

ASSESSING PEEK POLYMER PERFORMANCE IN HOT AND SOUR OIL AND GAS ENVIRONMENTS

THE IMPORTANCE OF HIGH QUALITY
DATA FOR LIFETIME PREDICTIONS

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The use of standard test methods for assessing the performance of polymers, including polyaryletherketones such as VICTREX® PEEK, in hot and sour environments has increased significantly over the past two years as the industry moves to more unconventional plays for oil and gas. Norsok and ISO compliance are the accepted industry standard, however additional data is helpful in achieving more conclusive interpretations and reducing risk even further.

Victrex, with more than three decades of expertise in providing PEEK polymer solutions to the Energy industry, have worked with independent, third-party affiliates to test our high-performance polymers in various environments to demonstrate a more accurate assessment of service life. **Influencing and testing beyond industry standards to deliver the most realistic insight into PEEK polymer lifetime expectancy - that's future performance.**

YOUR CHECKLIST FOR EVALUATING PERFORMANCE DATA

Victrex is dedicated to delivering high-quality products and unmatched technical expertise. By partnering with our customers, they are able to optimise application designs and better estimate the lifetime of their products in various operating environments. When evaluating material solutions for your next development, it is important to look beyond the minimum requirements of standard test protocols to better understand the performance of PEEK in harsh environments. The following questions will be helpful when evaluating materials.

1. DURATION AND TEMPERATURE

Q: Is the duration of the ageing test sufficient to allow realistic estimates of lifetime at lower temperatures?

Q: Are the selected ageing conditions relevant to the application?

Q: Can additional data at other temperatures provide an improved understanding and estimate of polymer lifetime?

A: Figure 1 reflects the potentially critical risks that may occur by relying on short-term ageing tests. The tensile half-life of VICTREX PEEK 450G™ polymer is calculated using data from 1,500-hour (long-term) and 700-hour or less (short-term) tests. In addition to using long-term tests, Victrex goes beyond the Norsok and ISO standard requirements of three ageing temperatures with the aim of achieving greater accuracy on lifetime predictions.

Figure 1: Half-life of VICTREX® PEEK 450G™ polymers derived from long-term (1,500 hours) and short-term (700 hours or less) testing at various temperatures

TEMPERATURE (°C)	PREDICTED HALF-LIFE FROM LONG-TERM DATA (YEARS)	PREDICTED HALF-LIFE FROM SHORT-TERM DATA (YEARS)
220	3	4
200	6	11
180	40	102
160	317	1127

2. MODULUS

Q: Are the most appropriate and relevant properties being used to predict lifetime?

A: Standard test protocols permit the use of modulus data for half-life calculations. However, tensile modulus is largely insensitive to ageing time for polymers such as PEEK with the result that lifetime estimates may be overly optimistic. Figure 2 shows long-term modulus data in a Norsok M710 Rev 3 (10% H₂S) environment. The data shows that modulus values reveal little information about the progress of the ageing process when it comes to PEEK.

3. CONCENTRATION EFFECTS

Q: Is there data regarding other concentrations and pressures to add confidence to the conclusions drawn from the ageing experiments?

A: Victrex has evaluated the ageing of its polymers in Norsok / ISO environments where the sour gas proportion of the gas phase has been increased to 20% and even 100%. The 100% gas phase testing results are shown in Figure 3. Ageing mechanisms may also change with gas pressure and concentration. It is important to understand the changes in degradation that these parameters affect to better relate standard test data to real applications.

4. CHEMICAL DEGRADATION

Q: Are you aware of additional analytical tests that may augment mechanical property data to reveal more accurate details of the chemical degradation process?

A: Mechanical property measurement after ageing of samples in hostile environments is only one approach to understanding the extent of chemical attack. Evaluating changes in molecular weight is extremely useful in identifying change that residual mechanicals do not detect. Figure 4 shows how, in the aqueous phase of an environment where the H₂S fraction has been increased to 20%, measuring strength does not indicate any clear degradation. Residual viscosity, which corresponds to molecular weight, shows a near continuous decline from the outset of the ageing.

Figure 2: Tensile modulus of VICTREX® PEEK 450G™ polymer vs. ageing time per Norsok M710 Rev. 3

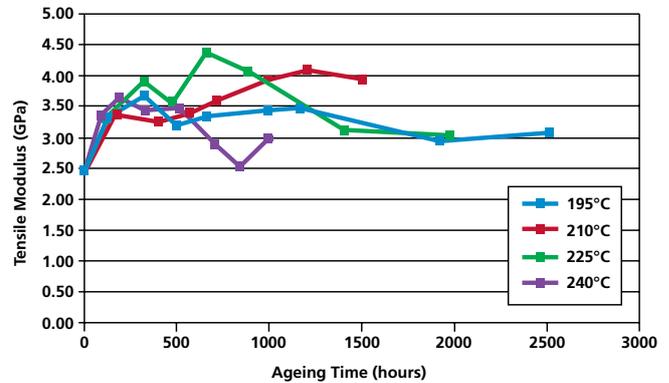


Figure 3: Tensile yield strength of VICTREX® PEEK 450G™ polymer vs. exposure time in Norsok M710 Rev. 2 aromatic fluid with 100% H₂S at 220°C

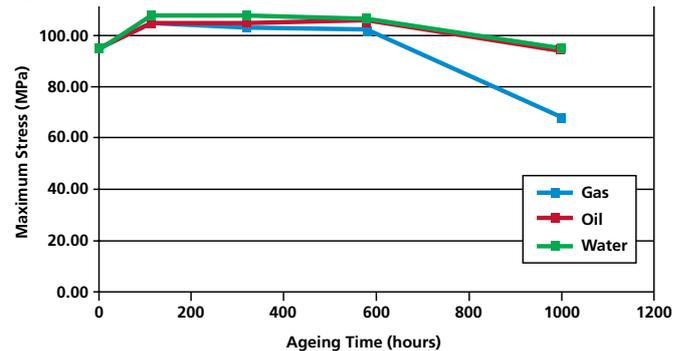
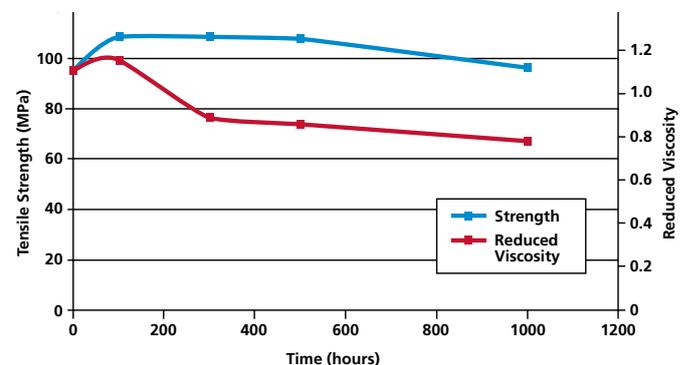


Figure 4: Tensile strength and residual viscosity of VICTREX® PEEK 450G™ polymer measured in the aqueous phase of 20% H₂S standard Norsok M710 environment





SUMMARY

For more than three decades, Victrex has collaborated with customers to understand their challenges and deliver high-performance solutions and technical expertise. As the industry continues to increasingly use standards to evaluate polymer performance, it becomes even more critical to understand best practices to improve confidence in component service life. The frequently asked questions that have been provided are a start. Please consult with Victrex should there be any specific questions or concerns.

Victrex can offer cutting-edge polymeric solutions, streamlined production facilities, application development expertise, technical support and a presence across the globe - that's a future performance partner.

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