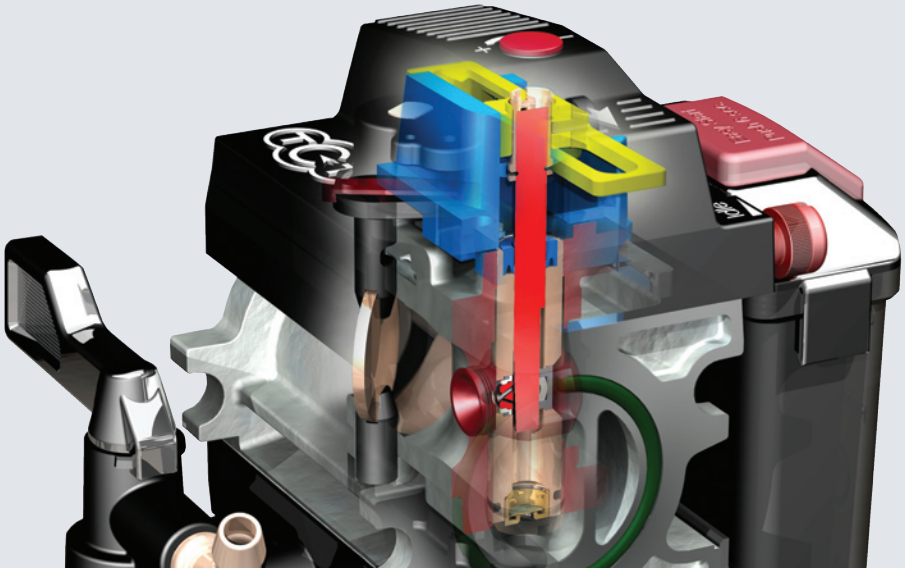
Total Combustion Technology (Fjölblendir EHF)

INNOVATING CLEAN, FUEL-EFFICIENT ENGINE TECHNOLOGIES WITH SOLIDWORKS FLOW SIMULATION



SolidWorks 3D CAD and SolidWorks Flow Simulation CFD analysis software help TCT to improve fuel system efficiency through simulation of air-fuel mixing behavior.

- Introduced series of engine fuel system innovations
- Compressed development cycles substantially
- Reduced prototyping by 80 percent
- Improved understanding of air-fuel flow and mixing

Total Combustion Technology (TCT) helps small engine manufacturers produce engines with improved fuel economy and performance while reducing harmful emissions. The new TCT fuel system may cut fuel consumption by almost 20 percent and carbon monoxide emissions by almost 80 percent. According to Chief Designer Kristján Björn Ómarsson, understanding the behavior of air-fuel flow within a carburetor has long been a challenge. Historically, Fjölblendir conducted costly physical testing and lengthy design iterations to produce advances in fuel systems. But as the company's engineers continued to push the limits of TCT design, they realized that improved analysis and 3D visualization of air and fuel flow within a closed carburetor system could provide significant benefits.

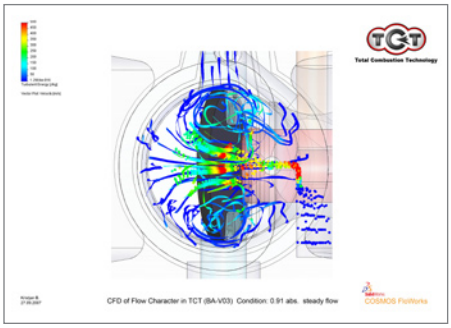
"We knew the ability to simulate air and fuel flow within a carburetor air chamber could reveal air traps, fuel collections, and flow obstacles," Ómarsson explains. "In the past, we relied on our own hand calculations, iterative testing, and use of good engineering practice and common sense to produce innovations in fuel system design. Going forward, we wanted to deploy new technologies to enhance our understanding, so we began investigating computational fluid dynamics (CFD) software packages that would help us to analyze air-fuel mixing behavior and simulate fuel atomization."

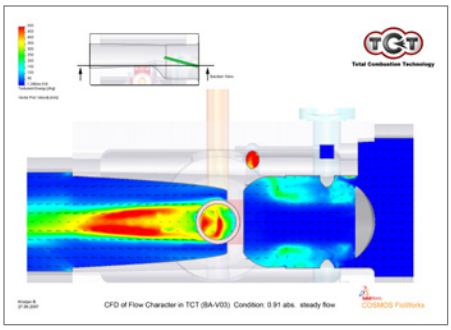
Because TCT engineers use the SolidWorks® 3D CAD package for mechanical design, Ómarsson evaluated the integrated SolidWorks Flow Simulation CFD analysis solution, which works directly on SolidWorks CAD models. "I decided to try SolidWorks Flow Simulation software to determine whether it could solve some of our flow-mixing problems," Ómarsson recalls. "I found the software to be easy to learn and truly amazing for simulating mixing behavior, which I simply could not visualize before using the software. SolidWorks Flow Simulation provides fantastic insights for developing fuel systems. I now use it regularly as an important application in our development process."

SolidWorks

"What I like most about SolidWorks Flow Simulation software is that I can eliminate between 10 and 15 prototype cycles on each project."

Kristján Björn Ómarsson, Chief Designer





With SolidWorks Flow Simulation CFD analysis capabilities, TCT engineers gain greater insight into air-fuel mixing behavior and fuel atomization.

Greater understanding shortens design cycles

Since implementing SolidWorks Flow Simulation software to analyze fluid flow in carburetors and other fuel system components, Fjölblendir has compressed its TCT design cycles while accelerating research and development of fuel system innovations. "We are doing things with the air-fuel mixture that you cannot do with a conventional carburetor," Ómarsson says. "We study how different shapes of the main air chamber and atomization nozzle affect the mixing of fuel and air. By optimizing the air-fuel mixture, we can create cleaner combustion that reduces emissions."

In addition to saving time through a greater understanding of specific flow characteristics, TCT engineers avoid delays associated with converting and translating files from a CAD application to a CFD analysis package and vice versa. "With SolidWorks Flow Simulation, I am already inside the CAD system and can quickly conduct as many analysis iterations as necessary," Ómarsson says.

Reducing prototypes cuts costs

The ability to simulate and analyze complex flows and their impact on fuel atomization enables Fjölblendir to develop innovative fuel systems which contribute to new, cost-effective advances in engine design. In 2003, Ómarsson designed a simple but very effective gas mixer for diesel dual-fuel applications that attaches to the main air intake manifold on any conventional diesel engine. Burning a mixture of 20 percent diesel and 80 percent natural gas will cut harmful emissions by about 80 percent. Using SolidWorks Flow Simulation software, Ómarsson was able to invent this dual-fuel gas-mixer by building a single prototype.

"What I like most about SolidWorks Flow Simulation software is that I can eliminate between 10 and 15 prototype cycles on each project," Ómarsson stresses. "Because I can now simulate flows more accurately based on engine size, speed, and air requirements, I learn quickly about how design changes can optimize air flow and fuel burn rates. Hopefully, I will never need to make more than three prototypes, which results in greatly reduced development costs."

Demonstrating new fuel system concepts

Ómarsson says SolidWorks Flow Simulation software also provides Fjölblendir with important air-fuel flow simulation visuals for demonstrating and explaining new concepts in fuel system design to customers, partners, and collaborators. "SolidWorks Flow Simulation is a valuable tool for showing proof of concepts and comparing TCT to conventional fuel systems like standard carburetors, communicating what is happening within a new system," Ómarsson explains. "The software makes it easy to show someone how, for example, a feature may trap and puddle fuel in certain areas.

"The ability to use visual and accurate simulation results to illustrate air-fuel mixing and flow makes it much easier to foster understanding, build support, and move forward with innovative concepts in fuel system design," he notes. "The analysis results we obtained on our fuel-efficient, reduced-emissions engine have been validated through actual testing."

SolidWorks

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