Wear and friction of PEEK composites, dry or lubricated.

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It is well known that water lubricated polymer contacts wear more than dry ones. This is the main reason for not using polymer bearings in hydropower stations. Oil lubricated bearings can leak and present therefore an environmental risk.

The present study investigates the wear and friction properties of PolyEther Ether Ketone (PEEK) sliding against stainless steel. A pin-on-cylinder setup with data acquisition is used for the experiments and the width of the wear scar on the pin is used as a measure for the wear extend. The test settings are carefully chosen to avoid hydrodynamic lubrication and thermal oxidization due to high PVs (pressure times velocity).

The materials are neat PEEK, PEEK with 10% PolyTetraFluoroEthylene (PTFE), PEEK with 30% carbon fibers (CF) and PEEK with 30% glass fibers (GF).

Adding fibers to PEEK (CF or GF) increased the wear by a factor of four. This may seem surprising but it is in accordance with the Ratner-Lancaster correlation which postulates that the wear rate is inversely proportional to the product of the strain and strength at break. Adding fibers may increase the strength but it decreases the strain at break even more.

Adding PTFE to PEEK decreases the wear rate under dry conditions. This correlates with the assumption that PTFE is transferred to the metal during sliding and the contact is then lubricated by a PTFE film.

Water lubrication increases the wear by a factor of ten, except in the case of CF where the wear is halved. There is no explanation for this but the PEEK with CF indicates that there are combinations that can cope with water lubrication.

To investigate the influence of the polarity of the lubricant, the very polar water has been replaced by the quasi-nonpolar n-heptane. This decreases the wear significantly. The n-heptane lubricated PEEK with CF shows the lowest wear rate in the present study.

In general the addition of a liquid lubricant decreases the friction. This property seems to be decoupled from the wear response in the present study.

Keywords: Polymer tribology, PEEK composites, lubrication (water, n-heptane, PTFE)

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