APS TECHNOLOGY

Facts

Challenge
To make oilfield drilling equipment even more durable and flexible using additive manufacturing.

Solution
The EOSINT M 280 makes it possible to build more complex drilling equipment, that even withstands the harsh environment of oil and gas wells.

Results
- Optimized: drilling assembly with part count reduced from four separate components to just one
- Efficient: optimized design increases drilling accuracy, reduces post-processing and production costs
- Fast: shorter lead times and times to market
- Profitable: no need for moulds and the production time involved

Drill bit and rotary steerable system (RSS): Complex parts for rotary steerable systems, which actively steer oil and gas wells, are now being produced by APS Technology, Inc. using industrial 3D printing technology from EOS. (image courtesy APS)

Additive Manufacturing – for a New Drilling Experience

Oilfield drilling equipment manufacturer APS steers manufacturing onto a new production path with components made using industrial 3D printing technology from EOS

Short profile

APS Technology is one of the world's most advanced and reliable companies to deliver field performance and design confidence for all oilfield and harsh environment needs. The Company was founded in 1993 in Connecticut.

Further information

www.aps-tech.com

Imagine trying to drill a hole through your living room wall, down the hallway and into the bedroom, all while standing in front of your house. Sounds impossible? Not when you use the right drilling technique – on the one hand flexible, but on the other hand perfectly built for a challenging task like this. Fortunately, carpenters and home improvement enthusiasts don't have to resort to such extreme drilling tactics for their work, but feats just as improbable as this are being performed daily in the oil and gas industry. Which is why, when it comes to producing drilling equipment for its oil fields, APS technology relies on additive manufacturing from EOS.

Challenge

Around the world, well drillers routinely cut holes several miles deep through various rock formations. Many of these well bores are steered through complex hole geometries, often while the drill bit is tens of thousands of feet deep. This innovative technology uses a combination of Measurement While Drilling (MWD) and Rotary Steerable Systems (RSS), mounted immediately behind the drill bit to take real-time measurements of borehole position and control the trajectory.

Aside from the obvious difficulties involved in when cutting rock hundreds of feet under the earth, the pressurized fluid used to cool the drill head and flush away cuttings is highly abrasive and rushes past very fast. This can wreak havoc not only on the down-hole systems, but also on many other types of drilling equipment, even destroying even super tough Inconel and 17-4 stainless steel.

This is just one of the many challenges faced by energy producers today. APS aims to help these well operators by offering them a variety of intelligent tools, including steerable drill motors, vibration dampers, modelling and analysis tools, and logging sensors, in addition to its MWD systems. Previously, many of the continuous improvement efforts at APS had been accomplished using a variety of additive manufacturing methods. "We've had lots of plastic parts made for us," says Paul Seaton, vice president of marketing at APS Technology. "And while it's nice to get your hands on them, and see how they fit together, they're of little value for testing our equipment. They just don't last."

Solution

EOS had the perfect solution in store for APS: additive manufacturing based on durable metal. Using this technology, the company was able to build long-lasting parts in a short space of time. The solution is known by the name of: EOSINT M 280. DMLS enables designers to create complex geometries that could not previously be manufactured, and challenges such as these have now become far more manageable. For example, various lattice structures and thin but strong webbing can now be created, producing parts that are far more space efficient than their traditionally machined counterparts.

A complete MWD system: Some internal turbine components were printed with an EOSINT M 280 system. (image courtesy APS)

"The system had only been here a month or so when I started working at APS," remembers Seaton. "They'd done a couple of test builds and other things to familiarize themselves with it, but it was certainly a new technology for all of us. EOS supported us with onsite training and application advice, and we were able tho progress pretty quickly into prototyping different parts. Because of those early wins, we are now shifting into more production-oriented work."

One of those wins is a five-stage turbine used to power a steerable drilling head and its onboard MWD system. Each turbine contains several parts printed using DMLS, an additive manufacturing process that, in the case of the EOSINT M 280, uses a high-power Yb-fibre laser and precision scanning optics to trace tissue-thin slices of a CAD model onto a bed of fine metal powder. As the laser passes, each individual metal particle melts and becomes fused to its neighbours and the layer underneath. Once each slice has been exposed and melted, a fresh layer of metal powder is spread over the burgeoning workpiece and the process is repeated, layer by layer, until complete.

Each turbine contains a number of complex end housings and five sets of stators and rotors, all of which are built on APS's EOSINT M 280. "However, now we've developed the ability to make those components in stainless steel, Inconel, and other metals, which is a huge advantage to us, because we can now 3D print actual parts and use them under real-world conditions," says Seaton. According to senior mechanical engineer Chris Funke, these components are definitely seeing real world drilling action, including service in the company's own test well, currently 3,000 feet deep.

Results

By using EOS technology, APS has reduced the part count in a drilling assembly from four separate components to just one. DMLS is also creating cost savings in the company's extensive machine shop, where jigs and fixtures that once took days or even weeks to machine can now be printed, unattended, overnight. Aside from the advantages APS has seen in part-count reduction and novel component shapes, designers are finding that product development cycles are substantially shorter.

The use of DMLS may be opening other doors for APS. Because the AM process can produce parts that are far closer to their intended geometry than previously possible, downstream machining operations are often simplified, and in some cases eliminated entirely. Furthermore, there's no need for APS to invest in moulds and other tooling that might only be used once. All that is needed is a CAD model and the metal powder to build them.

"We might give the shop a DMLS part that once took 18 hours to produce by traditional means from bar stock," Funke points out. "That part would have taken 22-26 hours to print, but it might have features that could not have been manufactured the traditional way, such as organic holes. Now, finishing that part would only require 3-4 hours to machine sealing surfaces and tighten tolerance features. So by using DMLS we've freed up the machine shop by 14-15 hours to run other product. DMLS is changing our entire manufacturing flow, potentially giving us greater capacity to work on other projects, or even bid on outside work. We have a lot of plans for the EOSINT M 280," says Funke.

"Traditional manufacturing methods have got us this far, but the improved efficiencies of parts created with DMLS are game changers. It creates a domino effect, where longer product life spans lead to less disruption for equipment maintenance, greater drilling time, and lower costs. Ultimately, this makes for a happier customer and additional sales orders."

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