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Simultaneous Measurement of Strain and Temperature in a Gasket for Condition Monitoring.

ABSTRACT - Masterthesis

In this master thesis the implementation of adding two strain gauge sensors in form of a nested shape inside a polymer gasket forming a “Smart Gasket” is conducted. The term “Smart Gasket” refer to the ability of the gasket to perform a monitoring function regarding its condition during operation. The condition of a gasket is determined by its state of degradation. Obtaining the knowledge of the state of the gasket could prevent safety risk issues and danger to the environment, e.g. in places where gaskets are used to seal hazardous chemicals and gases. Faulty or degraded gaskets may also lead to a low efficiency for the machine it is housed in, e.g. when used in a pneumatic and hydraulic machinery.

The monitoring of the condition of the gasket is done by measuring the strain and temperature of the gasket. In this thesis a polymer O-ring gasket is used. Measuring the strain could identify the state of degradation of the polymer gasket by determining the compression set endured by the gasket. Polymer gasket degradation could also be hastened by the unsuitable temperature affecting the gasket, therefore measurements regarding the temperature is also conducted.

Both measurements are done by the two embedded strain gauge sensors. Since it is embedded inside the gasket, the strain and temperature affecting the gasket will also influence the two strain gauges inside it. The nested shape of the two strain gauges reduces the discrepancy in spatial distribution of the strain and temperature affecting them. The strain gauges are made from two different metals and are connected to contacts which sticks out of the polymer gasket. The two metals for the strain gauge all have its distinct thermal coefficient of resistance (TCR) and gauge factor (GF), therefore enabling the opportunity to distinguish the resistance changes caused by temperature and strain.

The tasks related to this master thesis are to conduct a literature review regarding the degradation of polymer, the choice of material available for the strain gauges, the fabrication of the strain gauges, and methods for simultaneous strain and temperature measurement. Afterwards the design of the sensor with respect to manufacturability and available processes are conducted using AutoCAD. The fabrication of the sensor then can be performed based on the created design. After the sensor has been made, the gauge factor and TCR of each strain gauges are measured. Finally, the fabricated sensor is integrated into the polymer gasket and the measurements regarding the strain and temperature endured by the gasket is conducted.