

HIGH VISCOSITY LUBRICANT BASE OIL

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In the world of manufacturing and heavy industry, power is nothing without protection. Industrial gear oil is the specialised lubricant designed to protect enclosed gear sets operating under high loads, extreme temperatures, and intense pressure. Unlike standard automotive lubricants, these oils are specifically formulated to maintain a durable film between metal surfaces, thereby preventing catastrophic wear and ensuring the smooth transmission of torque. Whether it is a massive cooling tower fan, a conveyor system in a mining facility, or a high-precision gearbox in a food processing plant, industrial gear oils are the frontline defence against friction.

According to a market report, the global industrial gear oil market volume was estimated at 1.1 million tonnes in 2024 and is expected to reach 1.4 million tonnes by 2035, growing at a Compound Annual Growth Rate (CAGR) of 2.9% during the forecast period of 2024 to 2035 (ChemAnalyst, 2026). In terms of market size, another market study reported that the global industrial gear oils market was valued at USD9 billion in 2025 and is projected to reach USD13 billion by 2035, growing at 3.5% CAGR during the forecast period of 2025 to 2035 (Research Nester, 2026). The growth of the global industrial gear oil market is primarily driven by rapid industrialisation and automation across Asia-Pacific and the global shift towards high-performance synthetic lubricants.

In modern advanced factories and the renewable energy sector, particularly in wind power, demand for higher efficiency and reduced downtime has led to specialised oils capable of withstanding extreme pressures and temperatures becoming essential. Furthermore, increasingly stringent environmental and safety regulations are accelerating the adoption of biodegradable and food-grade formulations, pushing the industry towards more sustainable, high-value lubrication solutions.

Most conventional industrial gear oils are derived from mineral oil, which presents environmental and sustainability concerns due to their poor biodegradability and potential for leakage during operation. In recent years, the detection of mineral oil hydrocarbon (MOH) contamination in food products has raised serious health concerns associated with the use of such lubricants. To mitigate these safety and environmental issues, bio-based synthetic esters have emerged as sustainable alternatives to conventional mineral oil-based gear oils.

THE TECHNOLOGY

Two types of palm-based high-viscosity base oils were developed from palm-derived materials (*Figure 1*). The products, designated (a) PalmOLube HV220 and (b) PalmOLube HV320, are classified according to the ISO Viscosity Grade (ISO VG) system. Their kinematic viscosities at 40°C correspond to VG220 and VG320, respectively. The physicochemical and lubricating properties of these PalmOLube base oils are comparable to those of commercial mineral oil-based gear oils (*Table 1*). Therefore, PalmOLube base oils show strong potential as a substitute for conventional gear oils in commercial applications, particularly within the palm oil industry, thereby reducing the risk of MOH contamination.

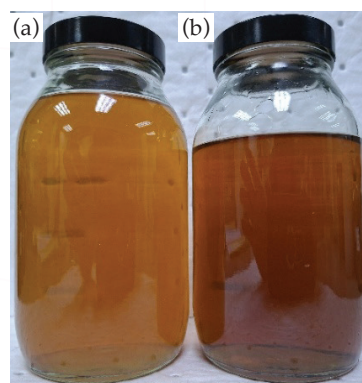


Figure 1. Palm-based high-viscosity base oils:
(a) PalmOLube HV220 and (b) PalmOLube HV320.

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TABLE 1. PHYSICOCHEMICAL AND LUBRICANT PROPERTIES OF PalmOLube HV220 AND PalmOLube HV320

Sample	KV		VI	PP (°C)	OOT (°C)	WSD (mm)	FP (°C)
	40°C, cSt	100°C, cSt					
PalmOLube HV220	240	31	171	-12	232	0.52	252
PalmOLube HV320	310	36	165	-9	235	0.51	261
Ref 1	230	20	100	-12	248	0.50	230
Ref 2	315	24	99	-6	250	0.48	245

Note: KV - kinematic viscosity; VI - viscosity index; PP - pour point; OOT - oxidation onset temperature; WSD - four-ball wear scar diameter; FP - flash point; Ref 1 - commercial mineral oil-based gear oil (VG 220); Ref 2 - commercial mineral oil-based gear oil (VG 320).

NOVELTY OF THE TECHNOLOGY

Sustainability and Purity

PalmOLube high-viscosity base oils are produced from over 90% palm oil derivatives, containing only trace mineral hydrocarbons. This composition makes them a premier alternative to traditional gear oils, significantly mitigating the risk of hydrocarbon contamination in food-grade environments.

Performance and Stability

By leveraging renewable palm-based derivatives, PalmOLube marks a new era in sustainable lubrication. With a naturally high viscosity index (VI), the fluid remains stable across extreme temperatures. This thermal consistency ensures superior film strength, reducing mechanical wear and extending the operational lifespan of critical machinery.

Durability and Efficiency

PalmOLube matches the performance of conventional lubricants with comparable oxidation onset temperatures (OOT) and wear scar diameter (WSD) results. It provides the oxidative stability needed for high-temperature service while maintaining the anti-wear protection required to lower maintenance costs. Additionally, with pour points (PP) between -9°C and -12°C, it offers excellent low-temperature fluidity without the need for heavy chemical additives.

BENEFITS AND ADVANTAGES

Sustainable Performance and Environmental Stewardship

PalmOLube base oils are engineered to support global sustainability objectives through biodegradable, non-toxic, and environmentally friendly products. Beyond its green credentials, PalmOLube outperforms conventional mineral-based gear oils by offering a superior VI, an elevated flash point (FP), and significantly lower evaporative loss. These enhanced properties, combined with robust oxidation stability, extend lubricant service life and directly reduce operational maintenance costs.

Safety and Economic Impact

In the food manufacturing sector, PalmOLube acts as a critical safeguard against MOH contamination, ensuring the highest standards of consumer safety. On a broader scale, the commercialisation of PalmOLube strengthens the local economy by reducing dependence on imported lubricants, driving domestic value addition, and opening new avenues for export revenue.

ECONOMIC ANALYSIS

The estimated production cost of PalmOLube high-viscosity base oils is approximately RM12.00/kg, positioning it as a cost-effective alternative to mineral oil-based gear oils. The mineral oil-based gear oil selling price is

about RM23.00/kg. This technology also offers existing lubricant companies the opportunity to diversify their portfolios by introducing environmentally acceptable and MOH-free lubricant products.

CONCLUSION

Overall, PalmOLube high-viscosity base oils represent a novel class of high-performance, sustainable palm-based lubricants that effectively bridge environmental responsibility with industrial applicability. By combining environmental benefits with viscosity stability, oxidation resistance, and anti-wear performance, PalmOLube stands out as a commercially viable and competitive alternative to conventional lubricants, marking an important step forward in the advancement of bio-lubricant technology and supporting global sustainability goals. In addition, the application of PalmOLube high-viscosity base oils in food manufacturing aligns

with growing market demand for products that emphasise both food safety and environmental sustainability.

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