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

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## 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%). © 2026 The Author(s)

Author keywords

Fuel degradation; Prolonged storage; Tropical weathering

Indexed keywords

Engineering controlled terms

Commercial vehicles; Diesel engines; Evaporation; Fuel storage; Ionization of gases; Tropics; Viscosity measurement; Weathering

Engineering uncontrolled terms

Ambients; Commercial fuels; Energy degradation; Evaporation kinetics; Fuel degradation; Gas chromatography-flame ionization detections; Prolonged storage; Tropical weathering; Vapor generation; Vehicle fuels

Engineering main heading

Gas chromatography

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