

Exploring Solketal Levulinate (SoLE) as a Promising Biodiesel Cold Flow Enhancement Agent

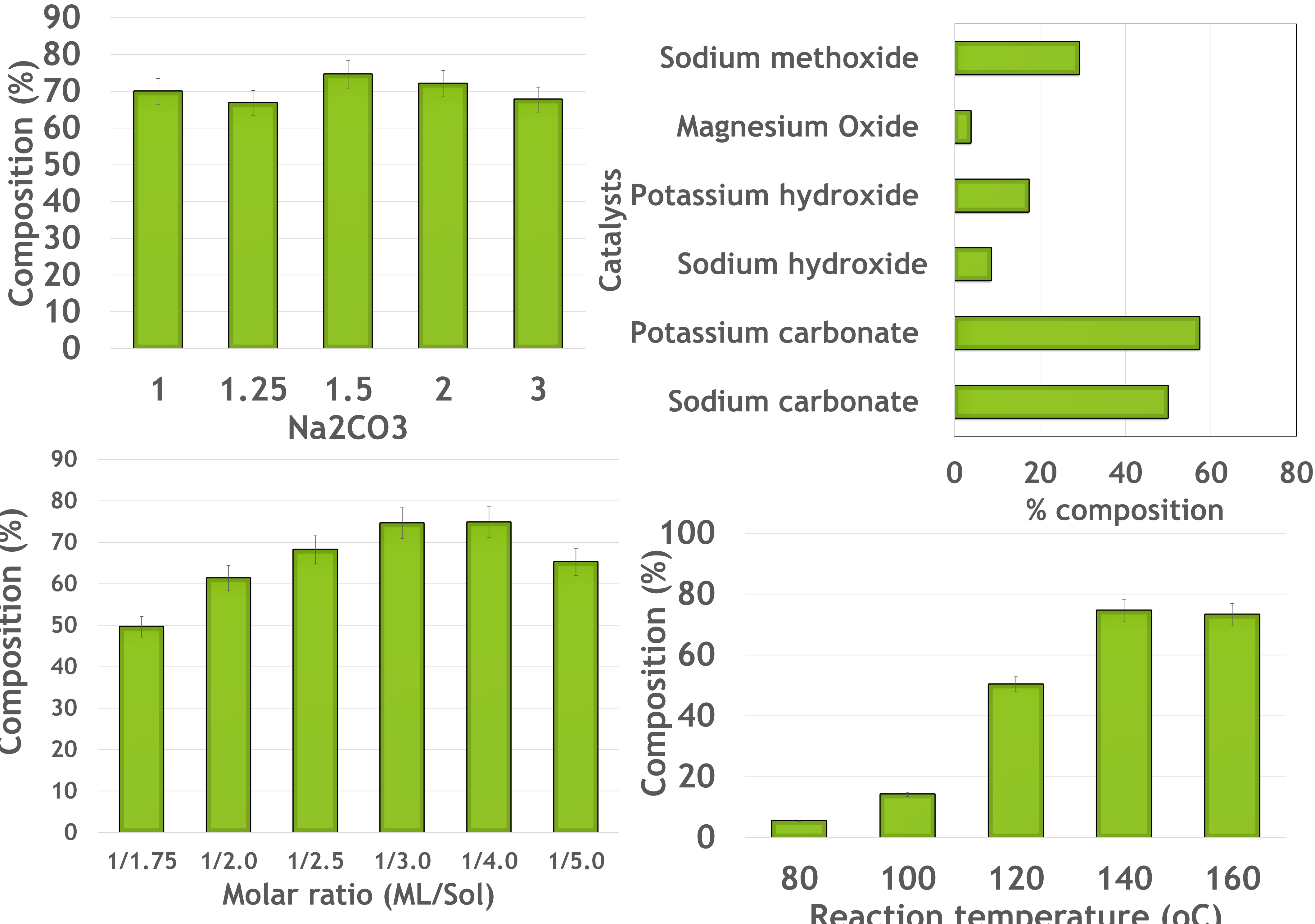
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ABSTRACT

In this study, we explored SoLE, a novel glycerol derivative, as a cold flow enhancer for palm biodiesel, a by-product of the biodiesel industry. SoLE was added to palm biodiesel at concentrations ranging from 0.5% to 20%, and we conducted a comprehensive analysis of key parameters: density, kinematic viscosity, pour point (PP), cloud point (CP), and cold flow plugging point (CFPP). The results revealed that incorporating 0.5% to 2.5% SoLE into palm biodiesel lowered density to meet EN ISO 12185 standards. Kinematic viscosity improved within the acceptable range of 3.5 to 5 mm²/s when SoLE was added below 5%. Blending 15-20% SoLE with palm biodiesel reduced pour and cloud points by 2-6°C, while CFPP showed limited improvement, decreasing by just 1°C. Notably, a 15% SoLE addition significantly enhanced the cold flow properties of palm biodiesel, except for CFPP. Overall, SoLE demonstrates promise as an effective additive to enhance palm biodiesel performance.

RESULTS & DISCUSSION



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INTRODUCTION

Concerns over depleting petroleum reserves drive research on renewable materials for fuel and chemical production. (Takkellapati, Li et al. 2018).

Biodiesel and oleochemical growth generate biomass, yielding notable by-products: glycerol and levulinic acid. (NMD Nik Siti Mariam, et al. 2021).

The free hydroxyl group of solketal holds potential for the production of solketal fatty ester additions in diesel and biodiesel fuels. (Nanda et al., 2016).

This study aims to optimize SoLE synthesis by reacting solketal with methyl levulinate and assess its potential as a palm biodiesel cold flow improver (CFI).

METHODOLOGY

Heat solketal, methyl levulinate, and a catalyst to the specified temperature and monitored reactions via TLC analysis.

As reaction complete, wash crude mixture with (d) water followed by solvent to extraction of SoLE.

Product was evaluated using gas chromatography (GC), ¹H and ¹³C NMR and Fourier transform infrared (FTIR).

CONCLUSION

SoLE was successfully synthesised in the presence of basic catalyst, Na₂CO₃ (1.5%) at 140°C for 4 hr reaction with molar ratio of 3:1 of solketal : ML. SoLE showed potential as CFI additive to palm biodiesel at 15% addition. Pour point had improved up to 5°C. Cloud point showed reduction up to 6°C. Density showed to met the standard EN ISO 12185. Kinematic viscosity values met with ASTM standard method D 445–12. The results of the project are important to the palm biodiesel industry especially on its sustainability and the their cold flow properties improvement.

Pour Point:
Reduced the pour point of palm biodiesel from 19°C to 14°C.

Cloud Point
Reduced from 21°C to 15°C. This is a reduction of cloud point of 6°C.

Palm biodiesel blended with 15% SoLE have showed to improve the palm-biodiesel cold flow characteristics.

Density of Palm biodiesel blended with 15% SoLE met EN ISO 12185 standards.

Kinematic viscosity values of palm biodiesel met with ASTM D 445–12 standard.