How to measure the interfacial properties of solid oils with TRACKER™

INTRODUCTION

The **solidifying properties of oils** are harnessed in a wide range of industrial, food, cosmetic, and pharmaceutical applications. These properties stem from the ability of certain oils to crystallize, harden, or form solid structures under specific conditions, such as temperature changes or interactions with other substances.

- **Controlled Solidification**: Oils like coconut oil and hydrogenated oils solidify based on temperature variations, allowing precise control over texture and consistency.
- **Active Ingredient Retention**: Solidified oils can create stable matrices that encapsulate or protect active compounds, fragrances, or other sensitive ingredients.
- **Emolliency and Low-Temperature Melting**: In cosmetic and pharmaceutical products, these oils provide a smooth, rich texture while melting easily upon skin contact or at specific temperatures.

However, **measuring the surface tension** of such oils can be challenging due to their solidifying nature, specially when their melting point is high. To address this, the **TRACKER™ drop tensiometer** is equipped with a specialized syringe holder that allows the sample to be heated both in the syringe and at the needle tip, ensuring accurate measurements.
To demonstrate the capabilities of the TRACKER™, the **surface tension of three solid oils**—coconut oil, butter, and paraffin wax—was measured at both the air-oil and water-oil interfaces.

SAMPLE PREPARATION

The syringe and the needle are preheated in an oven set to the target temperature (**T**). Approximately 20 g of solidified oil is placed in a 50 mL Falcon tube and melted in a bain-marie at **T**. Once fully liquefied, the oil sample is transferred to the oven, where it is stored alongside the syringe and needle for about **30 minutes** to ensure uniform temperature equilibration.

Simultaneously, the **TRACKER™** cuvette holder and syringe holder are connected in series to a thermostatic bath programmed to maintain **T**. The cuvette is inserted into the holder and filled with the second phase (Air or Water), then left to stabilize at **T** for **30 minutes**.

The syringe is filled with the supernatant of the melted oil and immediately placed in the **TRACKER™** syringe holder. A **15-minute** stabilization period is observed before initiating **Measurement Protocol 1** or **2**.

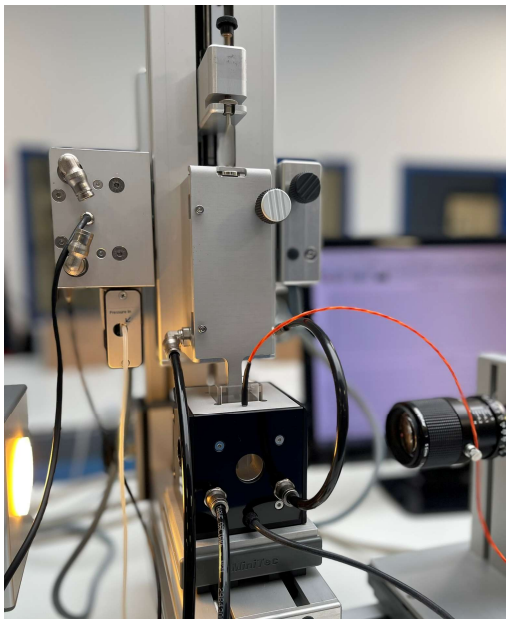
MEASUREMENT PROTOCOL

Protocol 1: Oil-Water interface

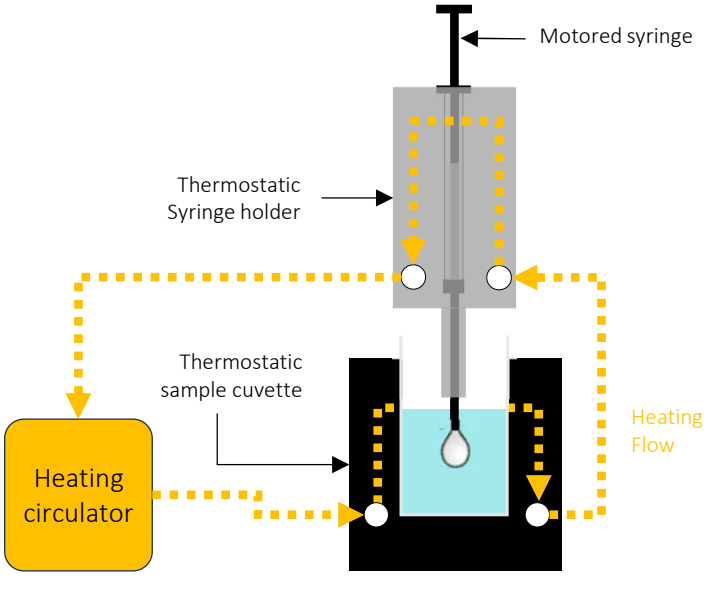
- A 30 µL oil drop is generated at the oil-water interface.
- The drop volume is maintained constant for 10 minutes.
- A sinusoidal volume modulation is applied with an amplitude of 2 µL and a period of 10 seconds per cycle, over 5 oscillations.
- After the oscillations, the drop volume is held steady for 60 seconds before starting the next cycle.
- A total of 3 oscillation cycles are performed.

Protocol 2: Oil-Air interface

- A 10 µL oil drop is generated at the oil-air interface.
- The drop volume is kept constant for 10 minutes.
- A sinusoidal volume change is applied with an amplitude of 1 µL and a period of 10 seconds per cycle, over 5 oscillations.
- The drop volume is then maintained steady for 60 seconds before beginning the next oscillation cycle.
- A total of 3 oscillation cycles are performed.

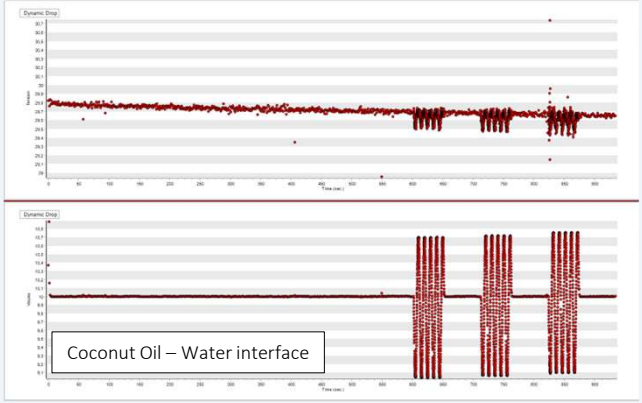


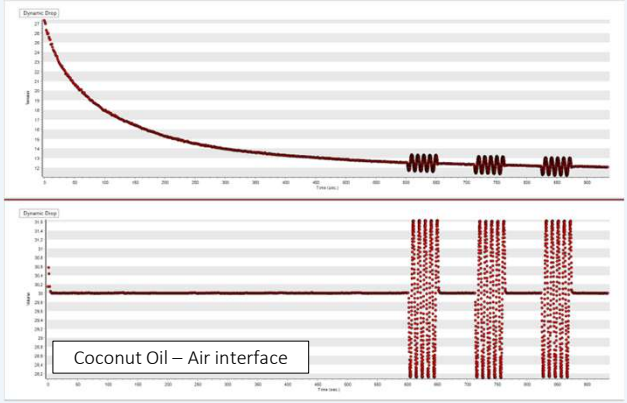
TRACKER™ equipped with the cuvette holder and syringe holder connected to the heating circulator

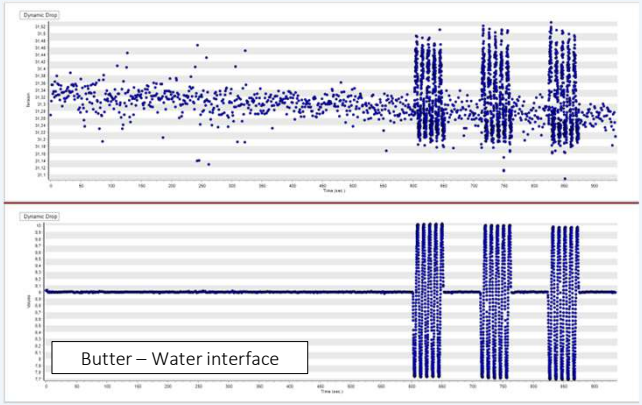


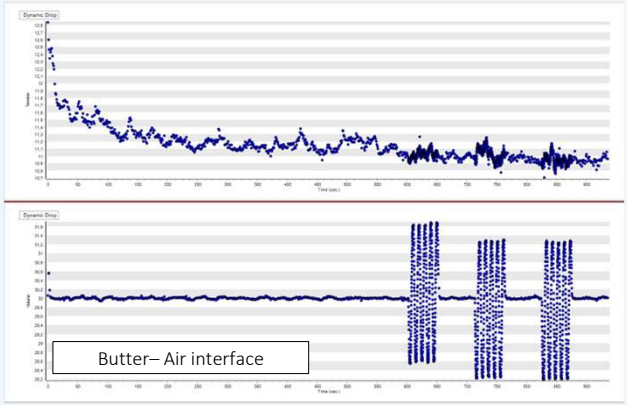
Schematic diagram of the TRACKER™ experimental setup

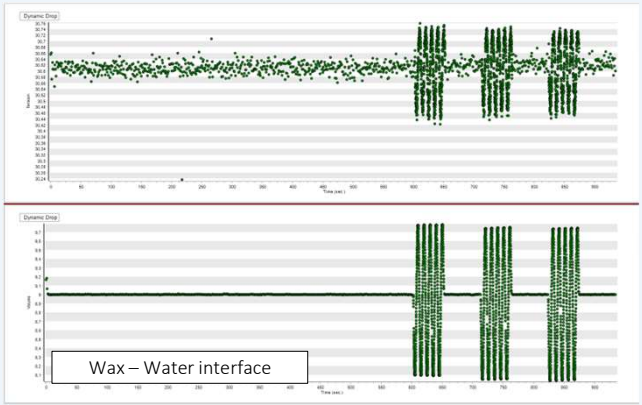
RESULTS

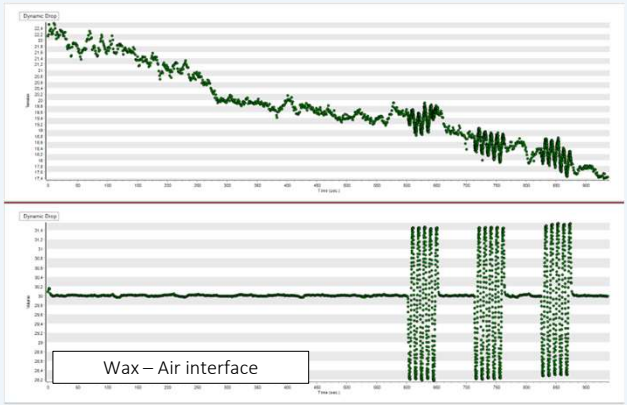












All measurements were repeated 3 times.

Interface	Method	Needle	syringe	Target T° (T in °C)	T° measured (Tm in °C)	Measurement protocole	Drop initial volume (µL)
Coconut oil-Water	Rising Drop	G14, J shape	SGE 500µL	35	34,5	Protocol 1	30
Coconut oil-Air	Pendant drop	G18 straight	SGE 500µL	35	34,5	Protocol 2	10
Butter-Water	Rising Drop	G14, J shape	SGE 500µL	45	45	Protocol 1	30
Butter-Air	Pendant drop	G18 straight	SGE 500µL	45	45	Protocol 2	10
Paraffin Wax-Water	Rising Drop	G14, J shape	SGE 500µL	80	76	Protocol 1	30
Paraffin Wax-Air	Pendant drop	G18 straight	SGE 500µL	80	76	Protocol 2	9

Note: The supernatant of the melted oil are not pure system. That can impact the value of the surface tension calculated

CONCLUSION

By following this experimental protocol, the **TRACKER™ enables precise and reliable measurement of the interfacial properties of solidifying oils at both air and water interfaces.**