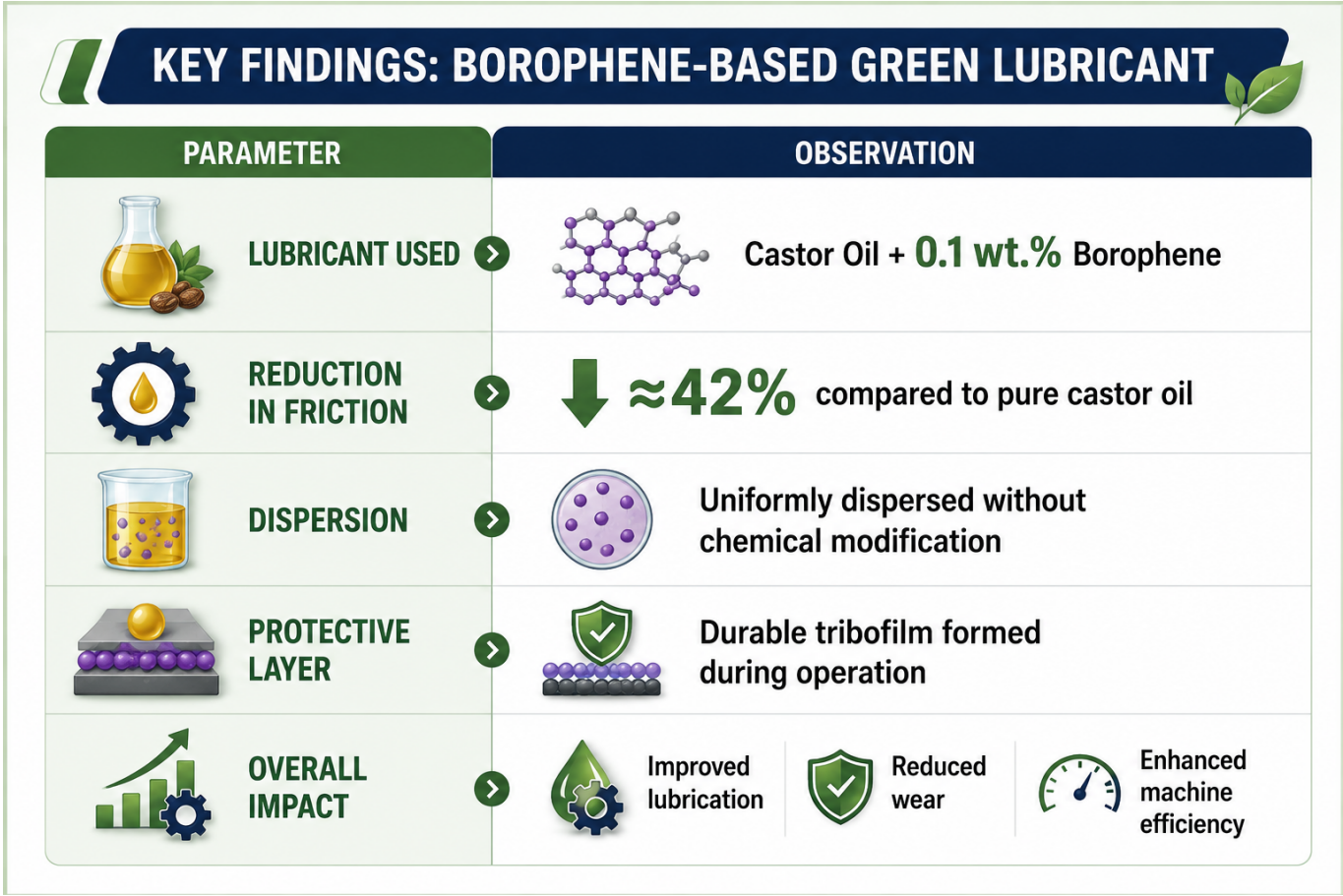
Borophene-Based Green Lubricant

Prelims: *Current events of national and international importance | Science & Technology*

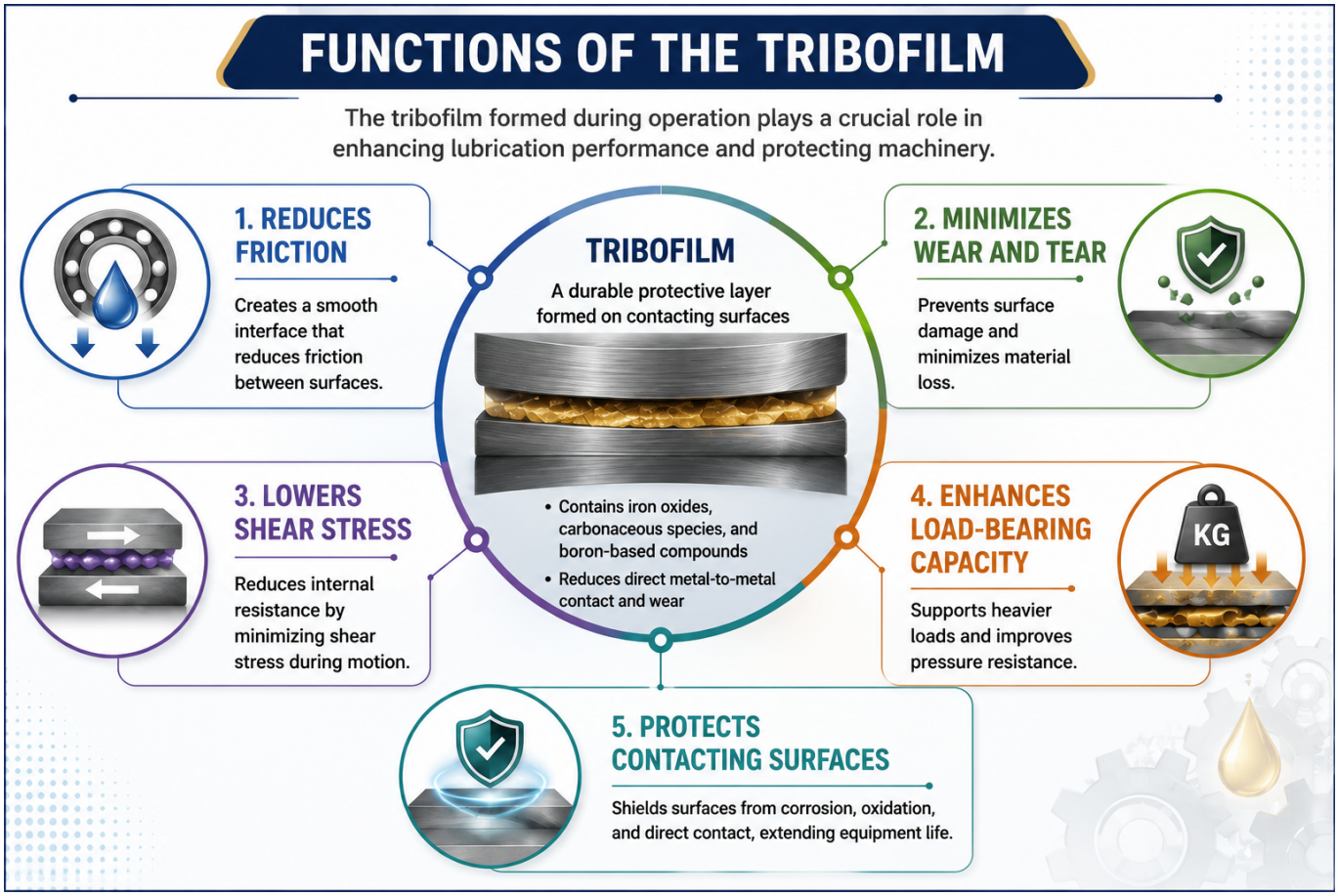
Why in News?

Recently, scientists from IASST, Guwahati, have demonstrated for the use of borophene, as a high-performance lubricant additive in castor oil.

- **Definition –** Borophene is a two-dimensional (2D) nanomaterial composed of a single atomic layer of boron atoms.
- **Properties**
    - High mechanical strength
    - Excellent thermal conductivity
    - High electrical conductivity
    - Superior chemical stability
    - Excellent load-bearing capability
- **Innovation –** A minimal concentration of 0.1 wt.% borophene was incorporated into castor oil by the researchers.
- The incorporation of the nano-additive resulted in a substantial improvement in lubrication performance, without necessitating chemical modification of the oil.



- **Mechanisms –** During operation, borophene generates a *protective tribofilm* composed of the following components:
    - Iron oxides
    - Carbonaceous compounds
    - Boron-based compounds



- **Key Advantages**

- **Energy Efficiency –** Borophene-based bio-lubricants reduce energy losses associated with friction.

- These lubricants contribute to improved operational efficiency in machinery.

- **Sustainability –** They utilize renewable and biodegradable castor oil as a base component.

- Their use reduces reliance on petroleum-based lubricants.

- **Equipment Protection –** Borophene-based bio-lubricants minimize wear and surface degradation of mechanical components.

- This protection extends the operational lifespan of machinery.

- **Environmental Benefits –** Borophene-based bio-lubricants are environmentally friendly alternatives to conventional lubricants.

- Their adoption supports sustainable manufacturing practices.

- **Applications**
    - Renewable energy systems, including wind and solar power equipment
    - Marine industry applications
    - Heavy industrial machinery and equipment
    - Automotive lubrication systems
    - Green manufacturing processes
    - Sustainable lubrication technologies

Institute of Advanced Study in Science and Technology (IASST)
• An autonomous institute under the Department of Science and Technology (DST). • **Located in –** Guwahati, Assam. • **Objectives** - To provide advanced analytical facilities for interdisciplinary sciences. - To assist researchers from IASST, other institutes, and industries. - To upgrade and maintain state-of-the-art infrastructure for research excellence.

Reference

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