

How an Oilfield Services Company Cut Total Cost of Ownership of Electrical Submersible Pump in Artificial Lift

Greene Tweed's crosslinked PEEK Arlon 3000XT® protects sensitive connectors for extreme temperatures in downhole environments

Challenge

A global oilfield services company needed to improve the performance of Stator, electrical connectors and sealing systems in Electrical Submersible Pumps (ESPs) that are critical for artificial lift in oil and gas wells.

Due to the harsh downhole environment, characterized by high temperatures and pressures, many of the ESP motor's electrical components needed to maintain good electrical resistance and insulation properties at elevated temperatures. Since the current solution was machined from polyimide only available in rod stock shapes, these components had to be machined to finished parameters, resulting in long lead times and higher costs to manufacture. Moreover, the system was highly vulnerable to water ingress. Even a small amount of moisture could cause it to fail, underscoring the need for materials with superior electrical insulation properties at high temperatures.

Analysis

In response to these issues, Greene Tweed (GT) began a root-cause analysis in 2023 and discovered that the incumbent polyimide materials, which could only be machined, were expensive to manufacture and hampered the ability to produce components in various shapes, leading to significant design and functional constraints. GT scientists and engineers initiated a comprehensive and multi-phase testing program to evaluate alternative materials that could offer improved durability, water resistance, and high-temperature electrical insulation while allowing easy molding into suitable alternative shapes.



Why Arlon 3000XT®

- Patented cross-linked PEEK formulated for extreme high-temperature environments and applications
- Proven performance at high temperatures ranging from 260°C to 300°C (500°F-572°F)
- Enhanced mechanical and electrical properties for thermal electrical insulating products
- Compared to competitors, Arlon 3000XT® performed better when tested at 300°C and fluid aged for 112 days (ASTM D638)



Solution

After analyzing the extreme operational conditions for the customer's ESP application, Greene Tweed identified Arlon 3000 XT® our patented crosslinked PEEK thermoplastic, widely known for its superior electrical insulation capabilities well suited for artificial lift applications in the oil and gas industry. These ESP applications required an electrically insulative material able to maintain its shape/dimensions, strength, and electrical properties in their proprietary oil environment at temperatures reaching 260°C-300°C (500°F -572 °F). Arlon 3000XT® is ideal for protecting sensitive electrical connectors in extreme temperature and pressure environments. Moreover, it offers the potential to be molded into various shapes, addressing the shortcomings of the incumbent polyimide.

Following the initial evaluation, the material was subjected to rigorous testing in an environment comparable to the customer's application.

The first step involved coupon testing to qualify the general material properties of Arlon 3000XT®. Following the successful qualification of the material through coupon testing, GT engineers proceeded to create machined prototypes to verify that the material properties observed in coupons translated into acceptable form, fit, and function in the actual ESP working downhole.

After verifying the material's properties and components' performance through prototypes, the next step was to produce injection molded parts using Arlon 3000XT®. The new production process, following the testing and validation phases, allowed GT to demonstrate the cost-effectiveness of the components made with Arlon 3000XT®.

The oilfield service company recognized the significant value of upgrading to Arlon 3000XT® after assessing its enhanced design flexibility and fabrication, high temperature electrical resistance, durability of the component material, lower total cost of ownership and shorter lead time.

The Result

After reviewing the comprehensive data and results from the testing and validation phases, the oilfield services company decided to upgrade their ESP's insulating components to Arlon 3000XT®. Enhanced electrical resistance at very high temperatures and minimum mechanical degradation have resulted in better reliability and longer life. The ability to mold the new material into various shapes has enabled the design of insulators that are completely watertight. The injection molding manufacturing process has significantly lowered the total cost of ownership.

Arlon 3000XT® is ideal for protecting sensitive electrical connectors in extreme temperature and pressure environments.

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