Cutting-Edge Simulation Improves Industrial Processes

ArcelorMittal

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ArcelorMittal S.A. is a multinational steel manufacturing corporation headquartered in Avenue de la Liberté, Luxembourg. It was formed in 2006 from the takeover and merger of Arcelor by Mittal Steel. ArcelorMittal is the world's largest steel producer, with an annual crude steel production of 93.6 million tones as of 2012.

ArcelorMittal needed help to optimize blast furnace fuel utilization and campaign life; increase energy efficiency of the billet reheat furnace; and improve uniformity of strip heating. In each case CFD simulation provided valuable insight into the complex heat transfer and fluid flow phenomenon occurring in these processes, leading to significant process improvements. ArcelorMittal also discovered process development time could be shrunk in half or more by using such technologies. The company found that advanced simulation and 3D VR avoided costly mistakes, such as an improperly designed furnace being built for manufacturing carbon anodes. Construction was halted until the redesign was finalized.

Simulation and Forecasting Technology role
Reduce process development time, 3D VR

Sector
Metals

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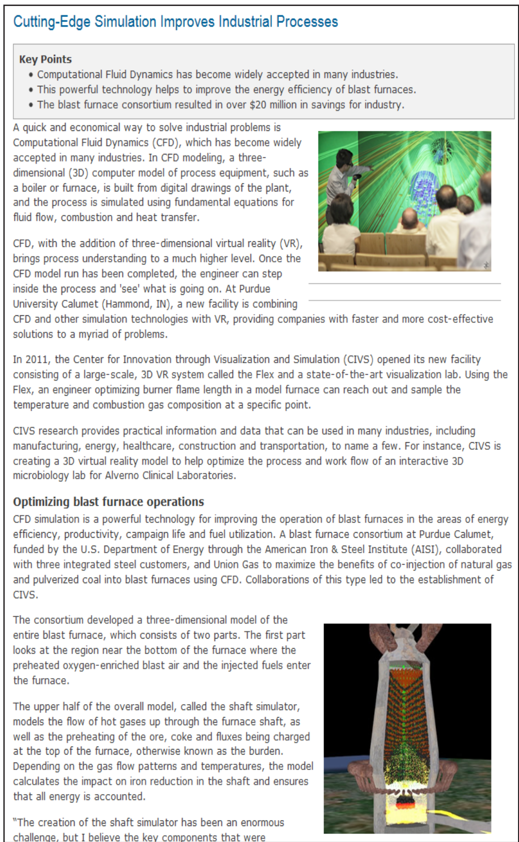

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Key Points

- Computational Fluid Dynamics has become widely accepted in many industries.
- This powerful technology helps to improve the energy efficiency of blast furnaces.
- The blast furnace consortium resulted in over $20 million in savings for industry.

A quick and economical way to solve industrial problems is Computational Fluid Dynamics (CFD), which has become widely accepted in many industries. In CFD modeling, a three-dimensional (3D) computer model of process equipment, such as a boiler or furnace, is built from digital drawings of the plant, and the process is simulated using fundamental equations for fluid flow, combustion and heat transfer.

CFD, with the addition of three-dimensional virtual reality (VR), brings process understanding to a much higher level. Once the CFD model run has been completed, the engineer can step inside the process and 'see' what is going on. At Purdue University Calumet (Hammond, IN), a new facility is combining CFD and other simulation technologies with VR, providing companies with faster and more cost-effective solutions to a myriad of problems.

In 2011, the Center for Innovation through Visualization and Simulation (CIVS) opened its new facility consisting of a large-scale, 3D VR system called the Flex and a state-of-the-art visualization lab. Using the Flex, an engineer optimizing burner flame length in a model furnace can reach out and sample the temperature and combustion gas composition at a specific point.

CIVS research provides practical information and data that can be used in many industries, including manufacturing, energy, healthcare, construction and transportation, to name a few. For instance, CIVS is creating a 3D virtual reality model to help optimize the process and work flow of an interactive 3D microbiology lab for Alverno Clinical Laboratories.

Optimizing blast furnace operations

CFD simulation is a powerful technology for improving the operation of blast furnaces in the areas of energy efficiency, productivity, campaign life and fuel utilization. A blast furnace consortium at Purdue Calumet, funded by the U.S. Department of Energy through the American Iron & Steel Institute (AISI), collaborated with three integrated steel customers, and Union Gas to maximize the benefits of co-injection of natural gas and pulverized coal into blast furnaces using CFD. Collaborations of this type led to the establishment of CIVS.

The consortium developed a three-dimensional model of the entire blast furnace, which consists of two parts. The first part looks at the region near the bottom of the furnace where the preheated oxygen-enriched blast air and the injected fuels enter the furnace.

The upper half of the overall model, called the shaft simulator, models the flow of hot gases up through the furnace shaft, as well as the preheating of the ore, coke and fluxes being charged at the top of the furnace, otherwise known as the burden. Depending on the gas flow patterns and temperatures, the model calculates the impact on iron reduction in the shaft and ensures that all energy is accounted.

"The creation of the shaft simulator has been an enormous challenge, but I believe the key components that were