

## Documents

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**Synergistic behavior of graphene and ionic liquid as bio-based lubricant additive**

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**Abstract**

The constant utilization of petroleum-based products has prompted concerns about the environment, hence a replacement for these products must be explored. Biolubricants are a suitable replacement for petroleum-based lubricants as they provide better lubricity. Biolubricant performance can be improved by the addition of graphene. However, there are reports that graphene is unable to form a stable suspension for a long period. This study used a graphene-ionic liquid additive combination to stabilize the dispersion in a biolubricant. Graphene and ionic liquid were dispersed into the biolubricant via a magnetic stirrer. The samples were tested using a high frequency reciprocating rig. The cast iron sample was then further observed using various techniques to determine the lubricating mechanism of the lubricant. Different dispersion stability of graphene was observed for different biolubricants, which can be improved with ionic liquids. All ionic liquid samples maintained an absorbance value of three for one month. The utilization of ionic liquid was also able to decrease the frictional performance by 33%. Further study showed that by using the ionic liquid alone, the frictional could only reduce the friction coefficient by 13% and graphene could only reduce the friction by 7%. A smooth worn surface scar can be seen on the graphene-IL sample compared to the prominent corrosive spot on the IL samples and abrasive scars on graphene samples. This indicates synergistic behavior between the two additives. It was found that the ionic liquid does not only improve the dispersion stability, but also plays a role in forming the tribolayer. © 2021 by the authors. Licensee MDPI, Basel, Switzerland.

**Author Keywords**

Biolubricant; Friction and wear; Graphene; Ionic liquid

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