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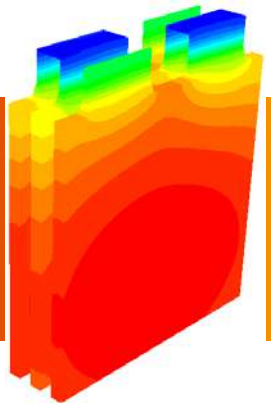
RESEARCH CENTRE FOR ENERGY RESOURCES AND CONSUMPTION

TECHNOLOGICAL SERVICE

CFD Simulation



CFD simulation is a standard technique that allows for the optimization of designs and processes at an industrial scale in a variety of applications. Simulation technology saves costs during prototyping phase, and shorten product development schedules.

Simulation technology affords a digital benchmark for testing new designs. Thus, it is possible to assure not only that the future asset or process will function appropriately, but that it will work optimally regarding consumptions, emissions, etc.

Objectives of the service:

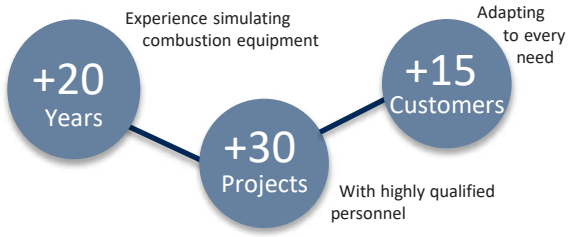
A digital benchmark allows to speed up the process of:

- Optimizing the design of an asset or industrial process during the first steps of development.
- Obtaining detailed information on critical points for the operation of an asset.
- **Reducing costs** in prototypes and experiments.

Applications:

- **Combustion equipment**: improve the design and performance of furnaces, boilers, burners, etc.
- **Industrial plants:** optimizing the operation of combustion equipment, scale-up of testing facilities, minimizing emissions, fouling, etc.
- **Electric equipment:** motherboards, converters, charging and accumulation systems, etc. We optimize refrigeration, improving reliability and durability of assets.
- **Heat transfer:** optimizing the design of deposits and insulating coverings.
- **Other topics:** our personnel has experience in the simulation of different processes, such as ink-jet, exhaust gas or wind turbines.

Key figures



Simulation tools

We rely on advanced software and hardware tools:

- ANSYS software for CFD simulations.
- Equipment for simulations: Beowulf cluster with 40 kernels (E5-2690V2 3.0G) and 128Gb RAM, OS RHEL 6.7.
- Software to develop sub-models and post-processing results (Matlab, EES y COMSOL).

Work methodology.

- Analysis of the problem and the customer needs.
- Detailed geometrical model from customer specifications: blueprints, CAD files, SolidWorks, etc.
- Choice of appropriate physical models: heat transfer turbulence, chemical reactions, combustion, etc.
- Analysis of the results and proposal of improvement measures. Evaluation of optimized designs.

Optimization by means of CFD

Analysis of the problem → Geometric model → Physical models → Analysis and proposals for improvement → Evaluation optimized design

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Benefits:

1 REDUCTION OF DESIGN COSTS

- ✓ Assessment of different designs and operating conditions at a reduced cost.
- ✓ Reduction of the number of experimental tests required to improve existing assets.
- ✓ Optimization of the number of prototypes required to develop new products .

2 OPTIMIZATION OF DESIGN AND OPERATION

- ✓ Realistic 3D simulation of physical processes.
  - ➢ Better understanding of a system´s behavior under real operating conditions.
- ✓ Assessment of equipment´s response upon changes in the operating conditions.
  - ➢ Efficient operation.
- ✓ Distinguish yourself from your competitors.

3 INCREASING QUALITY OF SERVICE AND CUSTOMER SATISFACTION

- ✓ Graphic information, rich and easy to understand for non-experts.
- ✓ Useful as a marketing tool to explain improvements in designs and processes.

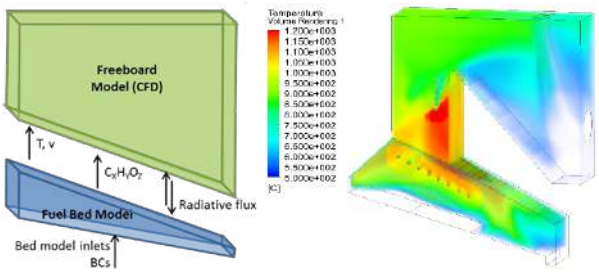

Figure 1. Example of a simulation

"Using CFD tools allows for a reduction of development time and production costs up to 25%."

Aberdeen Group, 2011

Addressed to:

CFD simulation technology can be applied to different industrial sectors:

- **Energy:** Simulation of combustion in furnaces and boilers:
  - Steel
  - Ceramics
  - Non-ferrous metals
  - Gas turbines
- **Electric:**
  - Heat transfer in solid materials: insulation, deposits.
  - Cooling of motherboards, charging and accumulation systems, inverters.
- **Cement, refractories, lime:**
  - Rotatory kilns for clinker and magnesite.
  - Calcination furnaces.
- **Fertilizers:**
  - Rotatory kilns for granulation.
- **Wind:**
  - Flow through a wind turbine or a field of turbines.

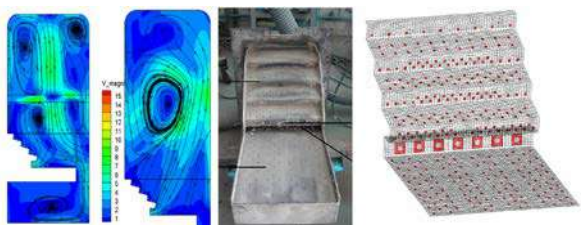

Figure 2. Example of a simulation

References

CIRCE possesses a long experience performing studies and analysis in combustion, having worked with companies such as DOW, FERTINAGRO and Lsolé:

FERTINAGRO · LSolé BIOMASS SOLUTIONS · DOW

* *Proyecto DISIRE*

CIRCE has performed numerous R&D projects:

- **EDEFU** - New Designs of Ecological Furnaces – *FP7 GA 246335*
- **HBE** – New hearth for efficient conversion of non-conventional biomass – *Retos Colaboración*
- **DISIRE** - Integrated Process Control based on Distributed In-Situ Sensors into Raw Material and Energy Feedstock – *H2020 GA636834*
- **VULKANO** - Novel integrated refurbishment solution as a key path towards creating eco-efficient and competitive furnaces – *H2020 GA 723803*
- Retrofitting of carbon thermal plants by energetic valorization of dumps and re-use of residues. *INNPACTO 2012*
- **BIOCARD** - Global Process To Improve Cynara cardunculus Exploitation for Energy Applications – *FP6 GA19829*

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