APEX HEAT TRANSFER

APEX-RESEARCH B.V.

APEX-RESEARCH CAPABILITIES

Research and Development within APEX Group

Research - the Foundation of APEX Group

APEX Group's products are based on internal and continuous research. We aim to improve our products by developing technologies that guarantee efficient heat transfer, long lifetime and trouble-free operation.

APEX Group's Technology is supported by its Research and Development Department, that primarily focuses on advanced flow analysis. We believe it is vital to develop our products with the support of the R&D professionals who are committed to APEX Group's vision and goals.

APEX-Research consists of qualified engineers with Master and PhD degrees in laser optical measurements and experimental fluid mechanics.

Advanced Flow Measurement Services

By using advanced laser optical measurement techniques we gain insight into the unknowns of turbulent flows. Moreover, our knowledge of internal channel flows and the distribution of large amounts of flow, facilitates the optimization of your process.

This helps our customers worldwide to achieve their targets for sustainability, while maintaining product quality. The work may be done in our laboratories or by request in the customer's installations.

APEX-Research offers:

- Experimental Fluid Dynamics;
- Flow modeling on scaled models;
- Analysis of boundary-layer phenomena;
- Heat transfer laboratory experiments;
- CFD Simulations.

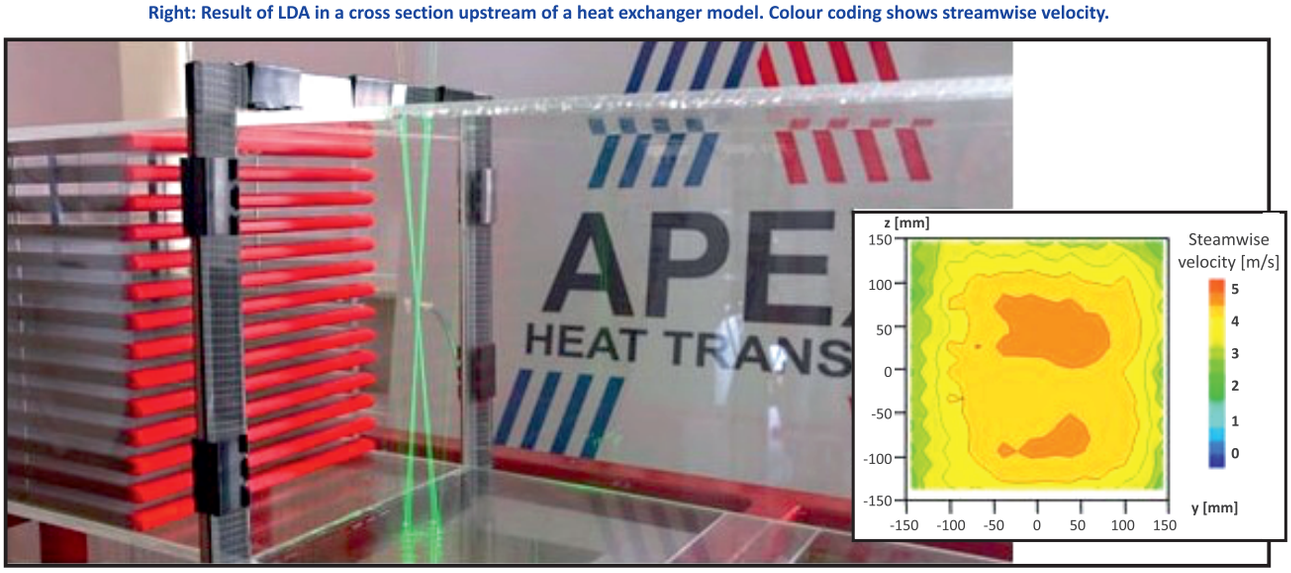
Experimental Equipment:

- Laser Doppler Anemometry (LDA) for accurate velocity measurements;
- Particle Image Velocimetry (PIV) for flow structure analysis;
- Static and dynamic pressure measurements for pressure drop analysis;
- Hot Wire Anemometry for turbulence analysis;
- Infrared Thermometry for heat transfer analysis;
- Thermo-element measurements;
- Latest 3D Printing technology.

Research & Development Facilities:

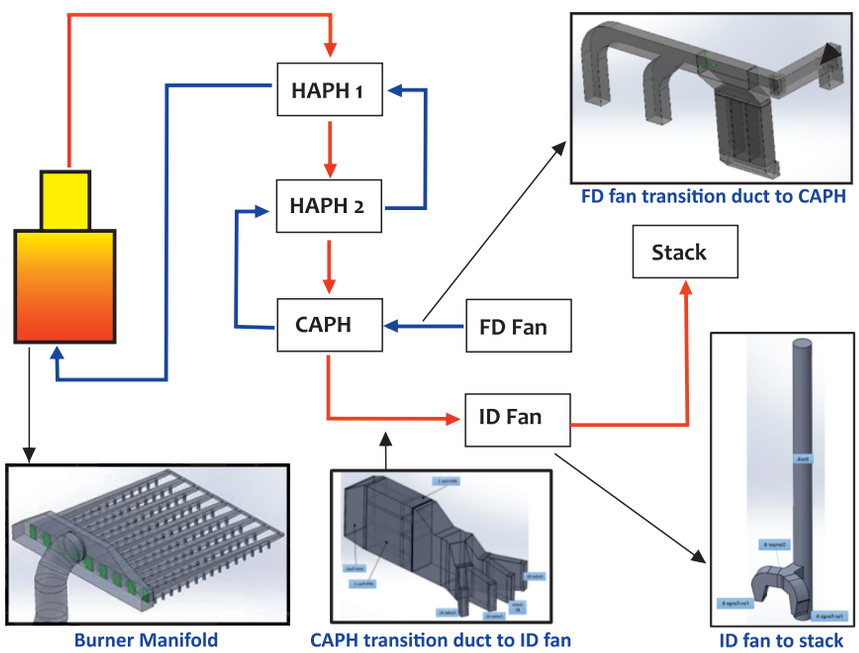
- Transparent facilities for flow analysis within scaled models;
- Hot flow facility for heat transfer studies;
- Enameling Laboratory for surface coating investigations.

**Left: Physical Model used for Laser Optical Measurement Techniques.
Laser Beams from LDA System can be observed as green lines in the image.
Right: Result of LDA in a cross section upstream of a heat exchanger model. Colour coding shows streamwise velocity.**



Predictable Operation
by simulation of the APH system

APEX Group Computational Fluid Dynamics (CFD) expertise covers the CFD simulation of the complete fired heater and heat recovery system. We can conduct various types of analysis, depending on the customer's requirements. We can simulate an actual installation, with the purpose to identify less effective areas in the system (e.g. un-uniform flow distribution, large pressure drop or vibrations in the fan). Additionally, we can simulate the optimization of the installation, with the target to overcome the imperfections and to achieve a reliable operation of the complete fired heater's air and flue gas distribution system.

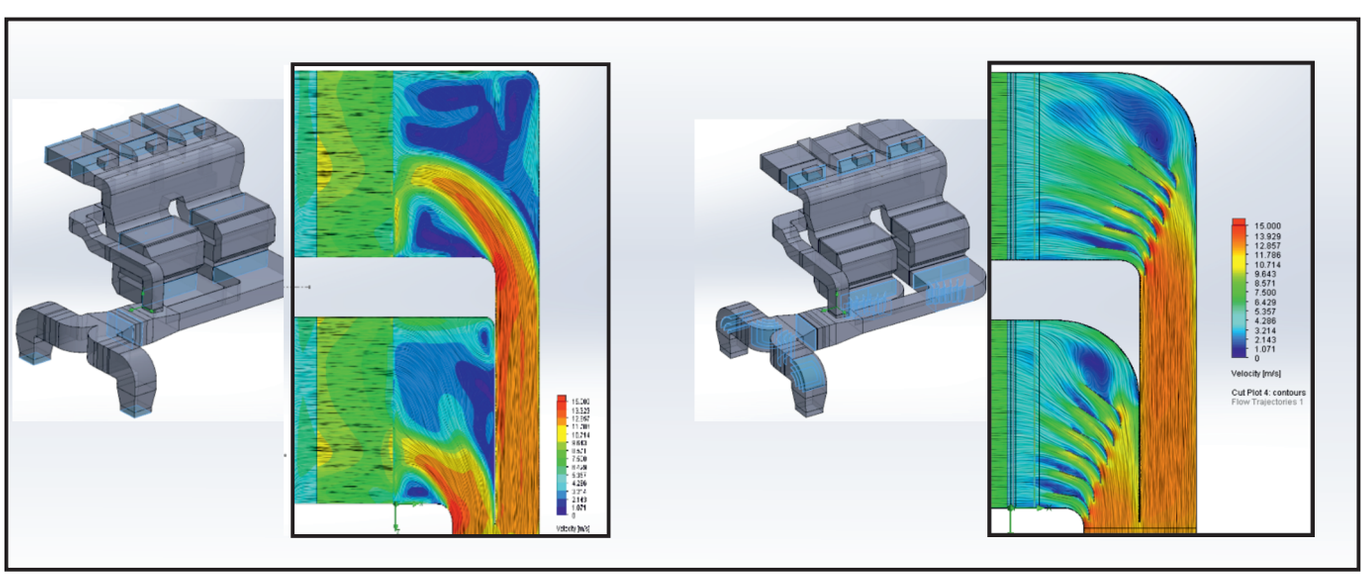


CFD:

- Commercial FloEFD using advanced k-ε model for simulation of turbulent flow fields and heat transfer;
- Simulation of customer's duct design;
- Simulation of concepts to be validated by model experiments.

Flow Simulation helps in:

- Analysis of flow mixing;
- Analysis of flow rate distribution;
- Analysis of by-pass flow;
- Pressure drop calculation;
- Analysis of flow uniformity;
- Identification of high velocity areas.



Example: Simulation and optimization of "Forced-draft Zone". Left: Original Design. Right: Improved Design. Colour coding shows velocity magnitude in m/s.

Case Study: Gas-Gas Heat Exchanger for a DeNOx Unit

Case Study

Gas flow rate: 120.000 kg/h
Duty: 2500 kW

DeNOx units are applied to remove the nitrogen oxide (NOx) from the flue gas, as this is the major component causing acid rain and photochemical smog.

For the reliable and effective performance of the DeNOx units, it is mandatory to have a defined and accurate flue gas temperature entering into the catalyst.

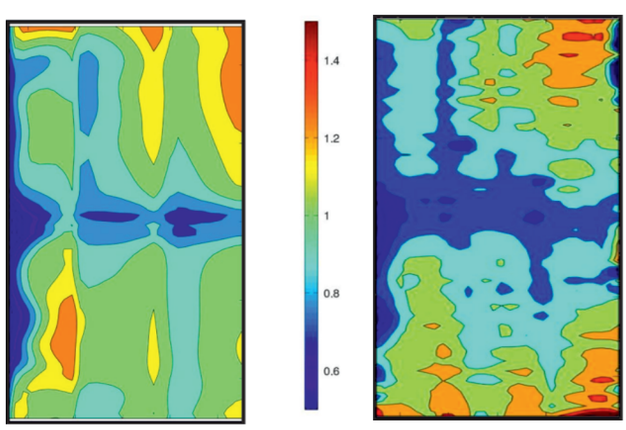
This can only be achieved by a well designed gas-gas heater with the confines of having a small temperature span exiting the equipment.
The small temperature span can mainly be achieved by a counter flow arrangement of the heat exchanger.

Nevertheless, special care needs to be taken to guarantee a proper flow distribution entering the heat exchanger.

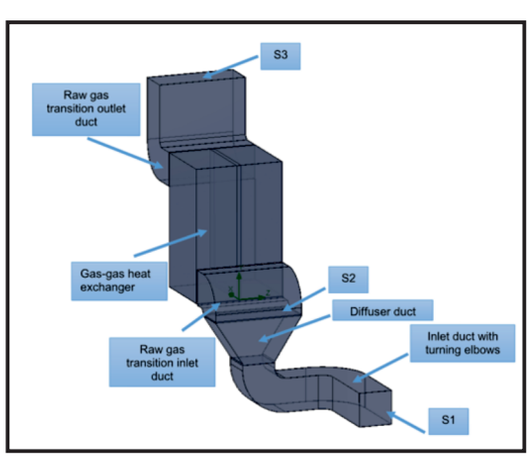
Non-uniform flow distribution may not affect the overall performance of the gas-gas heater, but has a major influence on the temperature distribution exiting the gas-gas heater.

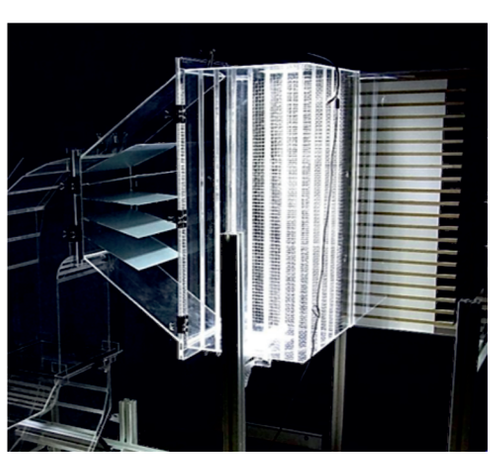
APEX-Research made a detailed investigation of the flow distribution entering the gas-gas heater and optimized it by inserting our APEX-delfino Flow-Conditioner and Transition Duct. The optimization was performed with Computational Fluid Dynamics (CFD) and the result were validated with a scaled down experimental flow model.

CORPEX® Gas-Gas Heater for a DeNOX unit



Computational (left) and experimental (right) results of the flow distribution entering the gas-gas heat exchanger, the mean deviation from the mean velocity is 10%.





Computational Model (left) and Experimental Model (right)

"APEX Group is dedicated to offering *engineering solutions*, not just a *commodity.*"

Mircea Dinulescu, Founder of APEX Group

Company Profile

APEX Group is specialized in designing and manufacturing high quality heat transfer equipment. CORPEX®, A-CORREX® & APEX-delfino® plate-type and tubular exchangers are designed to bear the most extreme requirements. We provide innovative engineering solutions for high performing heavy-duty gas/gas and gas/liquid equipment for heat recovery and environmental projects.

Experience and Vision

We encompass 45+ years of experience and expertise of our founder, Mr. Mircea Dinulescu, and share his vision - ***to research, create and provide engineering solutions*** for heat transfer industrial applications. To this day, our *Credo* remains unchanged, creating the strong foundation for APEX Group's position in the international market:

> *Started in 1990 as a small independent business, APEX GROUP will grow into a reputable designer and manufacturer of high quality low-priced industrial heat transfer and combustion equipment for the international market operating according to the quality principles laid out by international standard ISO 9001.*
>
> *M. Dinulescu, 1991*

Quality and Innovation

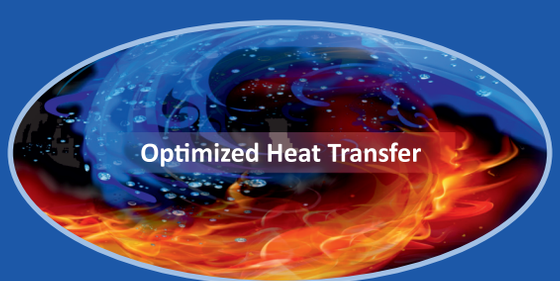
APEX Group's strength consists of know-how, patented technology, professionalism and leading-edge engineering. Our Research and Development Department supports APEX Group's activities by providing new solutions for continuously upgrading APEX Group's products and guaranteeing optimal heat transfer, long lifetime, trouble-free and user friendly operation.

Customers Worldwide

We take pride in being a family-owned company, which allows us to build close connections with our customers and guarantees a personal approach to each project. We strive to support our customers by engaging in dialogue and developing long-term partnerships. Our company is renowned world-wide and naturally we deliver to every corner of the world.

Broadening Horizons

By encouraging feedback from customers, APEX Group develops solutions and products that anticipate market needs. To materialize our concepts we have expanded our Engineering, Research and Fabrication facilities. Apex engineers are continuously keeping up to date with the newest industrial developments in order to provide optimum design for our customers.



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