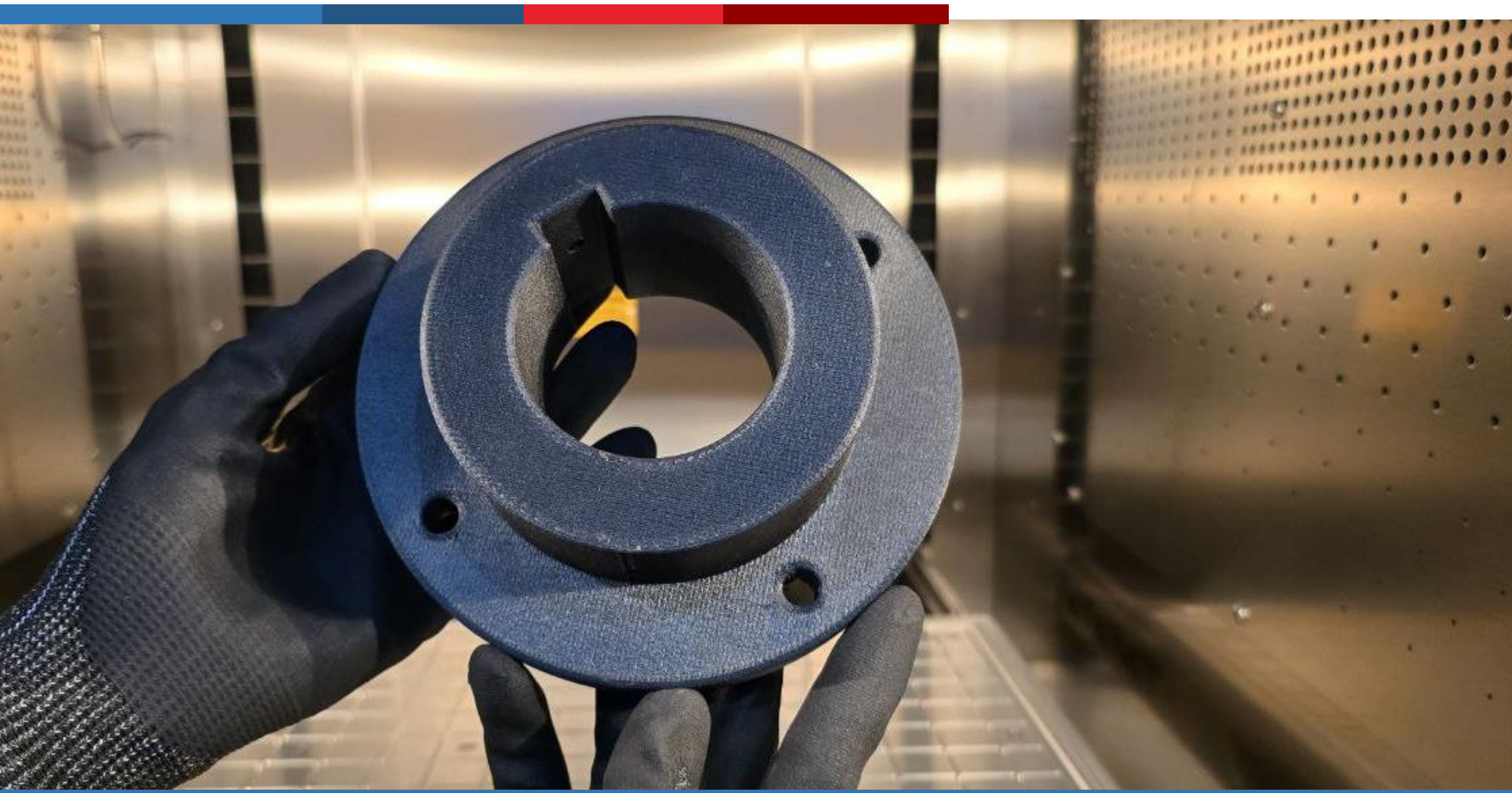
CASE STUDY

Additively Manufactured Motor Coupling Hub Replacement



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Introduction

Mist system pumps play critical roles in the oil and gas industry, such as delivering high-pressure water to extinguish fires, ensuring safety and operational integrity. The motor coupling hub is a key component in assembling the pump, connecting the motor shaft to the pump shaft and facilitating smooth rotational movement. Motor coupling hubs are usually made from low carbon steels because they offer an excellent balance of strength, ductility, weldability and machinability. These properties are required to withstand extreme cyclic and dynamic forces and maintain structural integrity under high stress.

Problem Statement

In August 2024, RusselSmith received a request from one of its customers to replace a motor coupling hub that had been damaged due to corrosion. The pump operates at a power of 30.1 kW, with the hub rotating at 980 RPM. To assist in the replacement process, the customer provided photographs along with drawings of the hub as it was assembled to the pump (Figure 1). Given the demanding and highly saline environment in which these pumps operate, the damaged hub had experienced uniform and localized corrosion on the surfaces and at the edges of the flange, respectively, and it was necessary to explore high-performance materials for manufacturing the replacement motor coupling hub.

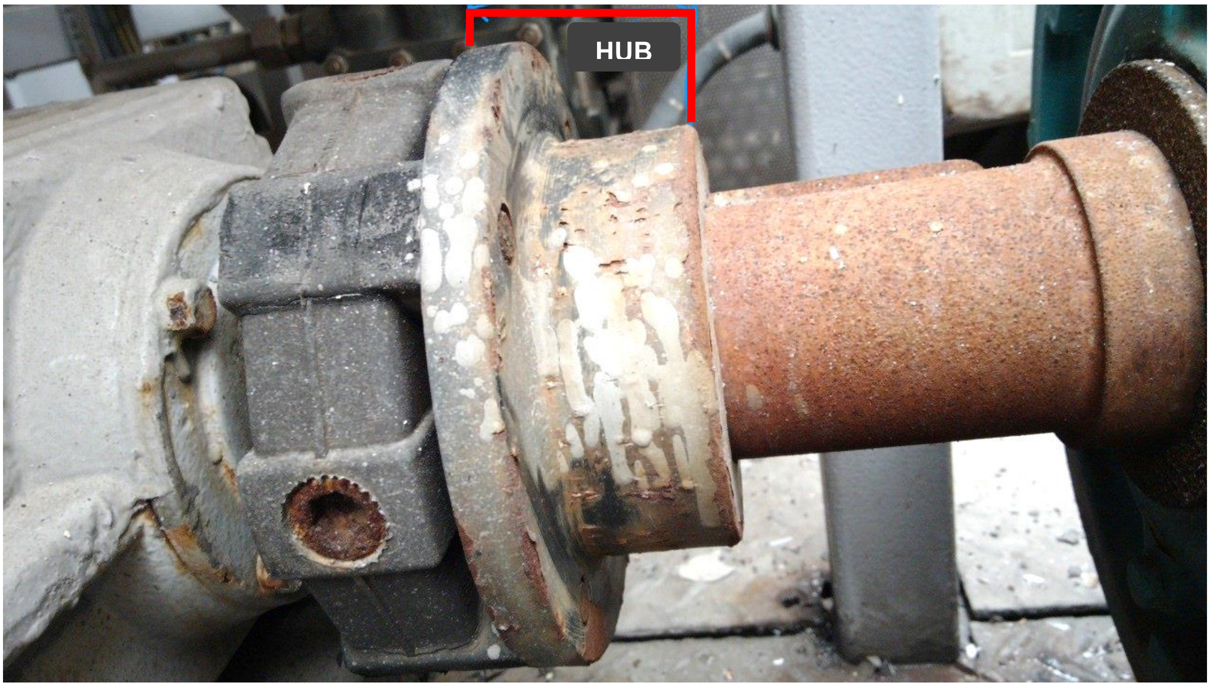

Figure 1: Coupling Assembly Connected to the Fire Water Pump

Our Solution

A key consideration in the replacement process was upgrading the low carbon steel hub to a high-performance polymer composite – reinforced polyamide composite. This was made possible after conducting a thorough material analysis and design evaluation, which included slight increases in flange thickness, adjustments to the counterbore depth, and precise dimensional allowances to account for potential shrinkage or expansion during the additive manufacturing process. These modifications ensured the composite material would meet the required performance standards in the operational environment.

The reinforced polyamide filament was dried in an HT dryer at 90ºC for 6 hours. The motor coupling hub was then printed using a free form fabrication printer, with the extrusion diameter set to 0.6 mm, an extrusion temperature of 450°C, and a build chamber temperature of 50°C. During printing, it was observed that the reinforced polyamide component did not undergo significant shrinkage or expansion, maintaining the initial design dimensions, despite the allowance for potential shrinkage or expansion in the design tolerances.

Post-processing activities on the motor coupling hub involved adjusting the keyway to ensure proper fit and alignment during assembly. Additionally, facing was performed for surface finishing, and tapping was carried out to create precise counterbore holes for secure attachment.

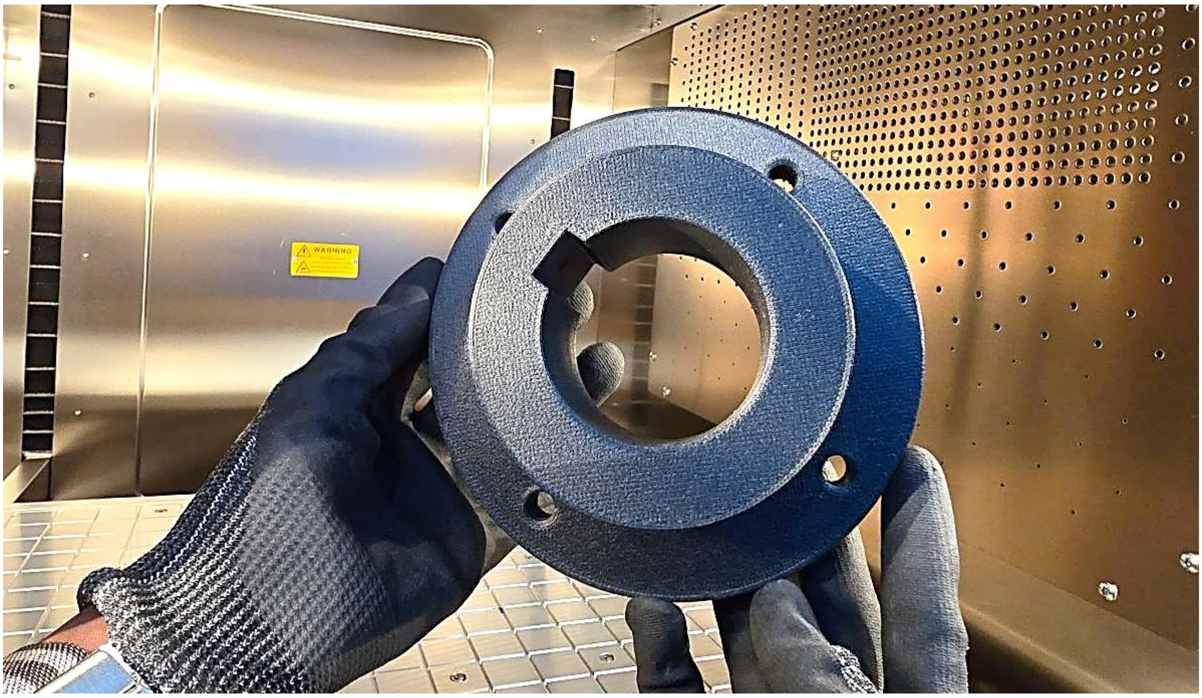

Figure 2: 3D Printed Motor Coupling Hub

The Result

The additively manufactured motor coupling hub was successfully installed on the mist system pump, where it has since been operating effectively under regular conditions. The customer has expressed satisfaction with the performance of the additively manufactured hub, noting that it met the required functionality and durability expectations.

As seen in Figure 3, the hub maintains a high degree of dimensional accuracy, which is critical for optimal performance. Figure 4 provides a visual confirmation of the hub's seamless integration into the pump system. This case demonstrates that the replacement hub, printed using Carbon PA pro filament, not only matched the mechanical properties of the original low carbon steel hub but also offered additional benefits, such as reduced production lead time and material efficiency.

Overall, this successful deployment showcases the potential of additive manufacturing in producing high-performance industrial components, reinforcing its role in innovative maintenance solutions.

Figure 3: Additively Manufactured Motor Coupling Hub

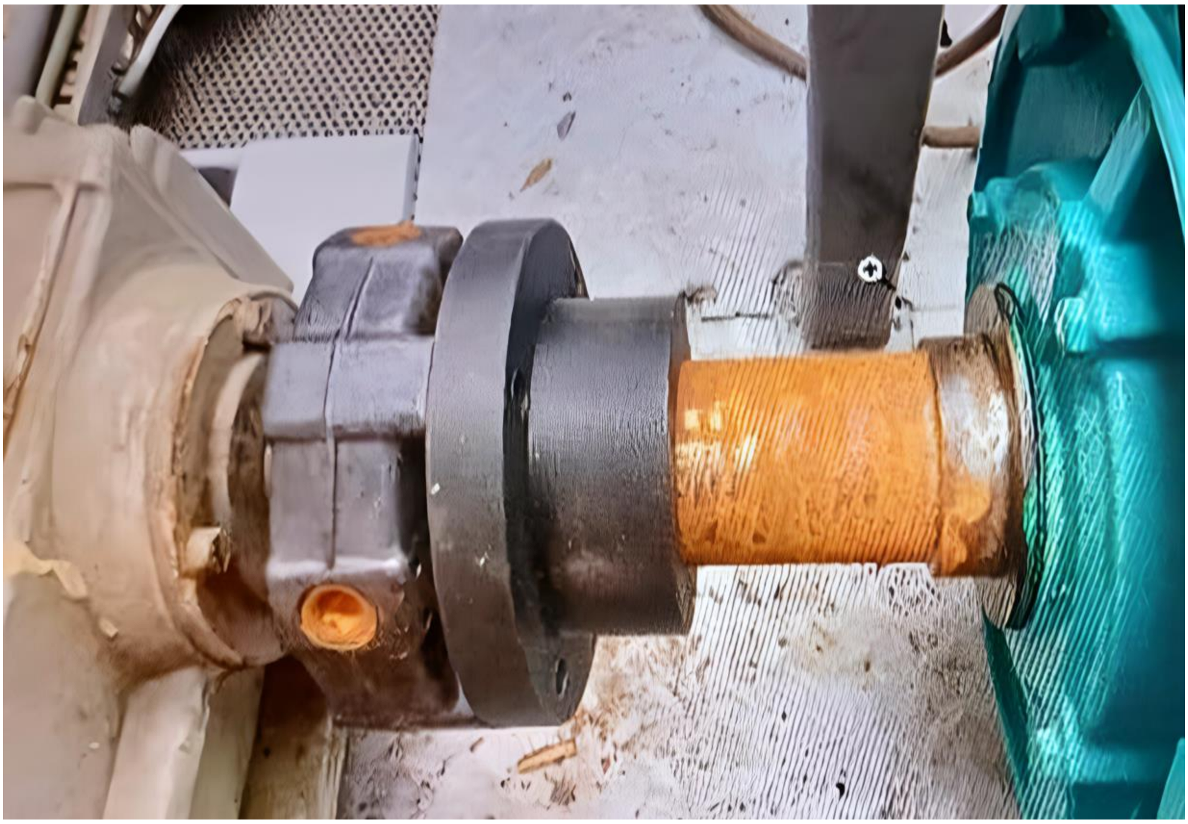

Figure 4: Integration of the Additively Manufactured Motor Coupling Hub in the Mist System Pump

Sustainability Impact

By utilizing additive manufacturing in the replacement of legacy parts, RusselSmith is demonstrating its commitment to minimizing waste, lowering carbon emissions, and optimizing material use.

The high-performance polymer composite used in manufacturing the hub in this case study not only improves mechanical functionality but also reduces the energy consumption of the entire system. This approach reflects RusselSmith's vision to develop sustainable, technologically advanced solutions for the African energy sector, fostering a more eco-friendly and efficient industrial landscape.

PROVIDING SUSTAINABLE SOLUTIONS
FOR THE FUTURE OF ENERGY

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