FRICTION OF PEEK WITH STEEL COUNTERPARTS IN EHL AND MIXED LUBRICATION

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ABSTRACT
Poly-ether-ether-ketone (PEEK) has better mechanical properties and higher thermal stability than other conventional polymers and therefore it is becoming a preferred material in many tribological applications. PEEK can be used unlubricated but lubrication has the potential to further reduce friction and wear [1]. However, previous reports have mainly focused on wear, and little is known on friction in EHL and mixed lubrication as found in gear and bearing applications. The aim of this study is to elucidate the friction behavior of PEEK with steel counterparts in EHL and mixed lubrication.

A poly−α−olefin oil (PAO) and a naphthenic base oil were used as lubricants. Their properties at the tested temperature of 25 ºC are shown in Table 1. Tribological tests were carried out on a mini traction machine (MTM) in a ball-on-disc configuration. The disc, covered with a PEEK sheet, and the steel ball are driven independently to create a mixed rolling/sliding contact with slide-roll ratios of 50 %. The applied loads were tested at 10 N and 50 N. The Ra surface roughness of the smooth steel balls was approximately 0.01 µm, and the semi-rough steel balls were shot blasted to Ra of approximately 0.1 µm.

The friction coefficient values as a function of Uη which is the entrainment speeds (U) multiplied by the dynamic viscosity (η) are shown in Fig. 1. It is expected that the lubrication regimes of our MTM tests were mainly EHL with smooth steel balls and EHL and mixed lubrication with semi-rough steel balls. The friction coefficient of PAO was load dependent only in the mixed lubrication regime. Interestingly, the naphthenic base oil showed almost the same friction as PAO at 10 N, but significantly higher friction than PAO at 50 N, throughout all the lubrication regimes. The literature indicates that the high pressure-viscosity coefficient (α) base oils have increased friction in full EHL regime [3]. By plotting the friction coefficient values of our MTM tests as a function of Uη emphasizes the effect of α which becomes noticeable at higher loads. It can also be seen that the influence of α on friction extends to the mixed lubrication regime with semi-rough steel balls.

Table 1 Properties of test lubricants at 25 ºC

		Poly-α-olefin	Naphthenic base oil
Dynamic viscosity (η)	Pa s	0.11	0.44
Pressure–viscosity coefficient (α) *	GPa^{-1}	22	33

* Calculated from kinematic viscosities according to [2]

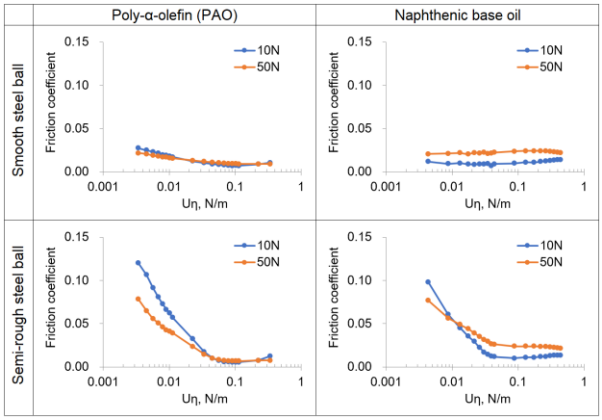

Fig.1 Friction coefficient as a function of Uη

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