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Gestamp Biomass Solutions R&D Department Gestamp Biomass Solutions

Company and activities

Gestamp Biomass Solutions belongs to Gestamp Corporation, a global supplier with more than 40.000 employees, which billed in 2014 more than 12.000 million dollars by means of its more than 140 plant worldwide.

The core business of Gestamp Biomass Solutions is the EPC boiler supply (design, construction, erection and commissioning of steam generators, mainly boilers for power and industrial plants).

Within this scope, it is included the design and turnkey supply of electric power generation plants (conventional fuels, biomass, solid urban wastes etc.), steam Boilers (conventional fuels, biomass, solid urban wastes incinerators, recovery (HRSG) etc.) or thermal equipment (heat exchangers).

The R&D department develop engineering services and research development to the other technical departments with open-source CFD software Code_Saturne.

Context of use of Code_Saturne at Gestamp Biomass Solutions

Gestamp Biomass Solutions is being using Code_Saturne since 2012 in a practical application of CFD to all the engineering stages of its product line in an horizontal integration.

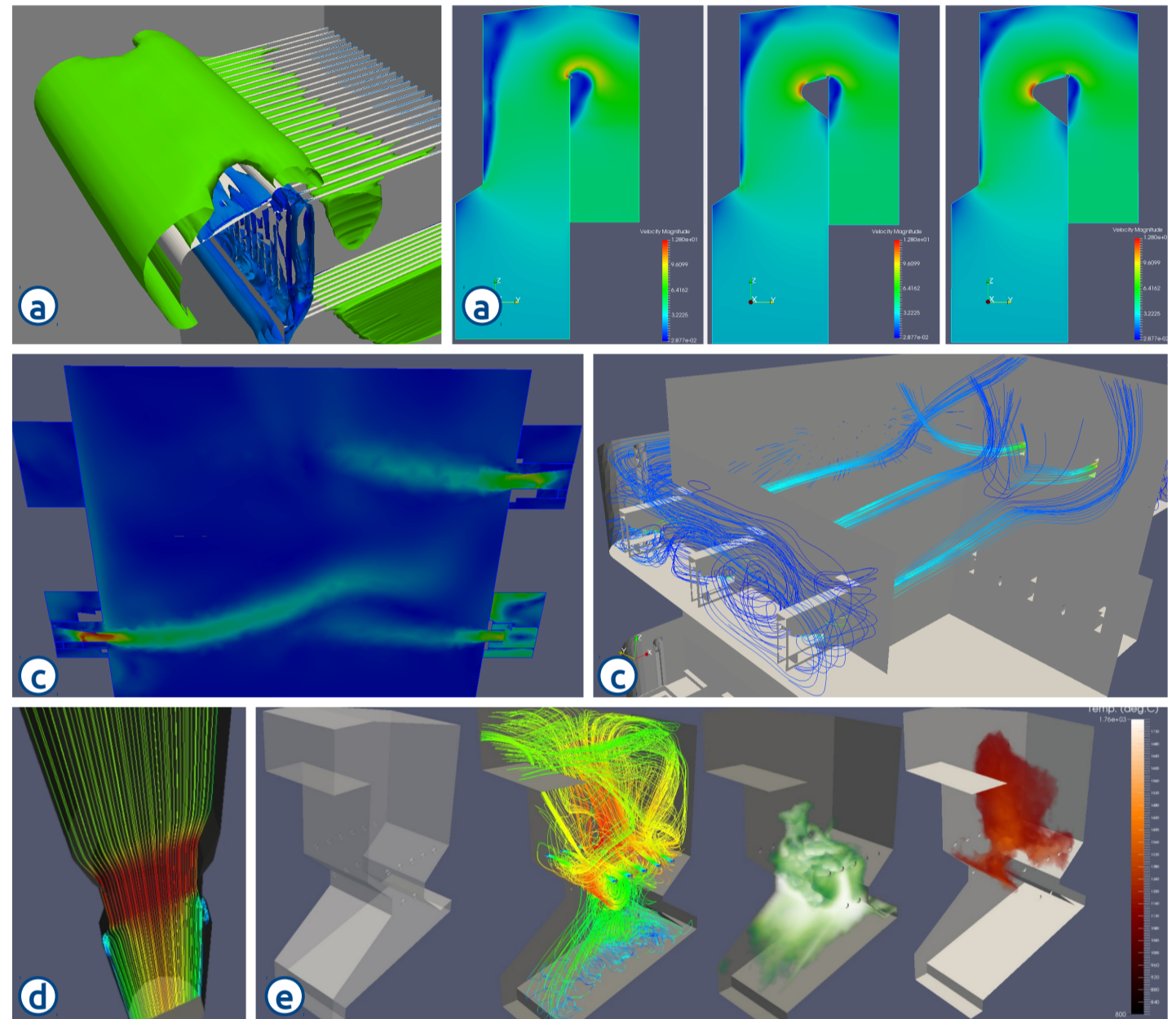
- *Preliminary engineering:* Equipment designs, assessment of techno-economical evaluation processes
- *Engineering support:* Mechanical designs where a flow distribution, head loss and thermal/combustion processes are present.
- *Operational analysis:* Modeling of observed physical phenomena of existent facilities (reverse-engineering) for improvements in later designs and performances in operation.
- *Research and development activities:* Evaluation and modification in existing equipment designs based in experiences and improvements on engineering services as service differentiation.

Use of Code_Saturne at engineering stages

In Gestamp Biomass Solutions, Code_Saturne is deemed an integrated tool which belongs to the natural flow of information of typical services and products developments of a power plants engineering company. Most of times, this integration involves process simulations of current designs and developments so that it provides a valuable feedback for other departments outputs.

Some of the aforementioned valuable calculations are following shown as typical engineering situations where the practical use of Code_Saturne marks a difference in Gestamp Biomass Solutions services.

- Optimization of flue gases flow patterns for biomass boilers of the company incoming projects** – An adequate flue gases distribution is essential for expand the representativeness threshold of analytical boiler models. Code_Saturne simulations reduces most the fluid distribution uncertainties of analytical models allowing a valuable boiler optimization at engineering stages. (Figure: Flow gases distribution on future 50MWt biomass boilers)
- Prediction of head losses and preferential distributions in fluid ducts networks** – Analytical simulations of flow ducts and pipes does not scope all physical matters which at the end may lead to traditionally accepted operational differences. Code_Saturne simulations able to predict some of these differences so that they can be scoped in some equipment requirements.
- Analyses and predictions of operational parameters of combustion processes** – Code_Saturne simulations ables to predict many of the combustion processes deviations as a result of the agreement of theoretical requirements and final physical solutions. Most of these effects are a consequence of turbulence deviations or other simulable effects so, Code_Saturne turns into an essential tool. (Figure: Over-fire air injections analysis in a 250MWt BFB boiler)
- Validation of engineering standards** – Engineering standards are a valuable database of good practices and designs considerations which are based on experience or standardization processes. Code_Saturne ables to evaluate these standards so that the valuable experience can be optimized with a validated calculation for a cost-effective result. (Figure: Venturi-type flow meter simulation)
- Support on technical evaluations processes** – Technical-economical evaluations requires preliminary calculations which supports the provided information. At a first glance, numerical simulations are not effective tools for these purposes although its results are technical and graphically representative as they implies an implicit message of the company capabilities. An adequate use of Code_Saturne is performed for these purposes through simplified but representative simulations. (Figure: Biomass gasificator simulation, preliminary syngas generation and temperature profile)

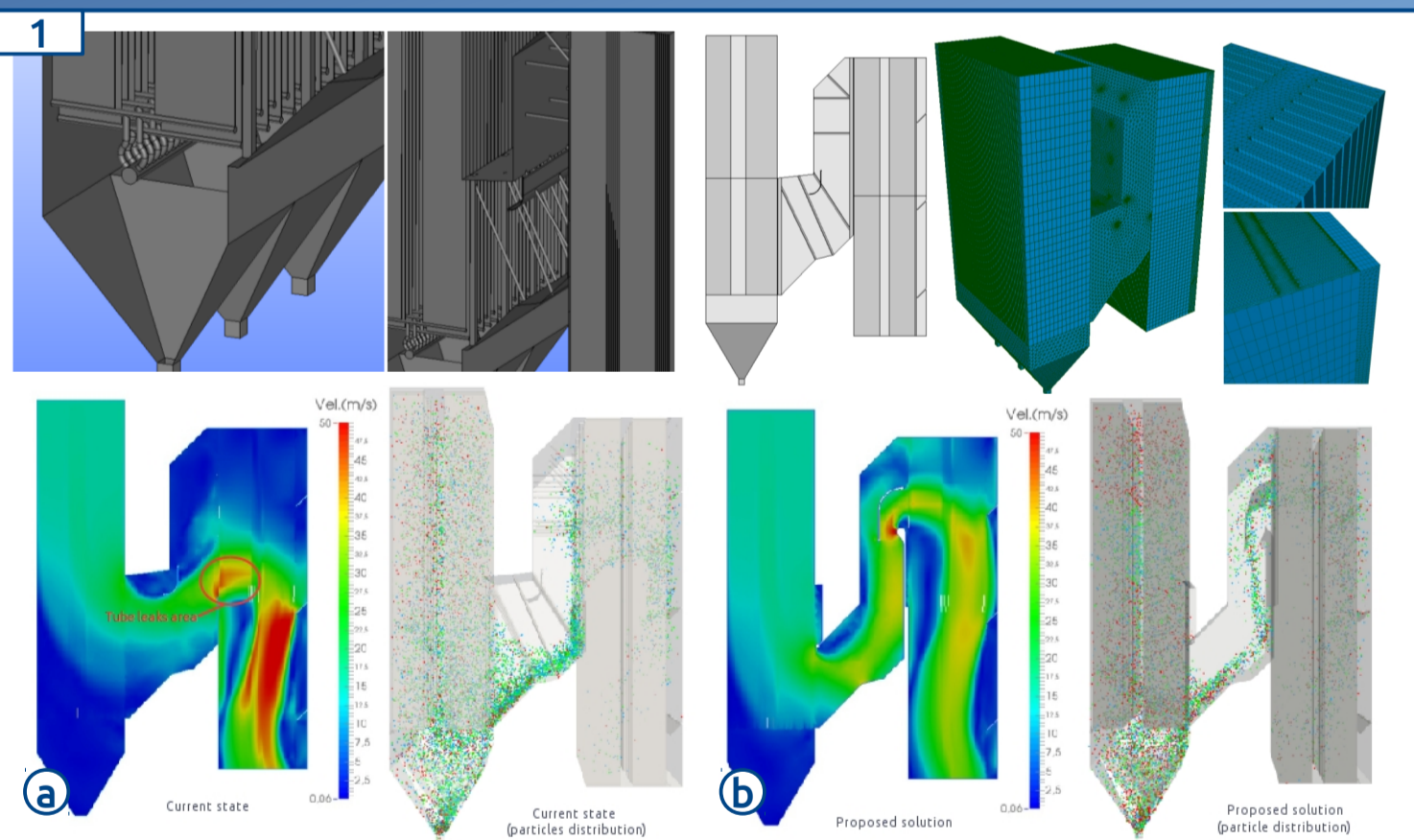


Use of Code_Saturne for Engineering services

Within its product portfolio, Gestamp Biomass Solutions provides engineering services by a practical utilization of numerical simulations performed with Code_Saturne. The accumulated experience overs the years of our technical staff matches with the R&D department knowledge of the numerical techniques and experience with the software to provide judicious results and their valuable application to achieve successful results.

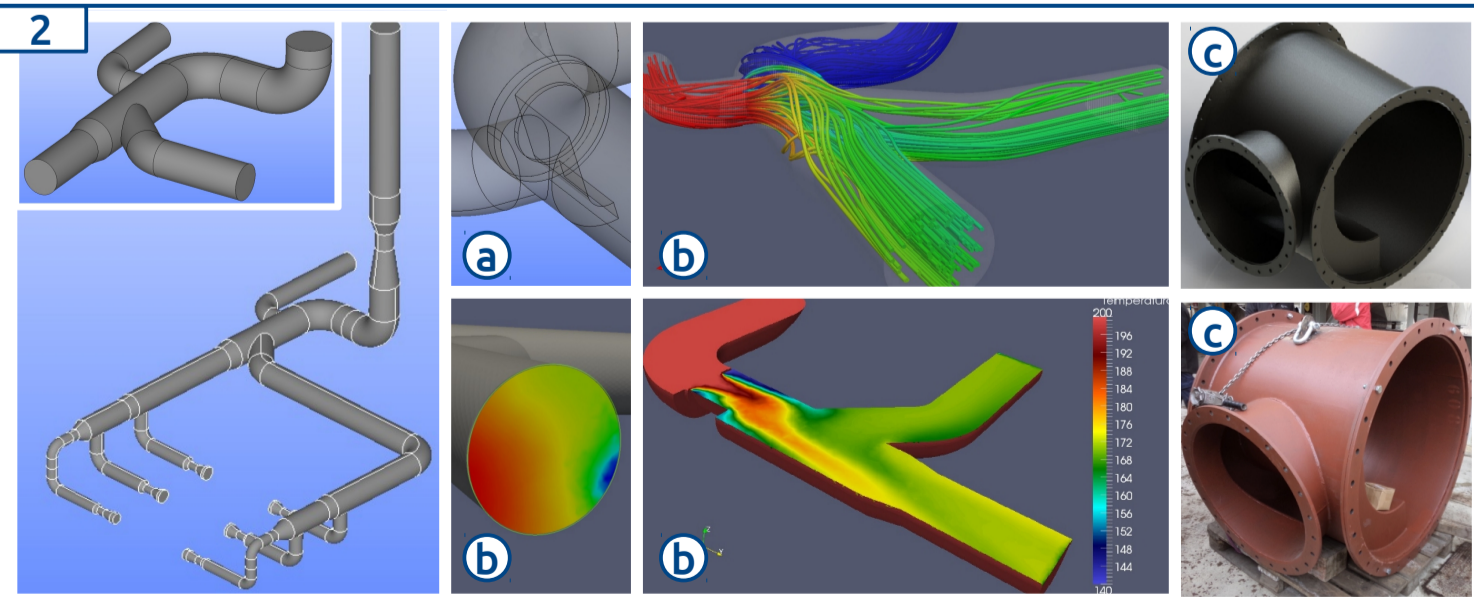
1) Study of the flue gases distribution inside the economizer of a BFB biomass boiler: During a BFB biomass boiler operation, leaks in the economizer finned tubes occurred presumably due to erosive effects of transported ashes and bed sand particles, so that the facility had to stop and perform repairs with a consequent loss of operational time. Several simulations were performed to check if the observed phenomena could be related with the flue gas internal distribution characteristics and with the associated particles transport. In order to evaluate if the current flue gas operating conditions can be related with the observed erosive phenomena, several simulations of a representative domain of the equipment in their current state have been performed according to both geometrical and process data gathered in on-site gathered information.

- Current state simulations confirms the presence of a high velocity preferential way which impinges directly on the finned tube banks where the erosive effects are observed. Based on these results, it was proposed/simulated different solutions through the insertion of removable internal elements to modify the flue gas behavior so that preferred ways and particle high-concentration areas change, with its consequent erosive effect.
- The performed simulations show the proposed modifications in the transition duct prior the economizer could potentially improve the flue gases distribution according to the velocity profile and particle distribution. The proposed simulation may reduce the flue gas impingement velocity on the finned tubes up to a 70%. These solutions are expected to reduce the erosive effect substantially with an additional flue gas flow distribution improvement and are planed to be installed in April 2016.



2) Study of the flue gases mixing system for a biomass plant: Grate combustion system of biomass boilers frequently recirculates some of the flue gases with the preheated combustion air to increase the combustion efficiency with a reduction on the NO_x generation. Because of the fluids nature, its mixing and distribution shall be analyzed in terms of head losses and mixing rate to ensure an adequate performance according to combustion analytical foresights.

- In order to ensure the mixing quality it was required several simulations of several flue gases mixing systems for a current biomass plant to define its most adequated and its impact on the process parameters.
- The parameters studied were the species uniformity, average temperature per branch, total head loss and pressure profile in time for a ramped flue gas entry.
- The resulting design was manufactured and installed in the Garray (Soria, Spain) Biomass Plant in 2014 with successful results and this design is now a Gestamp Biomass Solutions standard.

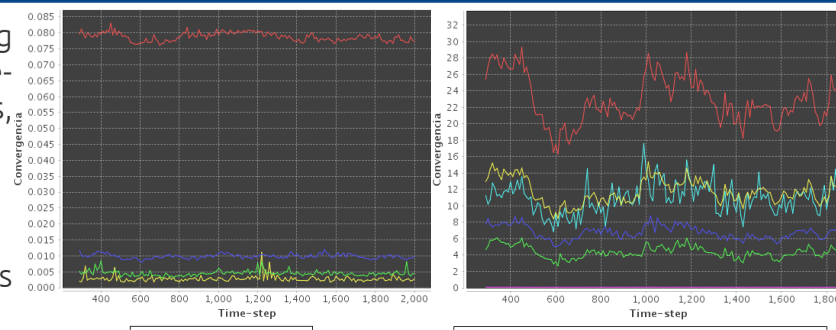


Relevant ongoing R&D works at Gestamp Biomass Solutions with Code_Saturne

Gestamp Biomass Solutions' most relevant R&D work is focused in the developing of an accurate, realizable and practical full-scale CFD model for olive residues grate-firing biomass boilers for engineering purposes, involving two independent works, also focused to be the PhD dissertation of the authors:

- Experimental and computational analysis of olive residues biomass-fired grates.
- Modeling fly ashes particle deposition on olive waste fired boiler.

Additionally, a monitoring tool has been developed for a real-time residuals supervision and interactive evaluation of the simulations with Code_Saturne.



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