

## Supplementary Material

### Lubrication Performance of $\alpha$ -Zirconium Phosphates as an Anti-Wear Additive in Vegetable Oil-Based Anhydrous Calcium Grease

**Table S1.** Wear rate ( $\times 10^{-9}$  mm<sup>3</sup>/ (N·m)) of vegetable oil and white oil grease samples at duration of 30 and 360 min.

| Oil         | Additive         | 30 min             | 360 min            |
|-------------|------------------|--------------------|--------------------|
| Castor oil  | $\alpha$ -ZrP    | $8.642 \pm 1.296$  | $0.931 \pm 0.140$  |
|             | MoS <sub>2</sub> | $19.414 \pm 1.941$ | $18.269 \pm 1.827$ |
|             | graphite         | $31.883 \pm 3.188$ | $52.765 \pm 5.277$ |
| Coconut oil | $\alpha$ -ZrP    | $7.623 \pm 1.143$  | $0.846 \pm 0.127$  |
|             | MoS <sub>2</sub> | $22.963 \pm 2.296$ | $14.506 \pm 1.451$ |
|             | graphite         | $32.377 \pm 3.238$ | $74.318 \pm 7.432$ |
| White oil   | $\alpha$ -ZrP    | $7.438 \pm 1.116$  | $1.062 \pm 0.159$  |
|             | MoS <sub>2</sub> | $12.253 \pm 1.225$ | $4.105 \pm 0.411$  |
|             | graphite         | $34.815 \pm 3.482$ | $5.674 \pm 0.567$  |

**Table S2.** Mean friction coefficients of vegetable oil and white oil grease samples at duration of 30 and 360 min.

| Oil         | Additive         | 30 min            | 360 min           |
|-------------|------------------|-------------------|-------------------|
| Castor oil  | $\alpha$ -ZrP    | $0.108 \pm 0.016$ | $0.099 \pm 0.015$ |
|             | MoS <sub>2</sub> | $0.117 \pm 0.012$ | $0.121 \pm 0.012$ |
|             | graphite         | $0.113 \pm 0.011$ | $0.117 \pm 0.012$ |
| Coconut oil | $\alpha$ -ZrP    | $0.109 \pm 0.016$ | $0.111 \pm 0.017$ |
|             | MoS <sub>2</sub> | $0.095 \pm 0.010$ | $0.097 \pm 0.010$ |
|             | graphite         | $0.109 \pm 0.011$ | $0.128 \pm 0.013$ |
| White oil   | $\alpha$ -ZrP    | $0.105 \pm 0.016$ | $0.107 \pm 0.016$ |
|             | MoS <sub>2</sub> | $0.098 \pm 0.010$ | $0.109 \pm 0.010$ |
|             | graphite         | $0.123 \pm 0.012$ | $0.126 \pm 0.013$ |