FOOD-GRADE PALM-BASED HYDRAULIC OIL

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Hydraulic machinery is an integral part of daily operations, spanning various industries including aviation, construction, automotive, trucking, industrial manufacturing, merchant shipping, and marine cargo handling. In these systems, hydraulic oil functions as a power transmission medium, enabling the movement, control, and operation of various components. According to a market report, the global hydraulic oil market volume was estimated at 1.76 million tonnes in 2025 and is expected to reach 2.18 million tonnes by 2030, growing at a CAGR of 4.37% during the forecast period (2025-2030) (Mordor Intelligence, 2024). In terms of market size, another market study reported that the global hydraulic oils market was valued at USD8.7 billion in 2024 and is projected to reach USD10.2 billion by 2029, growing at 3.2% CAGR from 2024 to 2029 (MarketsandMarkets, 2024). The key drivers of growth in the hydraulic fluids market are the rising demand for hygienically processed food, the rising need for hydraulic fluids from construction, mining, agricultural and marine sectors, and the growing adoption of automation in industries.

Most hydraulic oils used in modern machinery are derived from non-biodegradable and unsustainable mineral oil resources. These oils frequently leak from hydraulic systems, contributing to environmental pollution. Recently, concerns over mineral oil hydrocarbon (MOH) contamination in food products have emerged, raising health risks for consumers worldwide. One identified source of MOH contamination is the use of mineral oil-based hydraulic oils. To mitigate this issue, food-grade hydraulic oils are utilised in hydraulic machinery within the food industry.

THE TECHNOLOGY

A series of food-grade palm-based hydraulic oils (*Figure 1*) were formulated from palm-derived materials and lubricant additives. These hydraulic oils, labelled as (a) PalmOLube VG32, (b) PalmOLube VG46, and (c) PalmOLube VG68, are classified according to the ISO VG system, with their kinematic viscosities at 40°C corresponding to VG32, VG46, and VG68, respectively. The physicochemical and lubricating properties of these PalmOLube oils are comparable to, or even surpass those of commercial mineral oil-based or bio-based hydraulic oils (*Table 1*). As such, PalmOLube has the potential to effectively replace traditional hydraulic oils in commercial applications, particularly within the palm oil industry, thereby mitigating the risk of MOH contamination.

Figure 1. Food-grade palm-based hydraulic oils PalmOLube VG32, VG46 and VG68.

NOVELTY OF THE TECHNOLOGY

PalmOLube oils are primarily composed of palm oil derivatives (>95%) and food-grade additives, with

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TABLE 1. PHYSICOCHEMICAL AND LUBRICANT PROPERTIES OF PALMOLUBE VG32, VG46 AND VG68

Sample	KV		VI	PP (°C)	OOT (°C)	WSD (mm)
	40°C, cSt	100°C, cSt				
PalmOLube VG32	32.1	7.2	200	0	232	0.58
PalmOLube VG46	45.3	9.1	187	-3	240	0.53
PalmOLube VG68	66.9	12.7	192	0	236	0.58
Ref 1	68.3	8.9	105	-24	245	0.55
Ref 2	42.8	8.2	169	0	190	0.65
Ref 3	32.5	5.4	105	-30	248	0.55

Note: KV - kinematic viscosity; VI - viscosity index; PP - pour point; OOT - oxidation onset temperature; WSD - four-ball wear scar diameter; Ref 1 - commercial mineral oil-based lubricant; Ref 2 - commercial bio-lubricant; Ref 3 - commercial mineral oil-based lubricant.

only trace amounts of mineral oil hydrocarbons. As a result, they serve as excellent alternatives to mineral oil-based hydraulic oils, helping to reduce the risk of hydrocarbon contamination in food products.

This innovation represents a significant advancement in sustainable lubrication technology. PalmOLube is formulated using food-grade palm-based derivatives, offering a renewable and biodegradable alternative. It exhibits superior viscosity index (VI) values, ensuring better stability across temperatures, enhancing lubrication efficiency, reducing wear, and extending equipment lifespan.

PalmOLube also demonstrates oxidation onset temperature (OOT) values comparable to mineral oil-based lubricants. Its enhanced oxidative stability ensures a prolonged lubricant lifespan and reduced degradation under high temperatures. Additionally, its anti-wear properties, as evidenced by wear scar diameter (WSD) measurements, surpass those of commercial bio-lubricants and match mineral oil-based alternatives, minimising friction and wear to maintain system efficiency and lower maintenance costs.

A key novelty of PalmOLube is its formulation designed for tropical climates such as Malaysia and Indonesia, where low pour points are less critical. With pour points ranging from 0°C to -3°C, it optimally balances flow properties with sustainability, eliminating the need for excessive chemical additives required for cold regions. This strategic optimisation makes it ideal for industries in warm climates while maintaining essential lubrication performance.

BENEFITS AND ADVANTAGES

The PalmOLube hydraulic oils are environmentally friendly, biodegradable and non-toxic, which supports sustainable development objectives. They also exhibit enhanced characteristics, including a higher viscosity index, improved lubricity, an elevated flash point, and reduced evaporative losses compared to conventional mineral oil-based hydraulic oils. Additionally, PalmOLube provides enhanced oxidation stability, which extends the service life of the oils and reduces maintenance costs.

The adoption of food-grade palm-based hydraulic oils in food manufacturing helps prevent contamination from mineral oil-based lubricants, thereby ensuring the safety of food products for consumers. Moreover, commercialising this product not only decreases reliance on imported lubricants but also enhances value addition within the local economy and increases export revenues.

ESTIMATED COST

The estimated production cost of food-grade palm-based hydraulic oils (PalmOLube) is between RM6.50 and RM7.20 per kg, making it a cost-effective alternative to mineral oil-based hydraulic oils. The economic outcome would be more favourable if a company already has an existing food-grade lubricant production facility,

in which the PalmOLube could directly utilise the existing production line. This technology also presents an opportunity for existing lubricant companies to expand their product range into food-grade and biodegradable products.

CONCLUSION

Overall, PalmOLube introduces a novel class of high-performance, sustainable palm-based hydraulic oils that bridge sustainability and industrial applicability. By balancing environmental benefits, viscosity stability, oxidation resistance, and anti-wear performance, PalmOLube emerges as a commercially viable and competitive alternative to traditional lubricants, marking a crucial step in advancing bio-lubricant technology and supporting global sustainability efforts. Moreover, the use of food-grade palm-based hydraulic oils in food manufacturing aligns with the growing market demand for products that prioritise both food safety and environmental sustainability.

REFERENCES

MarketsandMarkets (2024). *Hydraulic fluids market by base oil (mineral oil, synthetic oil), point of sale (OEM and aftermarket), application (mobile equipment), end-use industry (construction, agriculture, transportation, metal & mining), and region - Global Forecast to 2029*. Retrieved February 5, 2025, from https://www.marketsandmarkets.com/Market-Reports/hydraulic-fluid-market-71021039.html

Mordor Intelligence (2024). *Hydraulic fluids market size & share analysis - Growth trends & forecasts (2025-2030)*. Retrieved February 5, 2025, from https://www.mordorintelligence.com/industry-reports/hydraulic-fluid-market

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