“It used to take us six to eight days to produce a 26-inch injection head through CNC machining. Now, the same part can be completed within two days.” by Keith Burch - i-Tech

CASE STUDY

3D Printing in the deep sea

SUBSEA EQUIPMENT MANUFACTURER 3D PRINTS INJECTION TOOLS USING DIRECT DIGITAL MANUFACTURING

INDUSTRY | Automotive **TECHNOLOGY** | Fused Deposition Modeling (FDM)

From laying underwater cables and pipes to offshore oil and gas exploration, modern subsea operations involve some of the most complex systems, and are constantly challenged by changing ocean environments. Driven by government regulations and market pressure to control oil production and maintain environmentally friendly practices, subsea equipment manufacturers are actively looking for solutions to reduce development and operation costs.

OBJECTIVE 3D
PRINTERS | PARTS | SCANNERS

i-Tech is one of the leading global providers of remotely operated vehicles (ROVs) and intervention tooling solutions for offshore engineering. It operates one of the world's largest and most advanced fleets of ROVs to support major global energy companies in many flagship projects in the depths of the ocean.

Pipeline engineers and designers at i-Tech are confronted with problems caused by underwater pressure, unpredictable weather conditions and strong ocean currents in their deep-water operations. Equipment reliability is of the utmost importance to ensure that tools can be used for extended periods of time with minimal corrosion and damage. To optimize the design, performance and application of its Chemical Stick Injection Tool (CSIT), i-Tech turned to 3D printing.

Remotely Operated Vehicle (ROV) developed by i-Tech.

PRECISION ENABLED BY DIRECT DIGITAL MANUFACTURING

Mounted on an ROV, the CSIT is a modular tool that houses and injects a maximum of eight chemical sticks to protect subsea pipelines and spools up to 34 inches in size from corrosion and damage (i.e., rust). For larger spools, it takes 60 chemical sticks to provide sufficient protection, and requires eight deployments of the ROV, resulting in high finacial and time costs.

In order to improve that process, i-Tech fabricated a new tool that could carry different chemical stick configurations for various spool sizes, and be able to inject the required amount of sticks without multiple ROV launches and recoveries. In addition, the team wanted to design new tools that would enable them to deploy the chemical sticks within four hours at depth.

To fabricate the injection tool – which consists of a deployment head, a main body and an injection head – in different sizes, i-Tech first considered using traditional CNC machining because of the versatility in available materials. However, i-Tech quickly rejected this method due to the prolonged production time and the high volume of material waste, especially when creating the intricate injection heads. The team researched other manufacturing methods, and chose a PolyJet™ 3D Production System for its capability to build multiple parts with mixed and composite materials in one single print.

3D PRINTED PARTS WITH MULTI-MATERIAL FOR ENHANCED STRENGTH AND TOUGHNESS

"The injection head is a critical part of the CSIT because it is responsible for protecting the chemical sticks," said Keith Burch, engineering manager at i-Tech. "The system is extremely helpful as we were able to print different end-use parts of a tiny two-inch injection tool in high precision while maintaining strength and durability, such that the small head would not bend or break when it was inserted into the subsea pipelines."

To strengthen the injection heads and to stabilize the chemical sticks within, i-Tech engineers used a rigid material, VeroBlue™ for areas that needed to interface with the tool, and the composite Digital ABS™ material, which delivers high temperature resistance, dimensional stability and smooth surfaces, for the larger injection heads. Engineers printed the smaller heads of the main body by mixing a rubber-like translucent material, TangoPlus™ with Digital ABS for better shock absorbance and flexibility.

The i-Tech team was not only surprised by the strength, surface finishing and impact resistance of the printed injection tools, but were also excited about the reduction in production costs and turnaround time, as it meant that they could accommodate more iteration cycles to perfect their design.

"It would take us six to eight days to produce a 26-inch injection head through CNC machining. Now, the same part can be completed within two days. Moreover, we are able to fabricate designs with customized blend of materials to solve our complex challenges," said Burch.

2D image of the i-Tech Chemical Stick Injection Tool (CSIT).

3D printed i-Tech Chemical Stick Injection Tool (CSIT).

FROM INJECTION TOOLS TO FUNCTIONAL PROTOTYPES

Today, i-Tech has printed more than 35 injection tools which have been performing well in the North West Shelf, off the coast of Western Australia. The team has also enjoyed additional benefits, such as reducing machine-shop backlogs as the injection tools can be printed on demand. Burch has also 3D printed prototypes for other ROV components, including manipulator jaws for functional tests.

"In subsea operations, we are often presented with a full gamut of real-world complexities. We need to react and improve our designs promptly to catch up with the ever-changing ocean conditions," said Burch. "Stratasys® 3D Printing solution has never placed any limit on what we want to model and was able to do it quickly and effectively."

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PRINTERS | PARTS | SCANNERS

33-35 Yazaki Way, Carrum Downs, VIC 3201, Australia.
T +613 9785 2333 (AUS) +649 801 0830 (NZ)
MELBOURNE | SYDNEY | PERTH | ADELAIDE | BRISBANE | AUCKLAND

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