NANOCOMPOSITES WITH ELASTOMERIC PROPERTIES FOR GEOTHERMAL APPLICATIONS

In cooperation with Ruma Rubber BV

Geothermal energy is used for heating, cooling or conversion to other energy sources. It is obtainable near the earth surface in places like Iceland or New Zealand. However when not readily available one has to drill into the earth crust to reach this energy; the deeper, the higher the water temperature and its inherent energy rating. Temperatures of up to 300°C may be encountered in practice. At these extreme conditions, the lifetime of elastomeric seals based on carbon elastomers is shortened considerably.

Nanoparticles have been reported to increase the temperature and pressure resistance of Fluoro elastomer (FKM) composites, e.g. the use of nanoclay fillers to enhance the low and high thermal degradation of FKM compounds. In another study[2], Multi-Walled Carbon NanoTubes (MWNTs) were found to increase the temperature and pressure resistance of FKM and Perfluoro (FFKM) elastomers. Recently the synthesis and physical properties of a carbon nanotube (CNT) network was described[3]. The viscoelastic properties of this "nanotube-rubber" were found to be invariant over the temperature range from -196°C to 1000°C.

Objective

The goal of this study is to study the influence of nanofillers on the temperature and pressure resistance of elastomer seals for geothermal applications

Assignment

The graduate student will start with a literature search into the various kinds of nanoparticles incorporated in organic and inorganic polymers for high temperature and pressure applications. Besides the nanoparticles used the latest progress in elastomers for high temperature applications is of particular interest. Like for example elastomers developed for aviation, aerospace and gas and oil field exploration applications.

Sample preparation

After selection, the most promising nanofillers and elastomers will be blended. Samples for mechanical and dynamic mechanical testing will be produced. After preforming, the compounds will be vulcanized to produce cylindrical prototype seals bonded to a metal shaft. These samples will be used for pressure testing.

Sample testing

The mechanical and dynamic mechanical properties will be characterized using an Instron 3366 tensile tester and a Gabo Qualimeter Eplexor 500N respectively. The properties at elevated temperatures are of particular interest.

The pressure differentials these prototype seals can withstand will be tested at elevated temperatures in the pressure integrity (PIT) unit at RUMA. A schematic view of this unit is presented in Fig. 1. The metal core with the seal bonded to its surface is placed vertically in the test cylinder.

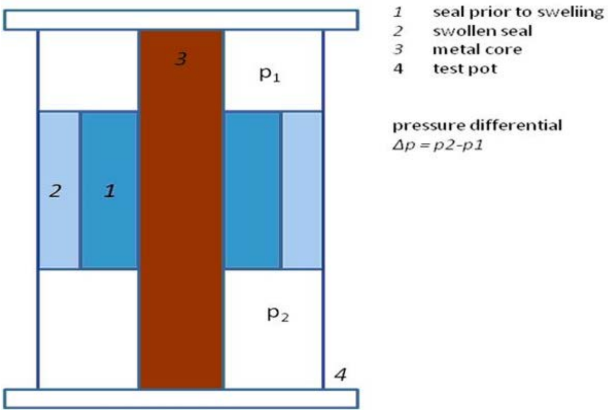

Fig. 1 Schematic view of PIT-unit for pressure testing of seals at temperatures up to 300°C and pressure differentials of 150 bar.

Report

The graduation report should contain clear an precise conclusions regarding the influence of

- the kind of nanofiller
- the various high temperature elastomers

Partners

This project will be done in cooperation with **RUMA**. This company is specialized in the development and production of high-quality elastomeric products such as sealings, rollers and other technical rubber goods. A part of the practical work is actually at the R&D labs of Ruma. http://www.rumarubber.com

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