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Tropical weathering of commercial fuels: Implications for evaporation kinetics, vapor generation, and energy degradation

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Source [CHEMICAL THERMODYNAMICS AND THERMAL ANALYSIS](#)

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Volume: 24

DOI: 10.1016/j.ctta.2026.100374

Article Number 100374

Published DEC 2026

Early Access SEP 2026

Indexed 2026-09-13

Document Type Article

Abstract The extended stockpiling of liquid vehicle fuels necessitates an understanding of their physicochemical degradation behaviors under ambient tropical conditions. This study investigates the long-term volatility, rheological shifts, and thermodynamic degradation of commercial vehicle fuels, specifically RON95, RON97, and ultra-low sulfur diesel subjected to a 130-day ambient weathering period. Characterizations were performed utilizing gravimetric monitoring, rotational viscometry, gas chromatography-flame ionization detection (GC-FID), and bomb calorimetry. The results demonstrated that prolonged atmospheric exposure altered fuel properties through light component evaporation. Over a 130-day storage period, RON95 exhibited the highest total mass loss at 79.32%, followed by RON97 at 75.00%, while Diesel displayed high stability with only a 1.30% loss. Viscosity increased across all samples due to the concentration of residual heavy hydrocarbons, with RON97 undergoing the largest increase (2.699 to 3.748 mPa.s), compared to RON95 (2.549 to 3.448 mPa.s) and Diesel (10.04 to 10.66 mPa.s). GC-FID confirmed varying reductions in light volatile fractions. Furthermore, 70 days of prolonged storage led to calorific value degradation across all samples, driven by light component loss. RON95 suffered the largest energy reduction (12.1%), followed by RON97 (6.0%) and Diesel (4.9%).

Keywords **Author Keywords:** [Fuel degradation](#); [Tropical weathering](#); [Prolonged storage](#)

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Data availability statement

Data will be made available on request.

Categories/ Classification

Research Areas: Thermodynamics; Engineering

Citation [1 Clinical & Life](#) , [1.65](#) , [1.65.1580 Occupational](#)

Topics: [Sciences](#) [Allergy](#) [Asthma](#)

Sustainable Development Goals: [03 Good Health and Well-being](#)

Web of Science Categories

[Thermodynamics; Engineering, Chemical](#)

Funding

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Universiti Putra Malaysia	GPI/2024/9794500	Show details

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Journal information

[CHEMICAL THERMODYNAMICS AND THERMAL ANALYSIS](#)

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eISSN 2667-3126

0.34

Journal
Citation
Indicator™
(2025)