A sustainable approach to decarbonization in industrial heat treatment processes

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Heating and quenching are key processes in industry, especially for thermal treatment applications. They play an important role in shaping material structure and quality. However, they come at a significant cost, with their long cycle times resulting in escalating energy consumption and environmental burdens, hindering industrial sustainability. In our era of decarbonization, this challenge becomes even more critical when reducing CO_2 emissions and minimizing energy consumption are primary. To advance towards decarbonization, the current trend is to shift from thermal treatment in gas-fired furnaces to electric furnaces.

Considering these challenges, this study shows the role of numerical simulations in making the shift from traditional gas furnaces to electric ones. This change tackles the problems tied to the energy usage of industrial furnaces while also fitting into the requirements of decarbonization. The substitution of natural gas by electricity will significantly reduce the amount of CO_2 emissions by the manufacturers.

Numerical simulations are an important tool for performing extensive tests and optimizing installations, like furnaces or quenching tanks. This is not only a cost-effective and environmentally friendly alternative, but it also ensures results close to experimental measurements and requirements.
In this study, we will simulate and test different scenarii to guide the shift from gas to electric furnaces. Using the qobeo® software for complex industrial installations, a similar scenario of heating ingots in a gas furnace will be compared to their heating in an electric furnace comparing the energy consumption and carbon emissions. Figure 1 shows an example of an industrial furnace that can be considered. Furthermore, an optimization study of the electrical furnace will also be conducted integrating PID controllers to ensure that maximum efficiency is achieved and the required temperature in the ingots is obtained.

The goal is to demonstrate the potential of numerical simulations in the field of industrial heat treatment, especially in the transition from gas to electric furnaces. Simulations can play a significant role in enhancing energy efficiency and reaching a sustainable future.

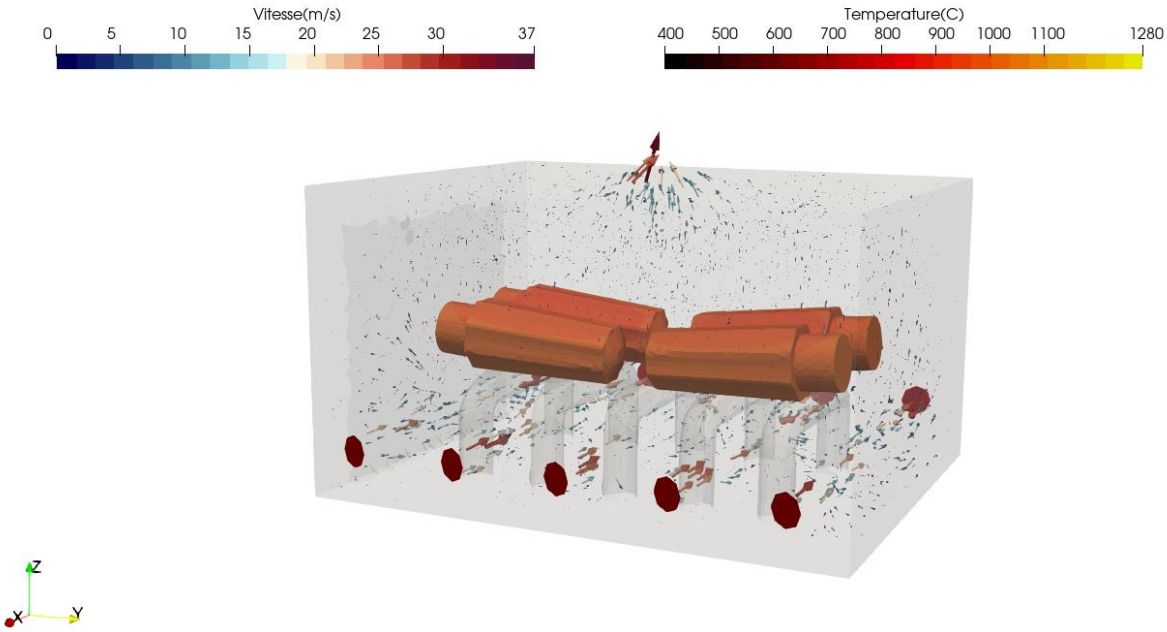

Figure 1: Example of industrial furnace and simulation using qobeo®