# Gas expanded lubricants – Improving energy efficiency using ‘smart’ fluids

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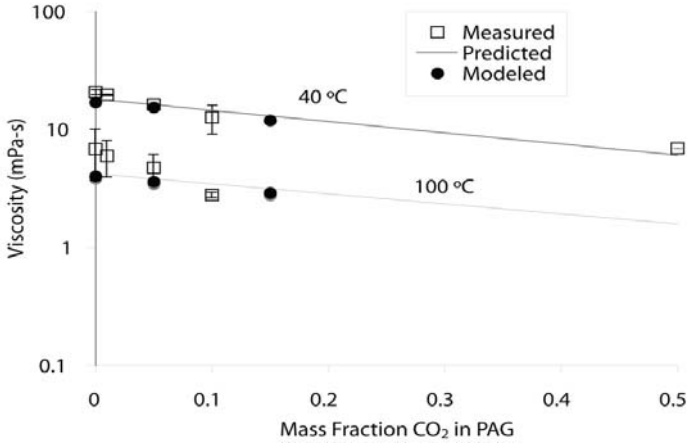
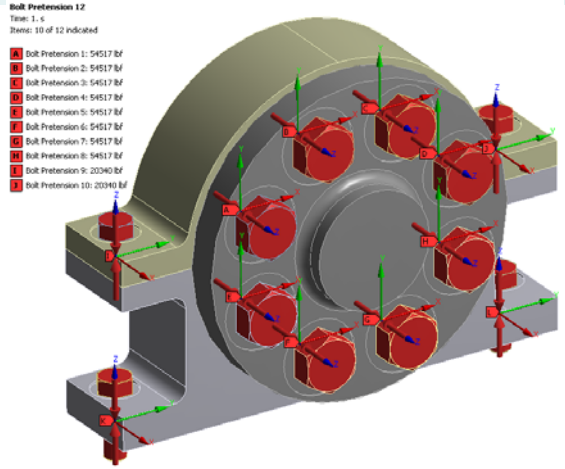
Gas expanded lubricants (GELs) are binary mixtures of synthetic lubricant and $CO_2$. Their properties can be varied in real time to minimize power losses in turbines and bearings where they provide vital function but also cause significant power losses. We have been characterizing the performance of these fluids via two specific tasks:

## Task 1. Measure the phase stability and viscosity of a PAG-$CO_2$ GEL formulation




We are focused on understanding 1) the diffusion of $CO_2$ into the lubricant 2) the oxidative stability of the mixtures and 3) the rheology of these mixtures under elevated temperatures and pressures. Here is a figure of viscosity under variable mass fraction of $CO_2$ in the mixture.

## Task 2. Develop an experimental testbed to measure bearing performance using GELs



To test GELs under real world conditions, it was necessary to design a custom test rig. This rig presented a unique set of design challenges because of the size, pressures, and speeds at which it will be operated. It is now under construction. Here is an image of the finite element analysis of the bearing housing.