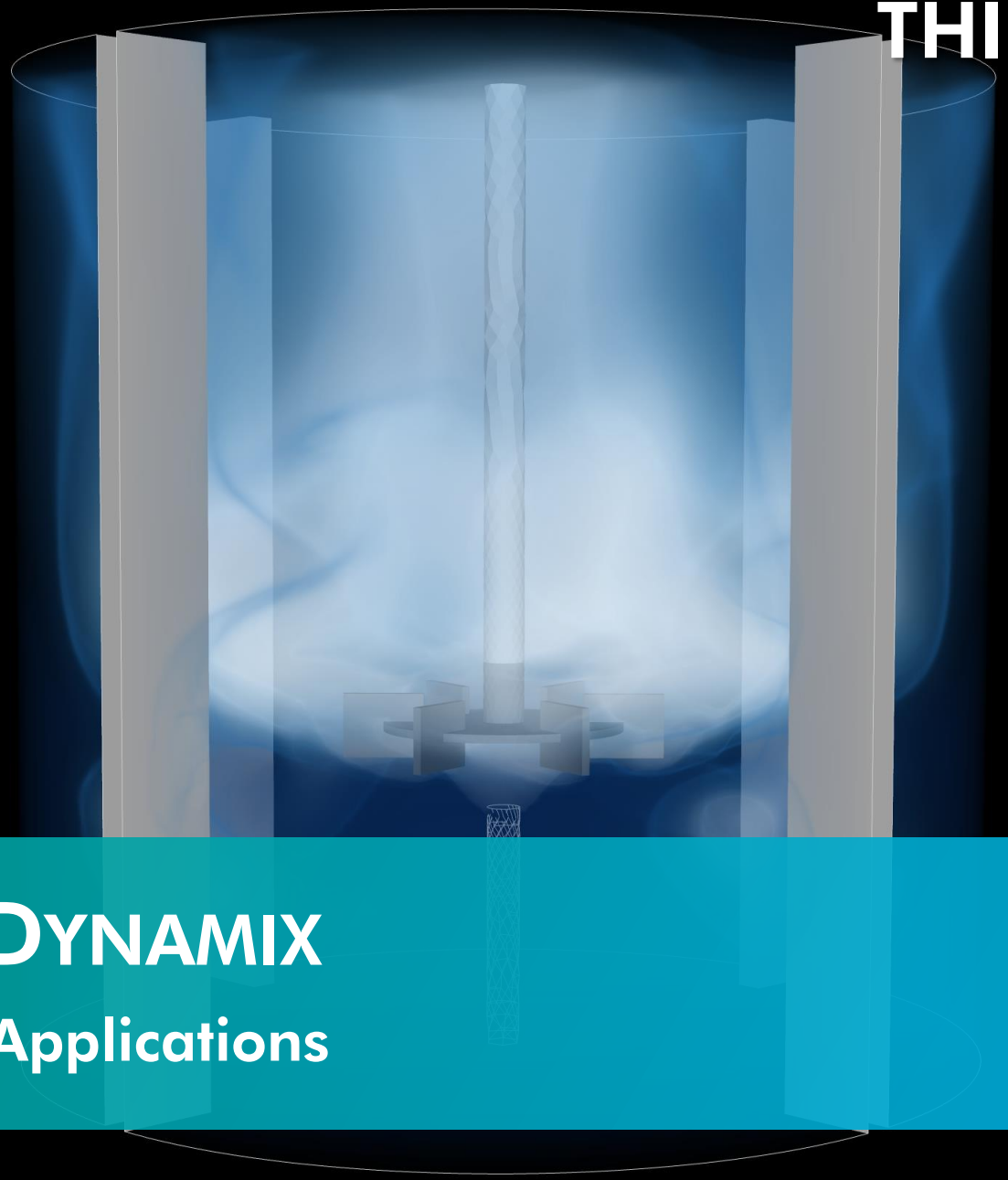
THINK Fluid Dynamix®



THINK FLUID DYNAMIX

CFD for Aeration Applications

THINK Fluid Dynamix®

CFD Engineering & Consulting

Provided by:
THINK Fluid Dynamix
Am Pestalozziring 21
D-91058 Erlangen (Germany)
Tel. +49 (0)9131 69098-00
http://www.think-fd.com

THINK Fluid Dynamix is the CFD based engineering and consulting business unit of **INVENT** Umwelt- und Verfahrenstechnik AG.

Definitions & Concepts

- Aeration in Biological and chemical reactors

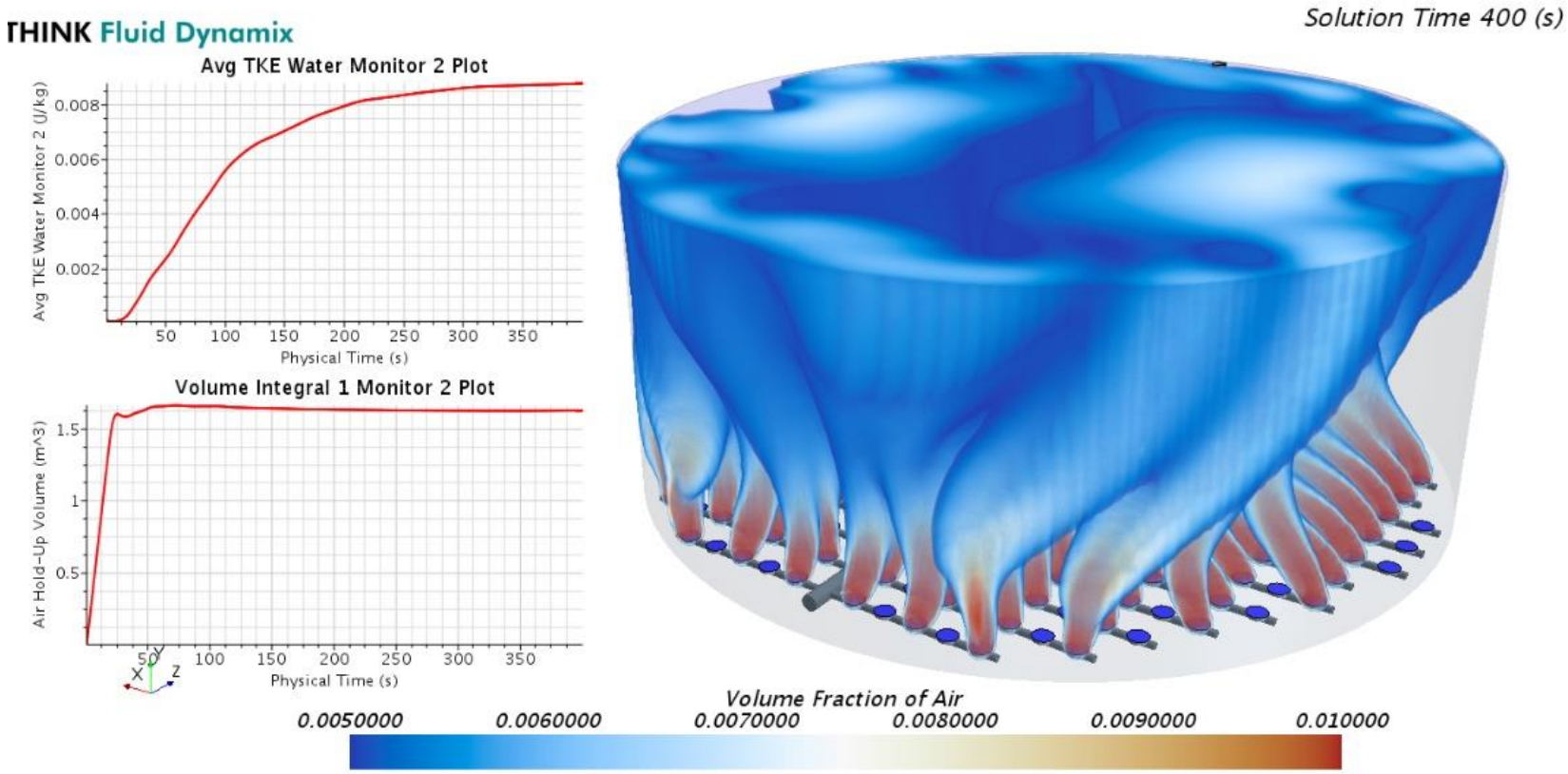
In industrial process engineering, aeration is a unit operation that involves the homogeneous dispersion of the gas-phase into the liquid-phase and the maximization of mass transfer (absorption or desorption). Absorption of gas into liquid to produce a chemical reaction is often a critical duty. Sometimes, the gas merely provides energy -via buoyancy- for mixing the liquid. The aeration in reactors plays an essential role for many processes in the water-treatment, chemical, pharmaceutical and biotechnology industries.

Using CFD Simulations, it is possible to analyze critical process parameters such as:

- Gas distribution over the entire system
- Total gas hold-up
- Mass transfer rate
- Mass transfer efficiency
- Size distribution of bubbles

Applications

- Analysis of biological reactors equipped with fine bubble diffusers.

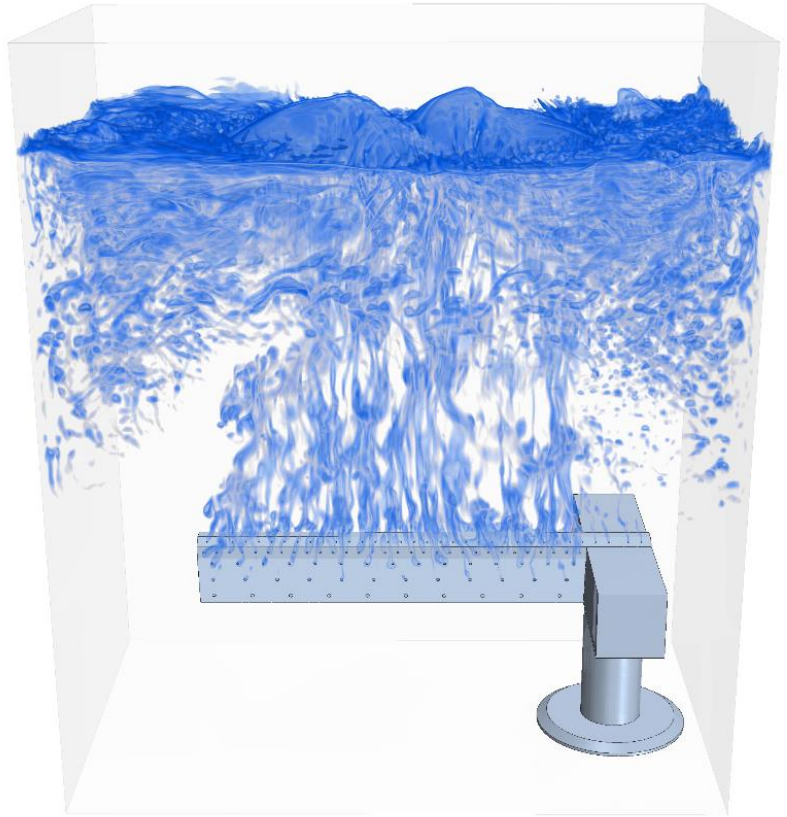


Fine bubble aeration is the best way to enhance the contact surface between the gas and the liquid phase resulting on higher mass transfer rate. There are, however, many other design parameters that has an influence on the oxygen transfer efficiency, for example the layout of the diffusers. With numerical simulations different designs can be analyzed to maximize design parameters.

THINK Fluid Dynamix®

Applications

- Analysis of biological reactors equipped with coarse bubble aerators.



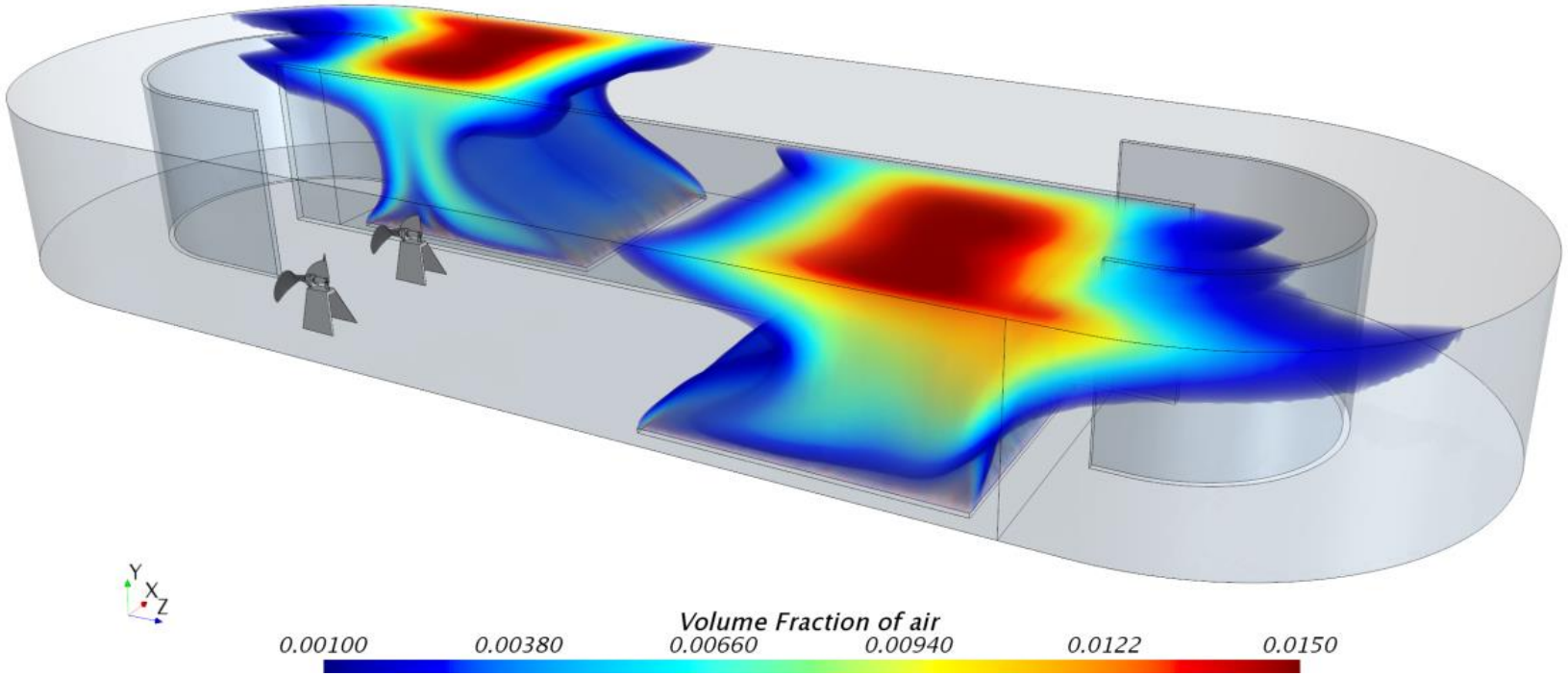
For many applications fine bubble diffusers cannot be installed or they perform with a poor efficiency, in such cases coarse bubble aerators have to be installed. Furthermore, coarse bubble aeration system are a good solution to add turbulence and mixing into the system. CFD simulations can provide an insightful description of such designs.

CFD as design tool

Analysis of operation in oxidation ditches.

→ Example of "Racetrack" shaped basin

THINK Fluid Dynamix

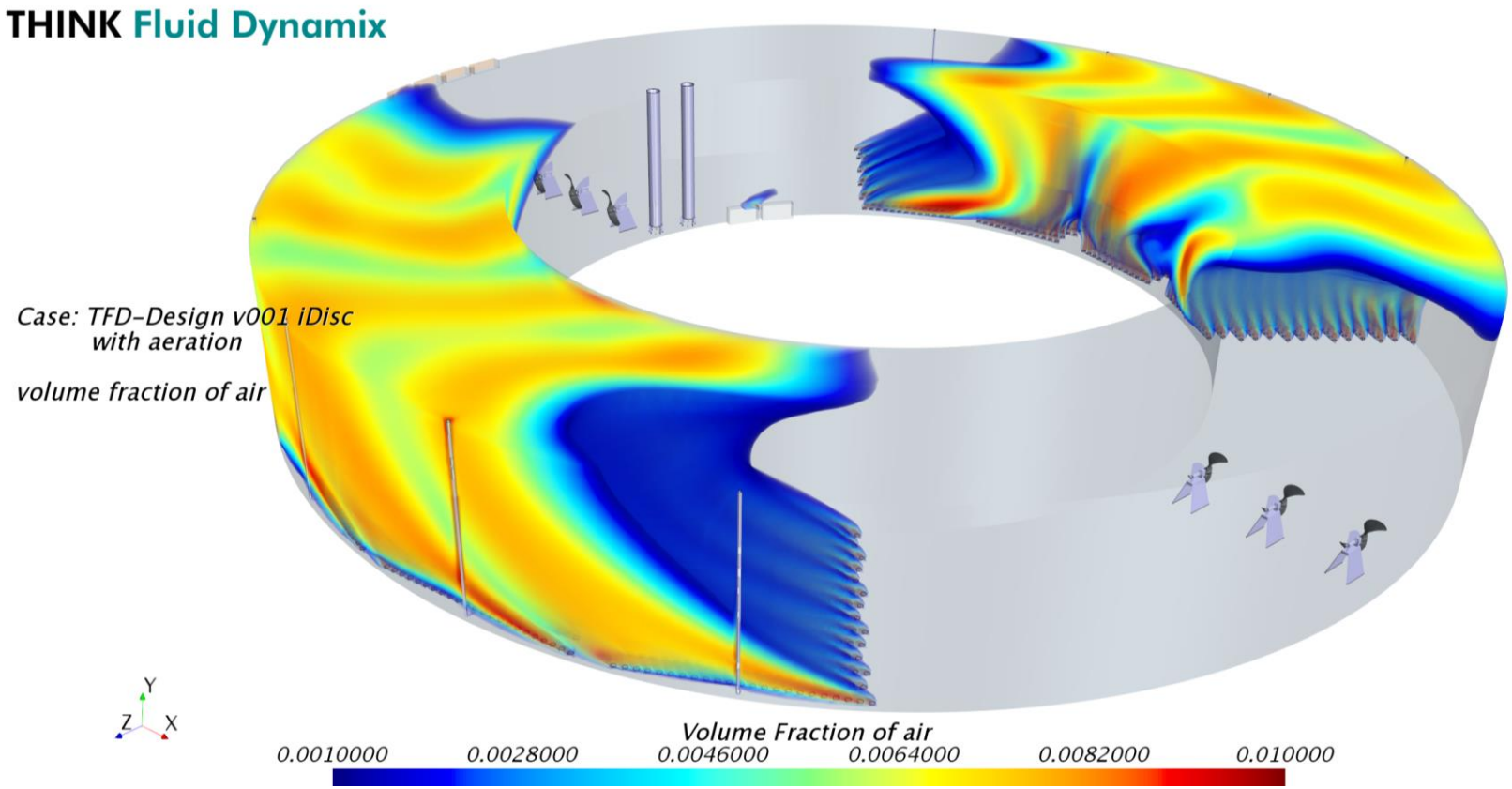


One of the most challenging applications of aeration in biological reactors are the so called oxidation ditches in wastewater treatment plants. Oxidation ditches are closed loop reactors equipped usually with fine bubble diffusers and large-diameter slowly rotating propellers. Goals of the process are the complete nitrification, nitrogen removal and also the prevention of sludge settling.

CFD as design tool

Analysis of operation in oxidation ditches.

→ Example of "Donut" shaped basin

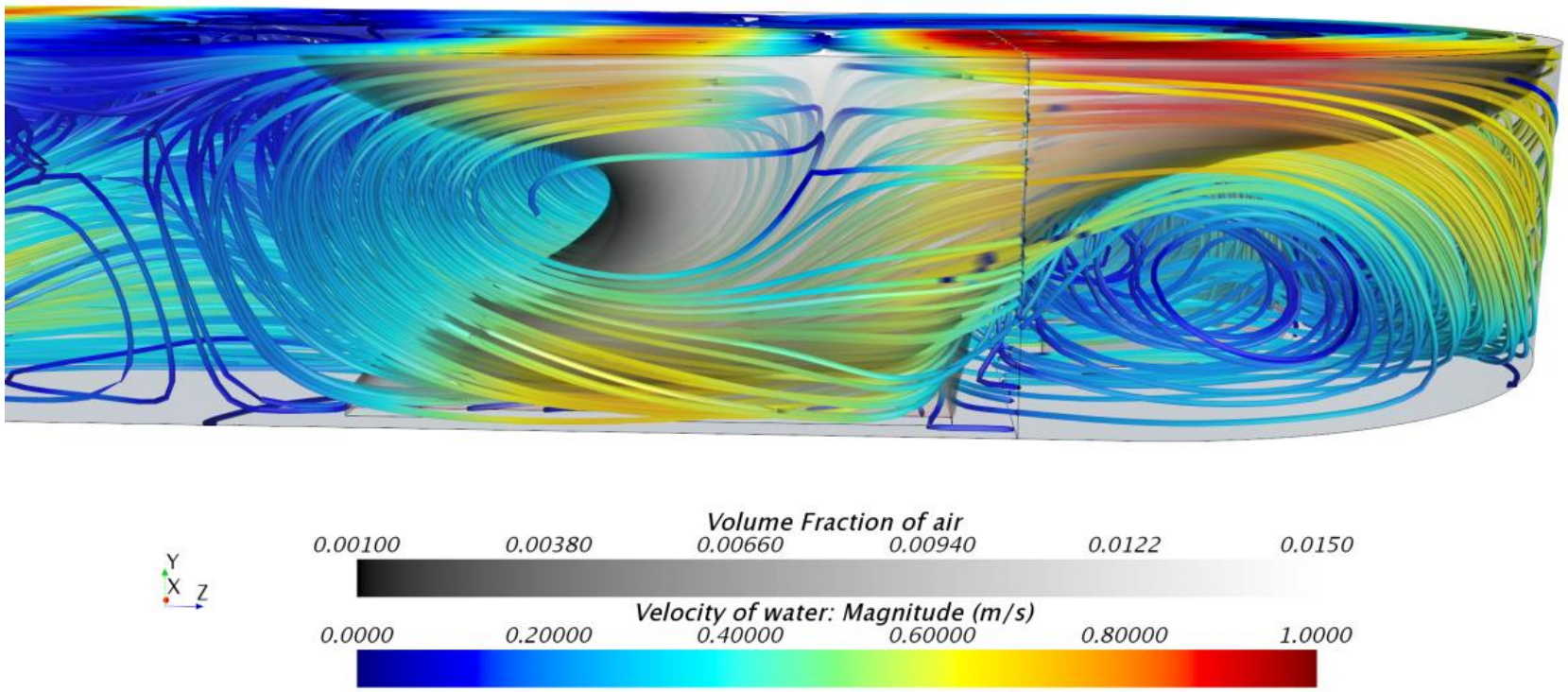


Oxidation diches exist in a large variety of shapes and sizes. This makes it very difficult to find general rules of thumbs to make efficient designs and therefore each case has to be specifically analyzed and , if necessary, optimized with the support of CFD simulations.

CFD as design tool

Analysis of operation in oxidation ditches.

→ the conflict between flow circulation and buoyancy forces.

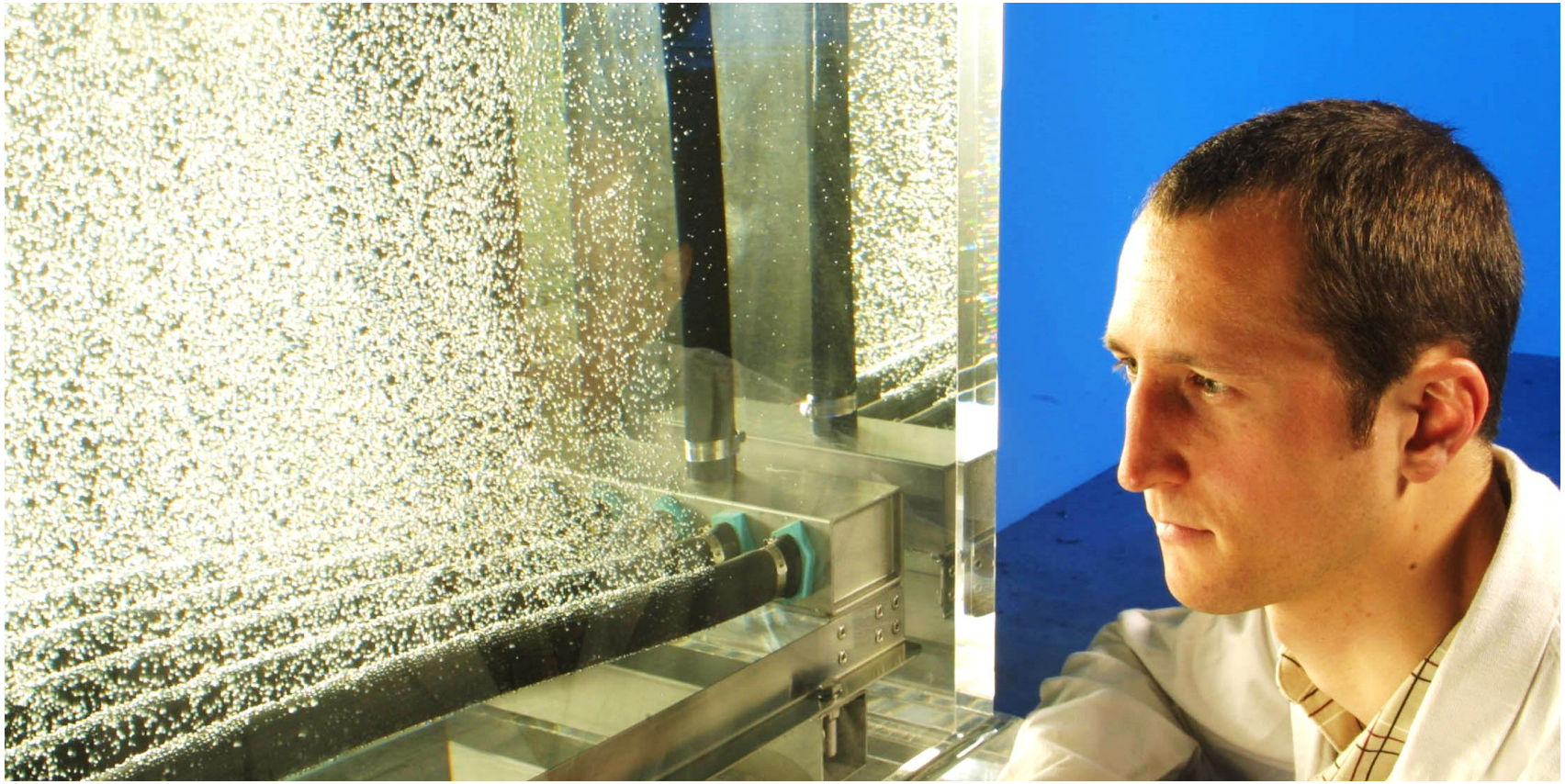


In oxidation ditches a natural conflict occurs between circulation flow induced by propellers and vertical flow induced by the buoyancy forces of the air load. A high air superficial velocity can result in the formation of strong vortex structures, which break the flow circulation and accelerate the natural rise of bubbles, resulting in a poor oxygen transfer rate and hence, in a lower reactor performance.

R&D

Study of gas-liquid mixing in stirred reactor by a Rushton turbine:

→ Experimental and numerical example of high specific gas load



The foundation of all serious scientific or engineering work is precise experimental results. Physical experiments form the basis of reliable technical knowledge. Our Research and Development team employs a number of both large and model test scale facilities specifically designed to carry out experimental testing and research.

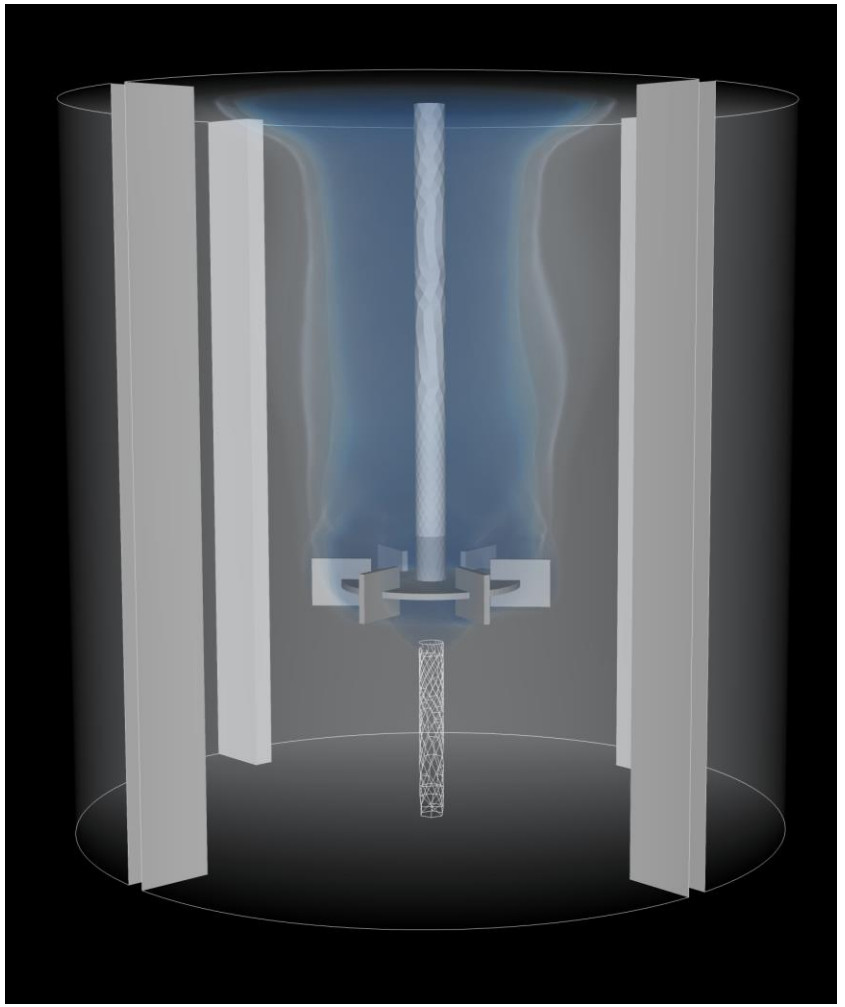
R&D

Study of gas-liquid mixing in stirred reactor by a Rushton turbine:

→ Comparison between experiment and CFD simulation at high specific gas load

Laboratory experiment: Time capture of air distribution

CFD results: Time averaged air distribution



THINK Fluid Dynamix®

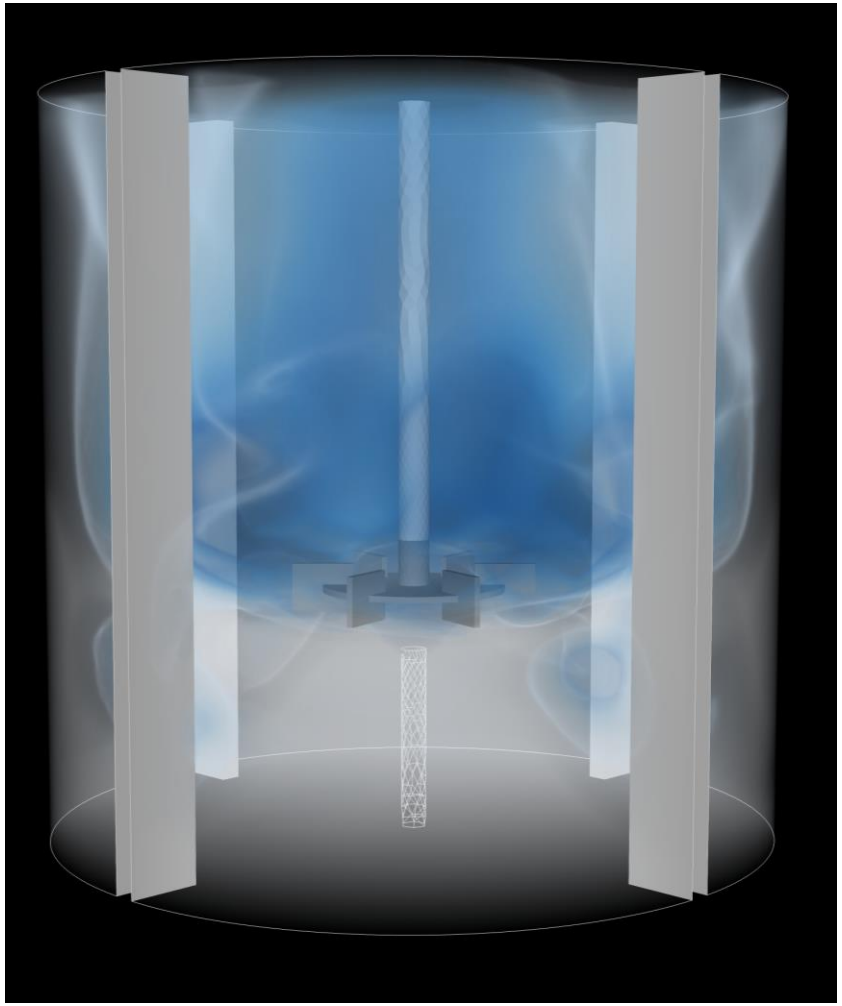
R&D

Study of gas-liquid mixing in stirred reactor by a Rushton turbine:

→ Comparison between experiment and CFD simulation at low specific gas load

Laboratory experiment: Time capture of air distribution

CFD results: Time averaged air distribution



THINK Fluid Dynamix®

Technical Competence

Company Video in YouTube

THINK **Fluid Dynamix** offers support and assistance with the design, optimization, and modernization of hydraulic structures in water and wastewater treatment plants.

More than 25 years of experience innovating and developing revolutionary solutions allow us to provide unique and in-depth analysis and solutions. We have a comprehensive functional and industrial expertise, and are passionate about taking on challenges that matter to our clients and to the environment.

The design of optimized process applications and hydraulic structures for the water and wastewater treatment industry requires a high level of multidisciplinary scientific and engineering skills. An optimal solution should show energy efficiency while maintaining a robust and reliable system approach

Sources:
Metcalf & Eddy (2014), Wastewater Engineering, 5th ed.
Paul, Atiemo-Obeng, Kresta (2003), Handbook of Industrial Mixing, 1st ed.

THINK Fluid Dynamix
Am Pestalozziring 21
D-91058 Erlangen (Germany)
Tel. +49 (0)9131 69098-00
www.think-fd.com