Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)

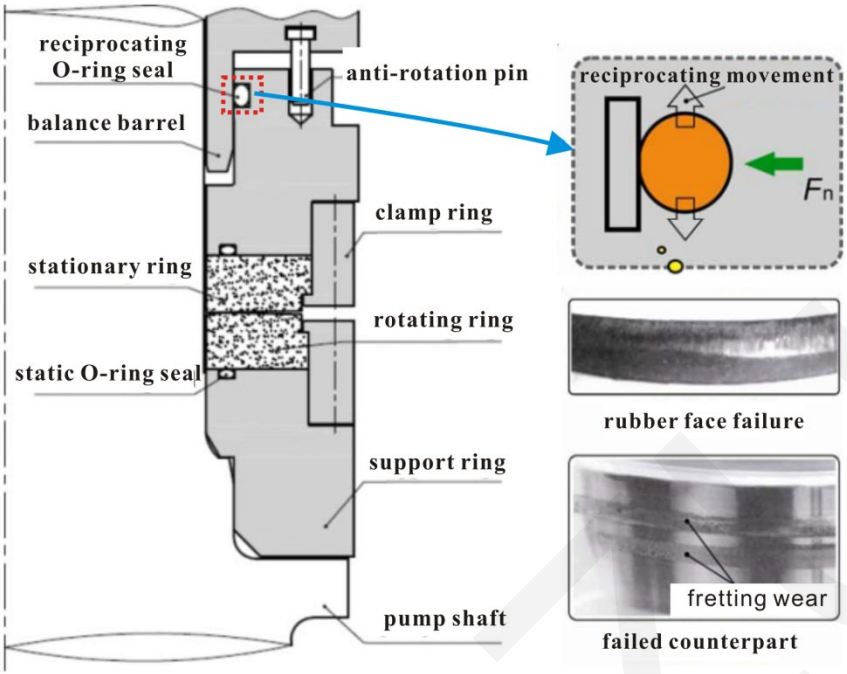
Influence of Al_2O_3 particles on the friction and wear behaviors of nitrile rubber against 316L stainless steel

Ming-xue SHEN, Jin-peng ZHENG,
Xiang-kai MENG, Xiao LI, Xu-dong PENG

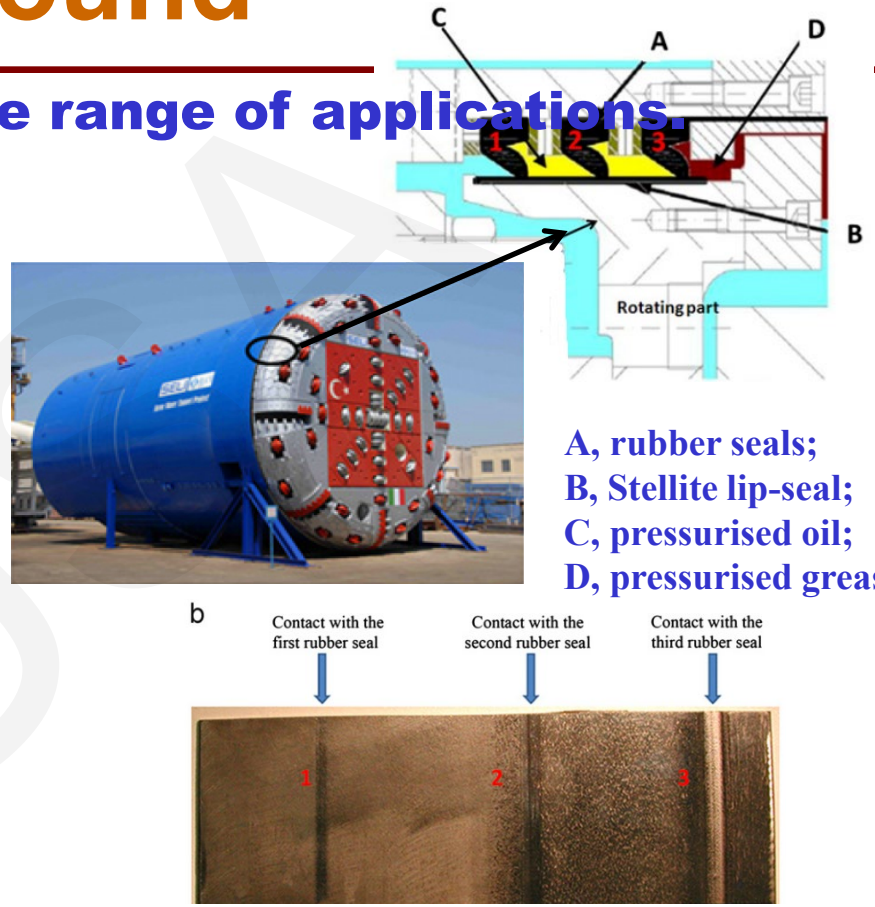
Cite this as: Ming-xue SHEN, Jin-peng ZHENG, Xiang-kai MENG, Xiao LI, Xu-dong PENG, 2015. Influence of Al_2O_3 particles on the friction and wear behaviors of nitrile rubber against 316L stainless steel. *Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)*, 16(2):151-160. [doi:10.1631/jzus.A1400217]

Background

- **Nitrile rubber (NBR) has a wide range of applications.**



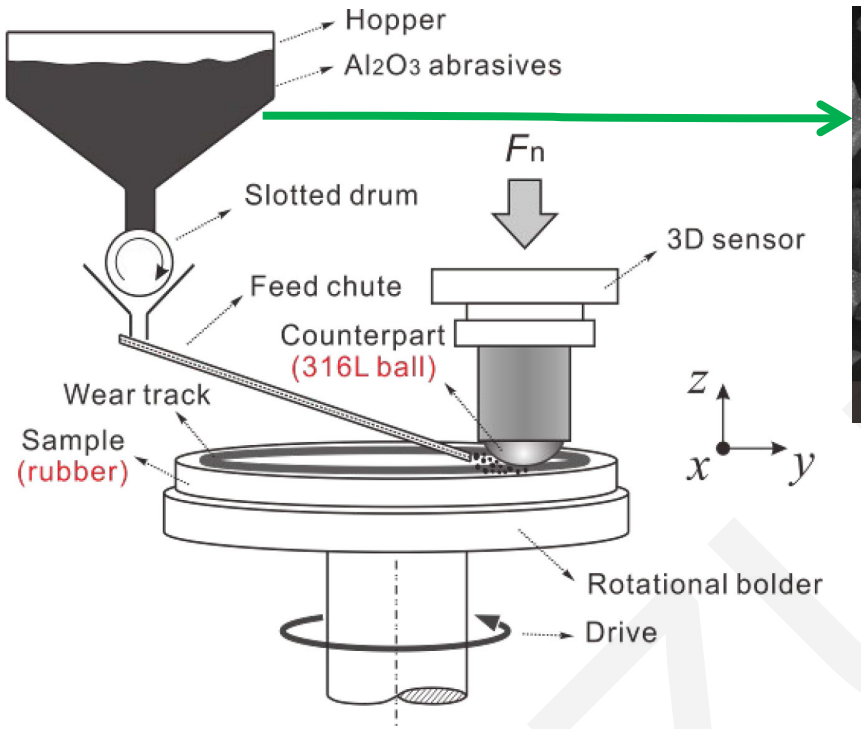
- Schematic diagram of the primary seal of the hydrostatic mechanical seal in RCPs

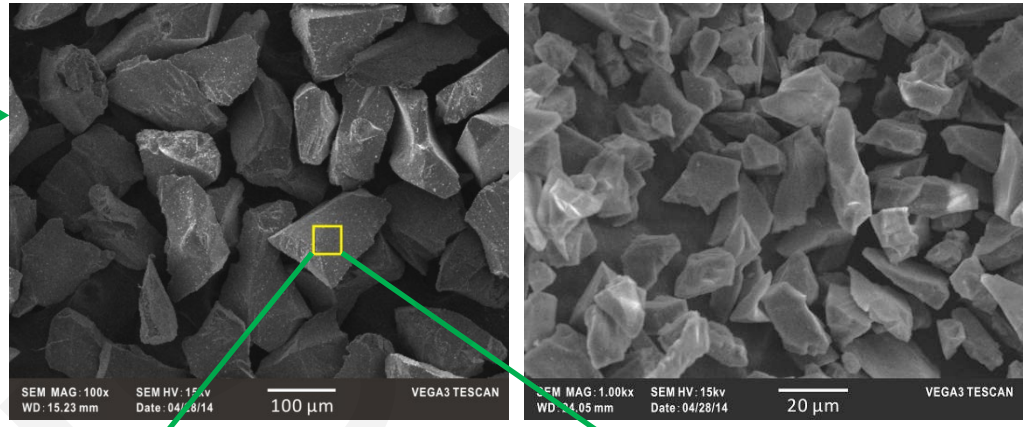


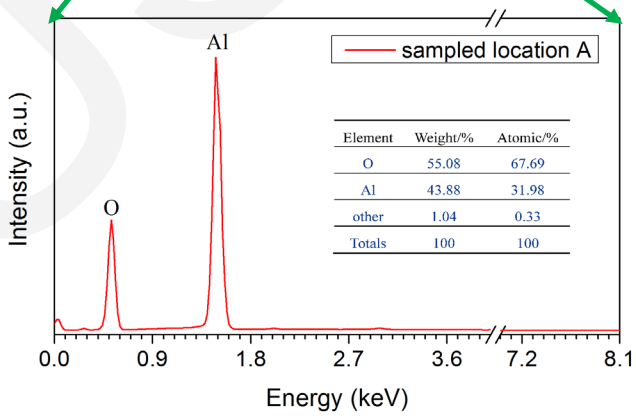
- The tunnel boring machine (TBM)----lip-seal zone

- As the most common pairs in seal components, rubber/metal tribo-pairs are widely used in compressors, plunger pumps, etc;
- The influence of hard particles on the damage behaviors of contact pairs as well as its wear mechanism has remained unclear.

Materials & Methods



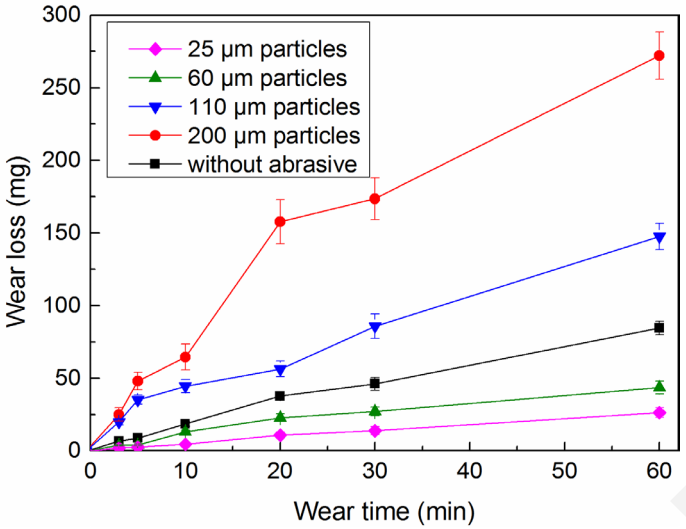


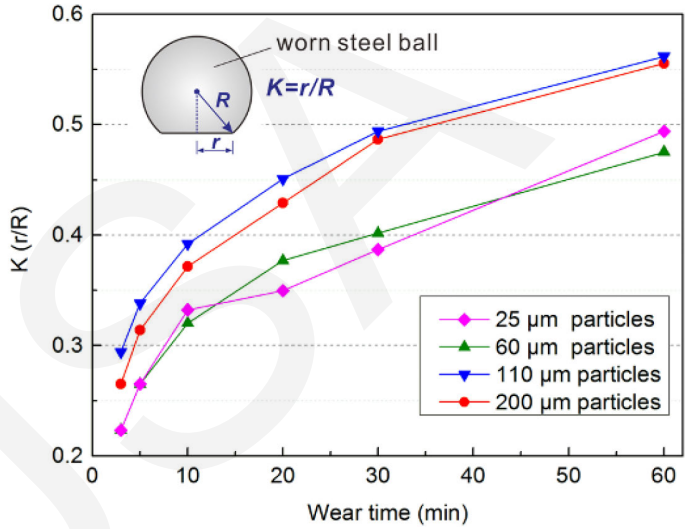


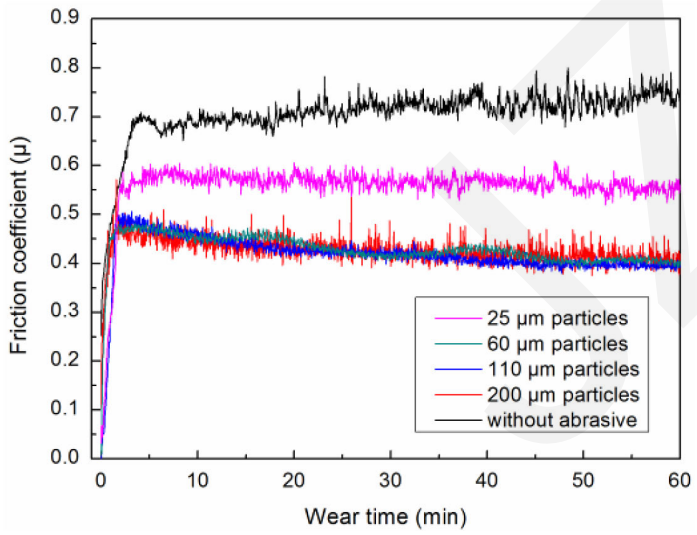
- Schematic illustration of the tribological tester with a sphere-on-disc contact

Material	σ_s(MPa)	σ_b (MPa)	Elongation (%)	E(GPa)	Density (g/cm^3)	Hardiness
316L	310	580	-	205	7.98	180 Hv
NBR	-	16.8	≥450	0.0116	1.32	72 Shore A

Major Results

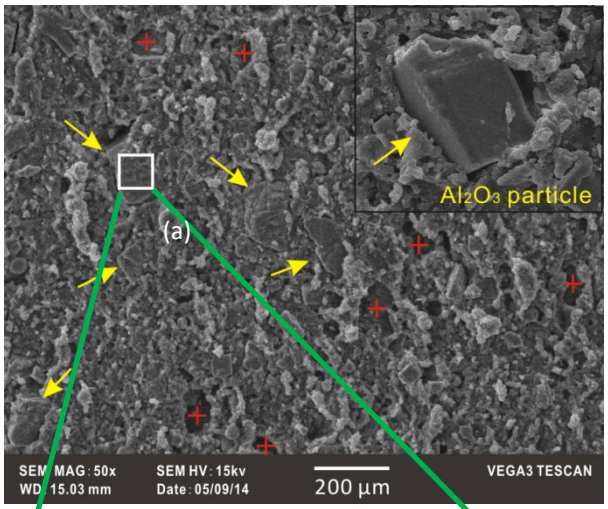


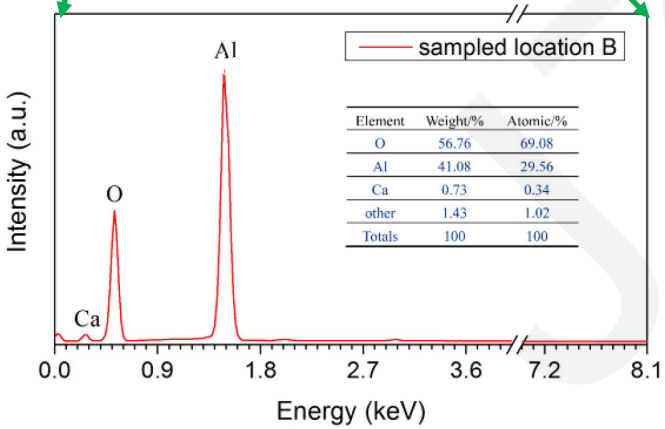




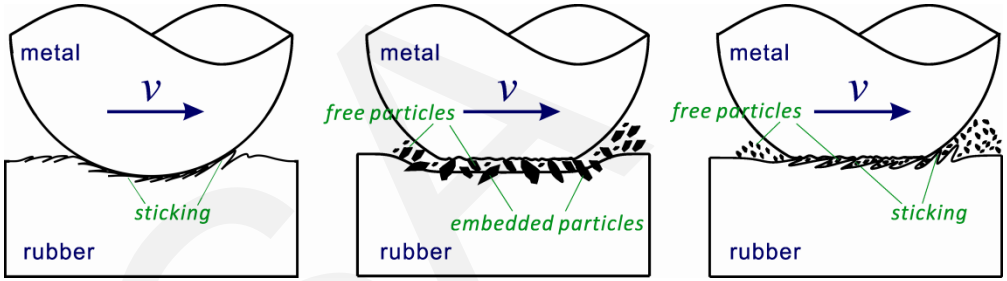
- The size of the Al_2O_3 particles had a great influence on the wear of NBR and metal counterpart;
- The friction coefficients, with and with no particles of different sizes, showed significantly different tendencies.

Major Results





Element	Weight/%	Atomic/%
O	56.76	69.08
Al	41.08	29.56
Ca	0.73	0.34
other	1.43	1.02
Totals	100	100



Without abrasive	Large-sized particles	Small-sized particles
Adhesive wear Fatigue wear	Abrasive wear	Abrasive & adhesive wear

- The nitrile rubber/ 316L stainless steel friction pair with and with no Al_2O_3 particles showed different wear mechanisms.

Conclusions

- Al_2O_3 particles greatly influenced the friction and wear properties of NBR/stainless steel tribo-pairs;
- The damage behaviors of NBR and stainless steel counterpart were different under varied normal loads;
- The NBR/stainless steel tribo-pairs presented different wear mechanisms under no particle conditions and with the different sizes of the particles.

JZUSA