

# FLOW-3D

## Customer Success Profile

### HIGHLIGHTS

#### Featured Customers

General Motors Powertrain

Graham-White  
Manufacturing Co.

#### Industry

Casting

#### Challenges

Pinpointing the location of core gas blow defects in complex castings.

Helping designers evaluate a multitude of venting designs prior to the first casting.

#### Results with FLOW-3D

Reduced scrap rates and less time spent on process design lets General Motors Powertrain and Graham-White Manufacturing stay ahead of the competition.

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**FLOW-3D**

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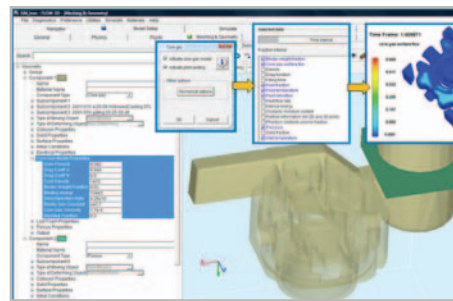
## Casting Better Parts by Detecting Porosity with FLOW-3D's Core Gas Model

Using FLOW-3D's core gas model helps casting engineers solve core gas related defects. Flow Science teams up with industry partners to produce better parts by addressing core gas issues using casting simulation software.

- 30% decrease in core blow scrap
- Successful application of CFD methods to core gas flow
- Significantly reduced time to market

### Producing High Quality Castings

Foundries must perform a great deal of up-front engineering to ensure casting quality is achieved on the first trial. In recent years, numerical tools for modeling metal flow, solidification, microstructure evolution and residual stresses have become commonplace. However, one casting

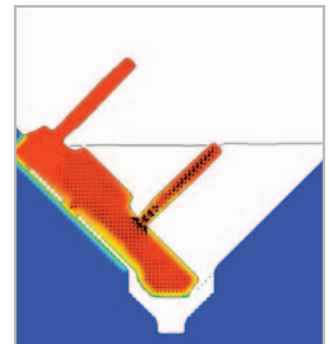


Results options such as core gas flux, binder weight fraction and out gassing rate can be analyzed using FLOW-3D's core gas model.

defect that has yet to be thoroughly addressed is the common core gas blow defect. The physics of this problem involves a complicated interaction between the metal, core and binder. Failure to solve it can result in high scrap levels. In most instances, the problem is merely managed – but never completely solved – by using a higher pour temperature and adding more wall stock to the affected areas.

### Designing the Optimum Break-Down

In the past, if materials and casting engineers found a porosity defect issue due to core gas bubbles, they would step through a standard series of problem-solving tasks: reduce the binder content, increase the core venting, coat the core or possibly bake the cores ahead of time. Since it was impossible to see the path that the gas followed, this was a long drawn-out process often taking weeks to complete for one part. And, it had to be repeated every time there was a problem with a different part.



GM engine block water jacket, showing binder weight fraction

The market-driven need to compress this processing timeline has prompted the development of casting simulation software. Useful for both design and manufacturing, computer-based modeling allows engineers to test a variety of approaches without any real-part cost or waste. To help foundries apply simulation specifically to venting design, Flow Science has recently added core gas modeling to its FLOW-3D casting analysis capabilities.

Call 505-982-0088 or email [sales@flow3d.com](mailto:sales@flow3d.com) for more information on how FLOW-3D can enhance the reliability and quality of your castings.

## Applying CFD Methods to Core Gas Flow

Due to the chemical complexity of resin-based binders, understanding just where and how the gas flows after sand-core thermal break-down is complicated. However, Flow Science collaborated with several groups to obtain experimental data and compare results with those from the numerical models. The company gathered core gas flow rate information from General Motors, Graham-White Manufacturing Co. and AlchemCast, getting real-world data on sand-resin cores used with aluminum, iron and steel.

Dr. David Goettsch, a casting analysis engineer at GM Powertrain, has used **FLOW-3D** for fifteen years for analyzing filling and solidification of metal castings. The new core gas model has been quite useful for optimizing the jacket core venting at the design stage. It is very difficult to implement vent tracks into an existing core box with all the other demands on the core prints. "Upfront analysis work on core gas venting can save you from high scrap rates during your start up," he explains. "Perhaps process changes can solve the problem. But it may take a lengthy test period to get to that point."

With the core gas model now available in **FLOW-3D** v9.4, Goettsch can try different insertion and venting locations and get a global diagnosis: seeing how much gas develops, where it goes, and how much got out before the metal front caught up to it. "It's very nice when you can actually see the root cause of the problem," he says. "These visualizations are great to try to get a little window on what the real phenomenon is doing."

## Multi-Core Challenges

Another experienced foundry engineer, Elizabeth Ryder of Graham-White Manufacturing Co., echoes the opinion that gas porosity has always been difficult to investigate. She adds that, "Particularly with multiple cores, it was hard to pinpoint which core was the source of the problem. You tried to address the whole system."

With ongoing production runs of 1700 parts, some of them in quantities of 10,000 parts per year, Graham-White was very receptive to improving its manufacturing processes through simulation.

Working with a 3D model of a grey-iron part (roughly 3in x 4in) created by laser scanning, Graham-White provided the current venting design for evaluation. This gating design comprised four impressions per pattern plate in a horizontally parted mold, with each impression having vents for each core. A central sprue enabled filling each mold in less than two seconds.

Simulation with **FLOW-3D** confirmed the fill rate, but also showed that one core had insufficient venting. Graham-White then began drilling deeper holes in the core to help channel more gas through the existing vents. Since switching its approach to the new venting design, the company has seen an approximately 30% decrease in core blow scrap.

Ryder says that **FLOW-3D** results helped narrow their design focus, letting them immediately zero in on which core (of a multi-core design) was the culprit, and even which area of the core was the problem source. "The more you can do on a computer ahead of time, the better," she says. "It all comes down to saving time."



*Core prints for casting with internal geometries must be sufficiently vented to avoid core gas blow defects.*