Microstructural Characterization of Next-Generation Particle-reinforced, Textured Gaskets

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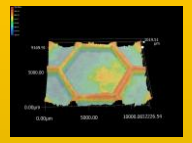
Introduction

This segment of study is part of a research collaboration conducted jointly by UCF and Garlock. The goal is to determine the failure mechanics of gaskets. Experiments conducted test gaskets of different types and thicknesses. Performing microscopy on the gaskets is how relationships are drawn between the gasket's properties and performance.

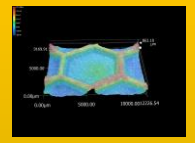
Gasket Material

The gaskets being tested are made out of a type of polytetrafluoroethylene, or PTFE. PTFE is a good choice of material for gaskets because it is hydrophobic and resistant to high temperatures. The type of PTFE that Garlock uses in these particular gaskets is textured. Rather than being flat across it's surface, it has raised peaks along the surface that follow a hexagonal pattern. The data gathered here are from the tests conducted with PTFE 3504 and PTFE 3500.

Close-up of Hexagon Texture of Untested Gaskets



3500



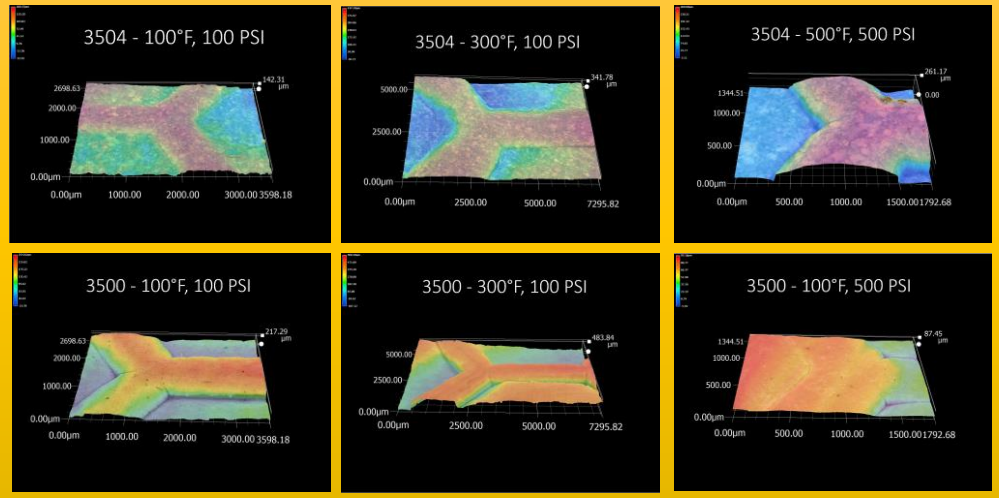
3504

Procedure

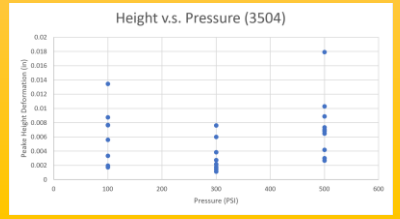
The various gaskets are put in a testing chamber, and a set of tests are done on each type of gasket. For each test, the pressure and/or temperature is changed. Using the same type of gasket for each different test ensures a fair comparison on how each of the gaskets fair. The gaskets are then analyzed under a type of microscope called a Keyence device that allows a topographical view to be taken of the surface of the gaskets. This allows the change in the gaskets' thickness (peak height) to be accurately measured, and for surface deformities, such as cracks, to be observed.

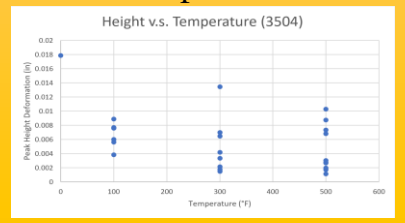
Testing Chamber Set-Up

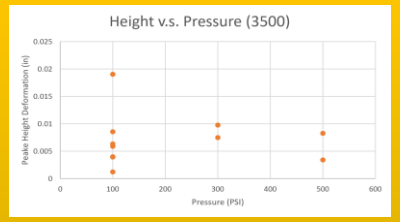
Microscopy of Topography Images

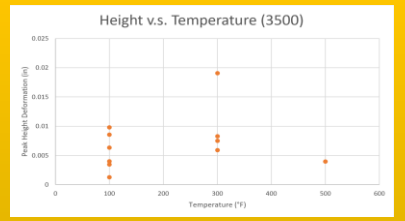


Deformation Data on All Samples

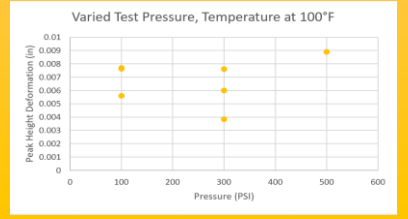


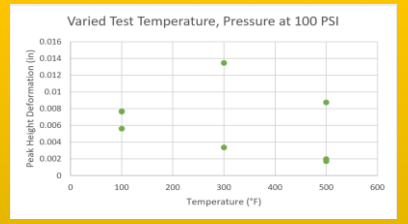






Specific Trends Emphasized





Conclusion

In the hexagon-height compression analysis, four pieces of criteria are being looked at: the change in height of the edges of the hexagon, the deformation of the middle area of the hexagon, and the change in both the inner and outer diameter of the gasket. The edge of the hexagon is mainly focused on for the purposes of this study. It appears that temperature has the most impact on topographical deformation. The average difference in hexagon height between the untested and tested 3504 gaskets was 0.0058 inches, and for the 3500 gaskets the average difference was 0.0071 inches.

Not surprisingly given the properties of the PTFE Material, none of the gaskets tested using this apparatus cracked. However some cracked samples were sent by Garlock for some preliminary analysis. It appears that the location of the crack formations are not dependent on the hexagon pattern of the textured gaskets. All cracks occurred tangent to a concentric circle near the middle between the outer and inner diameter of the gasket. The average length of the crack was roughly 0.0587 inches.

Future Work

The future of this project involves using the analysis from the tests to improve the design of the textured gaskets. To further the effectiveness of such analysis, tests of longer duration will want to be used. Also, Garlock has another type of material, PTFE 3510, that should be included in the next series of tests.

Acknowledgements

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References

- *Products* | Garlock www.garlock.com/en/products/