FLASH TEMPERATURE MEASURING DEVICE FOR TRIBOLOGICAL APPLICATIONS

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Friction excites heat, and this heat—according to Dr. Hisham Abdel-Aal of Drexel University—results in a “flash temperature, [which] is the sharp temperature rise that takes place at the surface between two rubbing solids upon motion” [1].

The objective of our project is to design and manufacture a rotating thermocouple that can measure this flash temperature between two in-contact surfaces, where one contact surface rotates relative to the other.

In situations such as drilling for oil, it is particularly dangerous to expose highly combustible substances such as oil to any sort of heat. This invention is intended for research and development, and industrial purposes—such as the automotive industry, petroleum industry, medical industry and thousands of other applications where rotating devices are used. In these applications, scientists and engineers will be able to accurately measure safe operating parameters (i.e. temperatures) of various materials. This will provide precise insight on which temperature levels can degrade equipment and thus, assist in preserving equipment life.

In today's industry, flash temperature is measured using approximate calculations and laser devices; these theoretical formulas make assumptions, such as assuming infinite contact surfaces, that skew the accuracy of safe operating parameter of any application where friction

heat is excited. Additionally, infrared lasers require extensive knowledge regarding a surface's material composition and emissivity in order to increase precision of results. The team has proposed methodology to accurately measure instantaneous spikes in temperature excited by friction between two in-contact surfaces—via a rotating thermocouple inserted beneath the surface of a rotating specimen experiencing contact friction.

The initial design involved inserting a thermocouple into the fixed cylinder where a ceramic contact point is housed, but it limited the amount of data we were able to collect from the system and limited how precisely the instrument could be calibrated. The final design involves inserting the contact junction of a thermocouple just below the surface of a rotating metal sample under consideration. To compensate for the problem of a rotating reference junction, the entire rotating specimen is surrounded by a circular metal wall. The flash temperature measurement instrument will be able to collect data for different materials experiencing friction, different rotational speeds of materials under friction, and for different external loads applied to the system. After fabrication, validation of the invention is expected by ensuring that thermocouple measurements are within appropriate ranges of theoretical calculations. Additionally, the pursuit of a patent for this technology is anticipated.

The photo below depicts the direct apparatus set up. The metal column held stationary, with a ceramic ball affixed. Rectangular specimen is rotated on circular disk, at some rotational velocity relative to the stationary column.

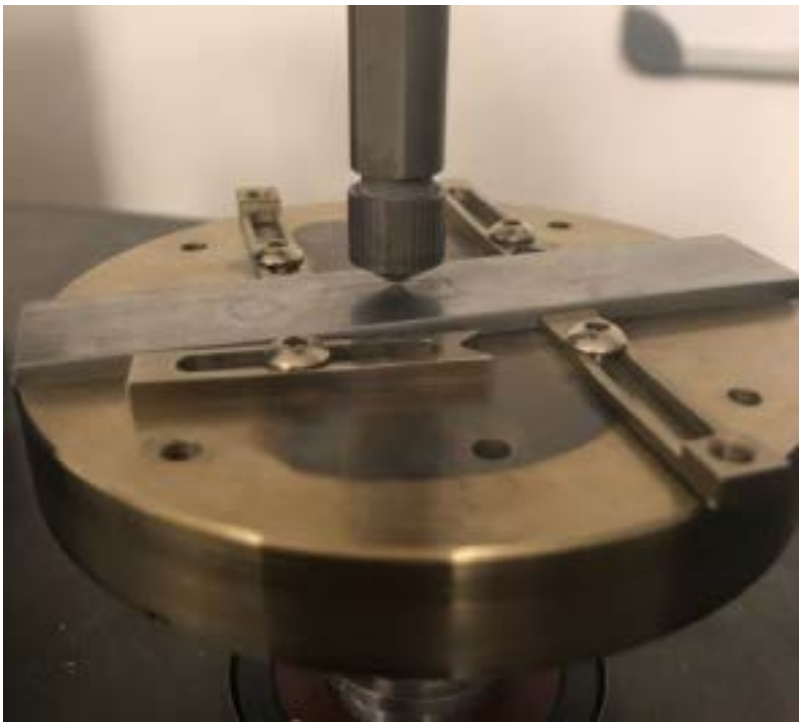

Figure 1. Picture of direct set-up of apparatus